ELECTRONICS Australia

HiFi, Radio & Computers

AUGUST 1980

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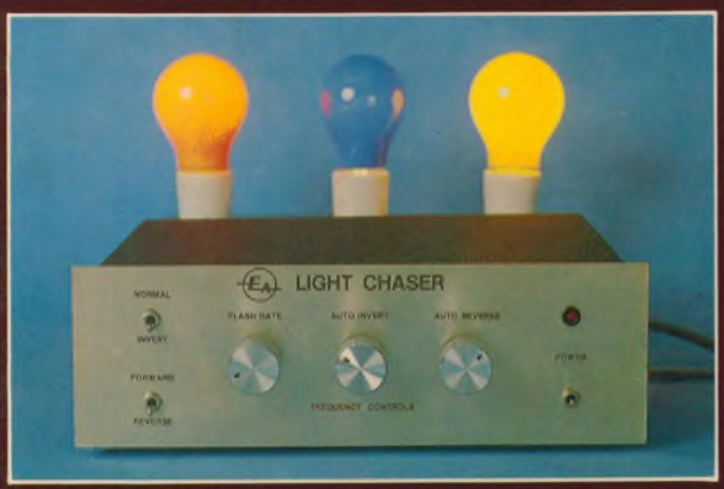
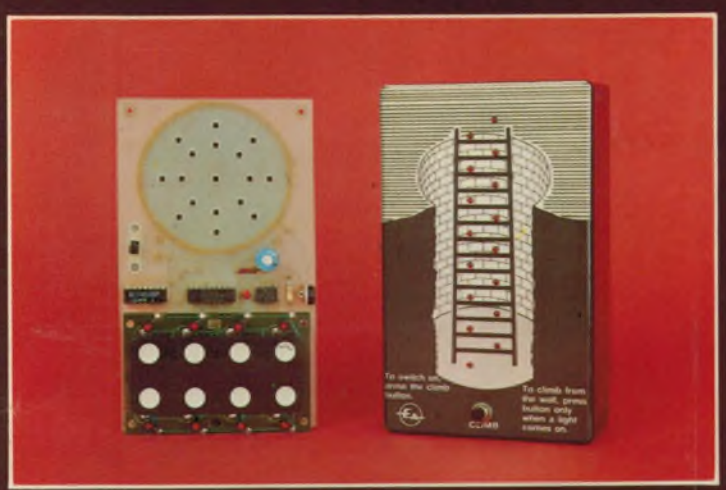


Build this

light chaser for 240V lamps. It has three channels and a variety of display modes



Or these novel

beginners' projects — a mini-organ and an intriguing game of skill called Leds & Ladders

Three Mile Island — a problem of human performance

EPROM Programmer for the Sorcerer personal computer

AM stereo: the FCC decision & its implications

You can win this Nakamichi cassette deck

DETAILS INSIDE

The Sony Casseiver.

A name like no other for a system like no other.

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The Casseiver combines a front-loading Dolby* cassette deck, with twin LED displays and soft-eject mechanism; a built-in amplifier delivering 15 watts/channel RMS; a sensitive 4-band AM/FM/SW1/SW2 stereo tuner and a full-range speaker system with passive cone radiators. And with provision to add on other components, such as a turntable, the Sony Casseiver is truly a system like no other.
Recommended retail price $499.

*Dolby is a registered trademark of Dolby Laboratories.

The PS-212A turntable (pictured) is an optional extra.
Recommended retail price $210.00.

SONY AUDIO

AP3412

ELECTRONICS Australia

Volume 42 No. 5 August, 1980

Australia's largest selling electronics magazine

Light chaser for 240V lamps

Costing around $70, this new Light Chaser features three output channels, variable flash rate, and several operating modes. See p52.

Exidy Sorcerer owners can burn their own software into EPROMs by using this version of the EPROM Programmer described last month. Details on p70.

COMING NEXT MONTH! – Find out what's coming by turning to p8.

On the cover

Several of our projects together with the Nakamichi 482 stereo cassette deck are featured on this month's front cover. Find out how you could win the cassette deck on p33 and read our in-depth review on p40.

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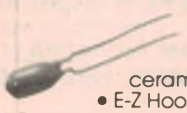

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Editorial Viewpoint

FM has a fight on its hands!

As this issue goes to press, engineers, technicians and riggers are battling to get Sydney's two new commercial FM-stereo stations to air. With two national stations, two commercials and three public broadcasters radiating full-coverage signals, the FM band is, at long last, beginning to look – and sound – populated.

With parallel expansion going on in other major centres, the situation in 1980 brings to a climax decades of argument and endeavour on the part of those who have championed the cause of FM broadcasting in this country.

The first and most notable proponent of FM broadcasting in Australia was the late Raymond Allsop, a friend of its inventor, Edwin H. Armstrong. Largely as a result of his eloquence, "experimental" FM stations were set up in Melbourne, Sydney, Adelaide and Brisbane (circa 1947) relaying selected programs from the ABC networks. In 1954 the then relatively new Australian Broadcasting Control Board recommended expansion of FM services, but reversed the decision in 1960, under pressure to find additional frequencies for TV services. The experimental transmitters were closed down and the voice of FM was silenced.

In 1974, following a change in Government, a new inquiry was held, chaired by Sir Francis McLean. He recommended that FM be recommenced in the normal VHF FM band, even if it meant that some TV stations had to be elbowed aside. The report was adopted, opening the way for pioneering groups like the Music Broadcasting Society to make a fresh start.

With the setting up of other public broadcasters, the National stations, and now the first two commercial stations, the battle has been won – but the war has just commenced.

Sydney's new commercial FM station managements are outwardly optimistic. What else could they be? They claim that, given sufficient publicity, they should each be able to capture better than 5% of the surveyed audience in a reasonable time and thus break even on costs. But not everyone is convinced that they will be able to induce that many listeners to click the all-important AM/FM switch. "If they get better than two or 3%", say the knockers, "I'll go and . . . . ." (do all kinds of strange things).

The simple fact is that, with 18 or more stations to choose from in the Sydney area, the average audience per station cannot be much more than 5%. Even allowing that the national stations and the special interest broadcasters can get by with less than this figure, the struggle for the rest of the cake is going to be intense indeed. In other cities, the statistics may differ but the tussle will be the same.

FM has, on its side, clean, wide-range stereo music. The ironic thing is that, for most listeners to date, the more important thing is who does the spiel in between the tracks!

Neville Williams

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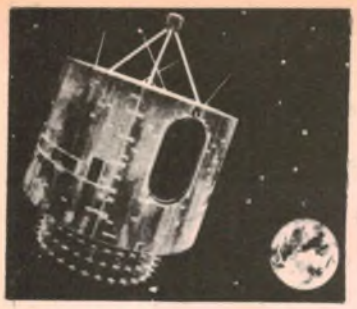

News Highlights

Computer society vulnerable warns Swedish report

Society is becoming too dependent on computers for its own safety, according to a report to the Swedish Ministry of Defence. The report warns of the dangers of unquestioning reliance on computers, and asks what happens when the computers cannot be used – or when important data falls into the hands of an enemy.

At least in Sweden, "vulnerability" has been added to the privacy and employment issues surrounding computers. In the report, entitled "The Vulnerability of the Computerised Society", a committee set up by the Swedish Ministry of Defence accuses the government of failing to have "exercised control over developments that have led to today's computerised society". In war and in peace, various forms of interference with the functioning of computers may cause severe disturbance and damage, the report states.

The report considers two aspects of computer vulnerability: external and internal. The first is to do with acts of war, natural disasters, and terrorist action, while the second concerns trends such as over-centralisation, unthinking dependence on key staff, and reliance on imports to keep computers running.

In many aspects, the report covers issues which are relevant to Australia, particularly as it warns that if it were impossible to obtain spare parts for the country's computers, government and business would quickly be disorganised.

Australia, like Sweden, is highly dependent on imports of computer equipment and services. The Swedish report states "Even a limited blockade against the import of spare parts would very quickly have serious effects." A Swedish newspaper survey supported this opinion, indicating that only 14% of computer users believed that they could carry on without their machines.

British Govt seeks union agreement on new technology

The British Government is appealing to the nation's Trade Union Council (TUC) to persuade Civil Service unions to abandon their opposition to the introduction of new technology which would involve the loss of jobs. The Government has warned the unions, however, that if no agreement is reached on the introduction of new equipment, the Government will bring it in despite union opposition.

The Society of Civil and Public Servants, the second largest of the Civil Service unions, has overwhelmingly supported policies which make the introduction of new technology dependent on the maintenance of existing job levels. Mr Campbell Christie, deputy general secretary of the SCPS, warned that "major difficulties" lay ahead for the Civil Service if the government maintained its "inflexible" attitude of refusing to provide satisfactory safeguards and guarantees on jobs.

New energy research: geothermal & "Magma Tap"

The first British attempt to tap geothermal energy – the heat contained in rocks deep below the surface of the earth – has been successful, resulting in the discovery of a large underground deposit of water with a temperature of 70°C. Early this year a test borehole was drilled in the grounds of a power station at Marchwood, near Southampton in southern England, and indications are that there is sufficient water in the area to heat about a thousand houses for several decades.

The UK is currently engaged in a $7.5 million research program to determine the potential of geothermal energy, and has been collecting information over the past three and a half years form boreholes drilled for other purposes.

Heated water from geothermal rock structures has been used to warm buildings in Hungary since the beginning of the century and, more recently, France has started to use water from "hot rocks" to heat apartment buildings around Paris.

By 1990 it is expected that nearly half a million French homes will be heated by geothermal energy. Water from underground sources has also been successfully used for power generation in New Zealand.

A report published in 1976 by the UK Department of Energy stated that the prospects for extracting and using heat from rocks in Britain were favourable enough to warrant more detailed study of a number of locations. It is estimated that the heat from each square kilometre of rocks could be recovered at a rate equal to 200,000 to 300,000 tonnes of coal annually for 20 years, and that the capital cost of extraction would be low compared with the present cost of fossil fuel.

Meanwhile researchers at Sandia Laboratories in Alburquerque, New Mexico, are working on a more ambitious project they call "Magma Tap", which involves tapping the energy potential of underground lakes of magma; molten rock with a temperature of over 1000°C. The National Magma Energy Advisory Panel, consisting of experts in volcanology, geophysics, tectonics and magma petrology, has concluded that the extraction energy from magma is feasible, and recommends that further research be carried out.

The US Geological Survey estimates that the total energy content of molten rock lying within 10km of the earth's surface inside the US is 3000 times the total annual energy needs of the country.

Present plans call for a heat exchange system to be sunk directly into a body of magma with a temperature of between 1000°C and 1250°C. The extracted heat would generate electricity at the surface in a conventional way – with steam turbines, for example. Research over the past few years has concentrated on the known reserve of magma under the Kilauea Iki lava lake in Hawaii.

Microcomputer + Video Disc Player = versatile home teaching system

The new home teaching system allows the user to study at his own pace and convenience.

Researchers at the Philips Research Laboratories in Eindhoven, The Netherlands, have devised a home teaching system which links a microcomputer and a video disc player. The result – a teaching program which can be tailored to the individual user and allows home study of any of a number of subjects.

Video discs used by the system are already available in the United States, but the addition of a microcomputer to control the video player has made the system far more flexible. The pupil can work through the recorded lesson with the help of a table of contents displayed on the computer, and the computer can ask questions in connection with the material offered. If the pupil does not have the answer, he can have the relevant portion of the video disc repeated. It is also possible for the progress of a lesson to depend on the answers to multiple choice questions.

So far the system is still in the experimental stage, but it could well point the way to the home study course of the future.

Electronic fuel saver stops engine

As part of the continuing search for ways to conserve petrol, Zemco Corporation of San Ramon, California, has developed an experimental "Fuel Saver" system which turns a car engine off whenever the car is stopped for more than two seconds and re-starts it automatically at a touch of the accelerator.

The system consists of a module mounted on the dashboard which monitors signals from the car's brakes, ignition coil, ignition switch, and two sensors – one on the accelerator pedal and the other a pick-up coil which detects the motion of the car. The circuitry is designed to allow the engine to warm up for three minutes, and requires that the car be moving before the first engine switch-off. The module also calculates and displays the amount of petrol saved.

Tested on the 22½ minute urban driving cycle prescribed as a standard by the US Environmental Protection Agency, the Fuel Saver decreased petrol consumption by 7.5%. The urban driving cycle has 15 idle periods of five seconds or longer, and is considered to be an accurate model of moderately congested city driving conditions.

The new system has some disadvantages however. Frequent re-starting, even though made easy by electronic circuitry, will obviously increase the work-load of the starting system. Zemco says, however, that quick re-starting of warm engines does not affect starter lifetime as much as long cranking of cold engines.

Wescon/80: big US electronics show

Wescon/80, America's largest electronics show, will be held at the Anaheim Convention Centre in Anaheim, California, from September 16 to September 18, 1980.

There will be over 1000 booths exhibiting the latest techniques, products, systems and services in electronics. The convention will concentrate on four product categories: microelectronics and fibre-optics; production, packaging, and test equipment; instrumentation and control systems; and, mini and microcomputers and EDP peripherals.

For further information contact Deborah Corrigall of the Commercial Section at the US Consulate General, Sydney.

New efforts to produce flat-screen TV

Efforts to produce a flat-panel TV set using a conventional picture-tube type approach have taken on new impetus following announcements by several US manufacturers. RCA has been working towards a flat screen display using the phenomenon of cathodoluminescence – bombarding phosphors with electrons – since 1973, and says that investigations could lead to a commercial production in the "mid- to-late 1980s".

Researchers at the RCA Laboratories in Princeton, NJ, are aiming at a panel 4cm thick by 125cm diagonal measurement, with all television circuits within the picture frame. It calls the approach "modular guided beam technology".

As planned the panel has a relatively conventional phosphor screen and shadow-mask. A 100cm long cathode runs along the base of the panel, and the screen is divided into forty 25mm vertical sections, each 75cm high and separated from the adjacent sections by a vertical electrode. The vertical "extract electrodes" are energised by each scan line and the electron beams are bent 90° through grids, a shadow-mask, and onto red, green, and blue phosphors. RCA has so far built a small prototype of one section of the dispalay.

Another television manufacturer, GTE, maker of Sylvania, Philco, and Saba TV sets, is working in a similar direction. GTE is working with a team of former Zenith engineers to develop large-screen gas discharge tubes suitable for colour TV displays.

Nuclear power — cheaper than coal

Britain's eight Magnox nuclear power stations have been generating electricity for a cash outlay of 5% less than that for comparable coal-fired stations, according to Mr Glyn England, chairman of the Central Electricity Generating Board (CEGB). He stated that by the end of March this year, the Magnox stations had produced 300,000 million units of electricity for an outlay of $3860 million. The cost of the 130 million tonnes of coal necessary to achieve the same output would have been $4000 million, he said.

Mr England added that provisional figures showed that the board's first nuclear power station of the advanced gas-cooled reactor (AGR) design – Hinkley Point B in south-west England – generated electricity at 2.64 cents per unit, compared with 3.02 cents per unit for Drax, the CEGB's newest coal-fired station. The CEGB expects to bring three more nuclear power stations on stream in England next year.

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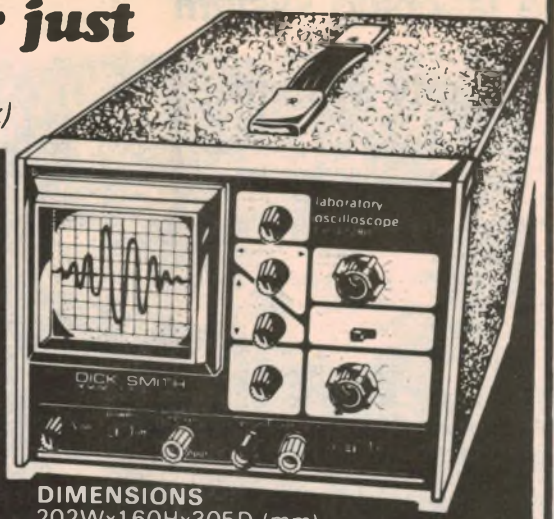

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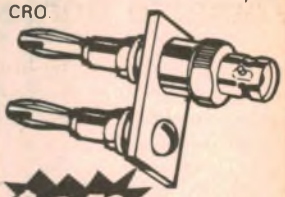

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NEWS HIGHLIGHTS

Versatile home security system

Emergency help in the home will soon be no further away than the touch of a button thanks to a new round-the-clock home protection service launched in Melbourne in June. The new service, Monitor Protection Services, will provide its subscribers with a full time monitoring service aimed at bringing help to the home in the event of an accident, sudden illness, fire, or burglary.

The security system incorporates three main elements: a wall unit installed near the home telephone, a "personal emergency transmitter" which the subscriber can use to call for help if the wall unit cannot be reached, and the central station at Monitor's Kew headquarters. The wall unit, which is about the size of a large shoebox, includes a button which can be pushed to call for help and a small speaker which emits a tone to tell the user that the machine's automatic dialling mechanism has been activated and is calling the central station.

Each subscriber provides Monitor headquarters with his specific protection needs for registration on a central computer, together with instructions on the action needed in an emergency. This information, which is confidential, may include the subscriber's medical record, doctor's name and telephone number, and information on the whereabouts of relatives.

The system will be expanded to other cities within six months.

$8 million hybrid vehicle contract to GE

The US General Electric company is organising a number of American, German, and Japanese companies into a team in order to produce two advanced hybrid cars for the US Department of Energy. The $8 million, 30 month project will produce a pair of four door saloons which will run at low speed on electric motors, at high speed on a 60kW Volkswagen engine of special design, and on both motors when bursts of high power are needed.

Both power units in the front wheel drive vehicles will be mounted longitudinally under the bonnet. The electric motor will be used for speeds up to 45km/h while the internal combustion engine will be used for higher speeds.

The vehicle is expected to be able to accelerate from zero to 80km/h in 12 seconds, and consume 40% to 50% less petrol than conventional cars of the same size.

A microprocessor will provide overall control of the vehicle's propulsion system, switching automatically between the power units - the driver will not have to decide which of the two motors should be used.

Although the design is aimed at a version suitable for mass production in the mid-1980s at a price of $7600, General Electric emphasises that it has no plans at the moment to either manufacture or market the cars. Instead, it sees long range opportunities as a supplier of items such as motors and electronics.

Business Briefs:

- **Vicom International Pty Ltd** has opened a store in Sydney at 339 Pacific Hwy, Crows Nest 2065 (Phone 436 2766). Manager of the store, which stocks a wide range of communications equipment, is Laurie Wade, VK2AQW.
- **NV Philips** Gloeilampenfabrieken and Sanyo Electric Co Ltd of Japan recently signed a licence agreement permitting Sanyo to manufacture and sell video disc players based on the optical system developed by Philips and MCA Inc.
- **Soanar Electronics Pty Ltd** has announced the appointment of Mr Peter Angus as their National Sales Manager. Mr Angus has been with Soanar since 1972, and was previously Victorian Sales Manager.
- **Multi-Contact Australia Pty Ltd** has announced the appointment of Mr Ken Gray as Senior Sales Engineer, High Current Products. Mr Gray's responsibilities will include sales and design engineering for the "Multilam" connection systems from Multi-Contact AG, Basel, Switzerland and high current switching and transmission systems from Schaltbau, West Germany.
- **Hewlett-Packard Australia Pty Ltd** has moved to new premises in North Ryde. The new address is 17-23 Talavera Road, North Ryde, NSW 2113.

Optical fibres for undersea cables

The world's first optical fibre undersea telephone cable was laid recently on the bottom of Loch Fyne in Scotland. The tidal salt water conditions in the Loch are similar to those encountered in the North Sea where the first commercial application of fibre optic cables is expected to take place.

Although only a trial system, the 9.5km loop of cable can carry up to 6000 simultaneous calls, whereas the largest conventional submarine cable carries only 5500.

In addition to a smaller cable carrying more calls with much less interference, optical fibres also offer potential savings in repeaters. A modern submarine cable needs repeaters every 5kms; with optical fibre links this spacing can be increased to 50kms or more.

Westinghouse to study coal conversion plant

Westinghouse Electric Corporation has submitted a proposal to the US Department of Energy for an alternative fuel plant that would produce methanol from coal.

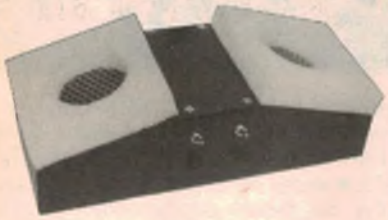
Westinghouse is to be prime contractor for the initial phase of the project, heading a team of Pennsylvania-based firms in a 12 month feasibility study that is expected to result in the detailed design and construction of a $US350 million prototype coal conversion facility by 1985.

The proposal was made in response to a Department of Energy request for projects that would lessen the dependence on imported petroleum fuels. The prototype plant would produce 10,500 barrels per day of fuel-grade methanol, which can substitute for oil or natural gas in industrial or electric utility applications, or, with further processing, serve as a petrol additive that would reduce petroleum use in transportation.

Ultimately the plant could be expanded to produce 100,000 barrels of methanol a day from 14,000 tonnes a day of bituminous coal.

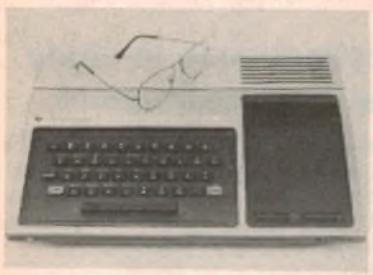
Coming September*

Acoustically Coupled Modem for Personal Computers



Here is a project that will be enthusiastically received by computer users: An acoustically coupled modem compatible with any serial interface; RS232, 20mA loop or TTL. It can transmit or receive at speeds up to 300 baud.

Texas TI-99/4 Home Computer Reviewed



We find the TI-99/4 to be quite different to other personal computers.

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***Our planning for this issue is well advanced but circumstances may change the final content. However, we will make every attempt to include the articles mentioned here.**

NEWS HIGHLIGHTS

New electronic focusing mechanism

Scientists at the Technical University of Berlin have developed a system based on the focusing mechanism of the human eye which focuses a video camera or other photographic device fully automatically.

Called "Biofocus", the new system is the result of a five-year development program by Ingo Rechenberg, Hans-Eberhard Koralewski, and Peter Bienert of the University's Institute for Measuring and Control Engineering. Many others around the world are also working on self-focusing mechanisms but, according to the Berlin researchers, they are approaching the problem from the wrong end, trying to develop highly precise distance measuring equipment and using the resulting measurements to control the camera lens. The result is generally sharp objects in the near field, with poor focus on objects further away.

The Berlin team set out instead to emulate the human eye. To focus, the eye evaluates contrast levels and the eye muscles are always in motion, shaping the lens of the eye so that the sharpest light-dark contrast, and an image of the highest possible contrast, is projected onto the retina.

Essentially, the Biofocus system does the same thing electronically. The photoconductive layer on the camera's vidicon tube takes the place of the retina's nerve cells, and an electric motor is used to adjust the camera lens for the sharpest image. A continous process of subtraction and comparison measures the brightness difference levels for the camera field and adjusts the camera lens in search of the optimum sharpness of the image.

The researchers see many applications for the Biofocus system. It could, for instance, be used in slide projectors, where an array of photocells would sense the brightness and sharpness of the projected slide and adjust the projector lens accordingly. Other applications include movie cameras, night-vision cameras, and electron microscopes. The initial high cost of the technique prevents its immediate use in amateur equipment.

US steps up battery research projects

As a result of renewed interest in electric vehicles, many new batteries are being developed which promise to be lighter and have a much higher power density than the conventional lead-acid battery.

The pace of research is paricularly energetic in the United States. For instance, a new lead plate has been developed at the California Institute of Technology's Jet Propulsion Laboratory in Pasadena. It will give conventional batteries a fourfold increase in power density and a doubling of battery life, according to a recent report.

The US currently has an estimated 3000 electric vehicles. Nearly all models now in use rely on some variation of the familiar lead-acid battery.

That situation is about to change. Last June, for example, Gulf and Western Industries released in the US three new vehicles powered by a new zinc chloride battery system. The cars can travel 240km at 90km/h carrying a family of four.

EA gains circulation

Figures released by the Audit Bureau of Circulations have confirmed "Electronics Australia" as the largest selling electronics magazine in Australia. Average sales for the six-month period from October '79 to March '80 (inclusive) were in excess of 46,250. This represents an increase of 12% over the corresponding period in the previous year, and is 40% more than our nearest competitor. Footnote: of the above number, in excess of 41,500 are sold in Australia. The rest are sold mainly in New Zealand.

Talking wheelchair for speech handicapped

Researchers at Psycho-Linguistic Research Associates, Menlo Park and Standord University Medical Centre, have developed a "talking wheelchair" that allows the victims of cerebral palsy or stroke to speak in spite of their disability.

The wheelchair carries a small computer and a speech synthesiser. Patients use a keyboard, joystick, or even a single button to construct sentences on a video display attached to the wheelchair, and then direct the microprocessor to drive the speech synthesiser. So far, six patients with various degrees of speech disability have used the wheelchair in successful trials.

"I have always wanted a really good loudspeaker system."

Today the cost of excellent turntables, cartridges, tape decks and amplifiers has fallen to the point where the average family man can afford equipment of a quality and performance-level that was impossible ten years ago.

But good loudspeakers have remained extremely expensive and, in most domestic hi-fi systems, the rest of the equipment can dramatically outperform the speaker.

Philips have set out to correct this imbalance.

In co-operation with Philips Elcoma Division, a leading Electronics magazine has developed the ETI 4000/1 speaker system.

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The accident at Three Mile Island

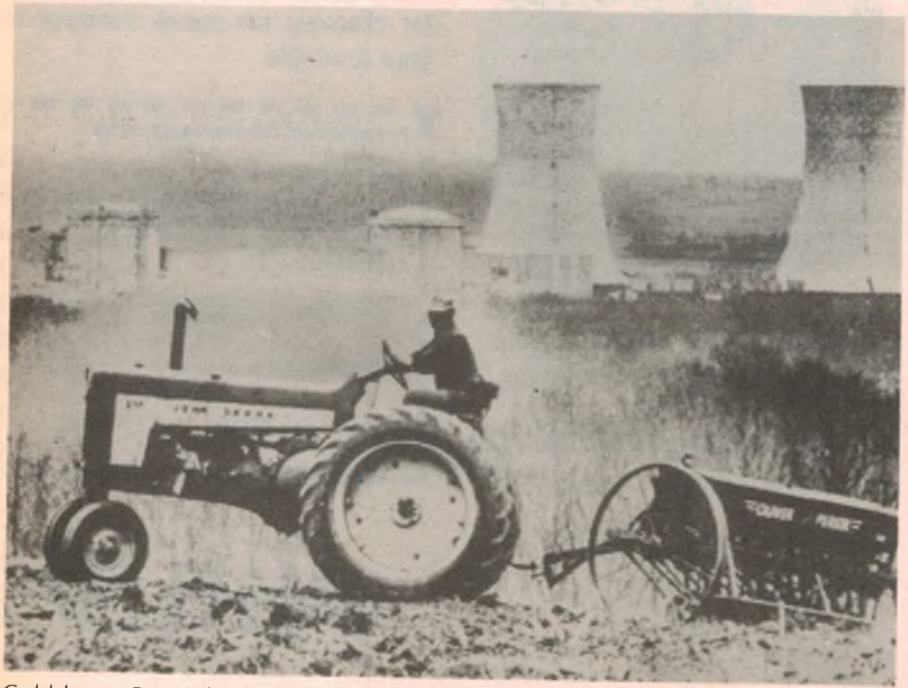
. . . design deficiencies & human error

The Three Mile Island accident has suddenly brought home the importance of human performance in modern technology. Experts now say that it may be man, rather than machine, that needs improvement. Certainly, in the case of a nuclear power station, the stakes for human error are considerable.

by JOEL GREENBERG

The collaborative symphony performed by man and modern machine is filled with sour notes. Because most human errors are subtle and inconsequential, they pass unnoticed and do not influence most of present-day technology's complex tasks. Close to five million aeroplanes take off and land safely each year in the United States; trains usually manage to stay on their tracks and transport people and materials without incident, if not always on schedule; massive ships generally are able to navigate amongst one another through narrow harbours. And, at least until now, nuclear plants have been able to provide huge amounts of power to large areas without blowing up or melting down.

But last year's near-meltdown at the Three Mile Island (TMI) nuclear plant in Pennsylvania is indicative of widespread and increasingly difficult problems of matching human performance and reliability with that of sophisticated machinery. As a rule, mistakes that do reach the public consciousness are so disastrously out of tune with the expected technological harmony that even the most untrained ear can pick them up. These errors usually lead to events that are fatal, or potentially so, to large numbers of people – the TMI accident; the derailment of trains carrying passengers or toxic chemicals; plane crashes that kill hundreds, such as those in San Diego, Chicago and the Canary Islands; the inexplicable collision of an oil tanker with a Coast Guard cutter on a clear, moonlit night in Tampa Bay.



Goldsboro, Pennsylvania, March 31, 1979 – an American farmer uses a tractor to plant grain near the TMI plant at the height of the accident.

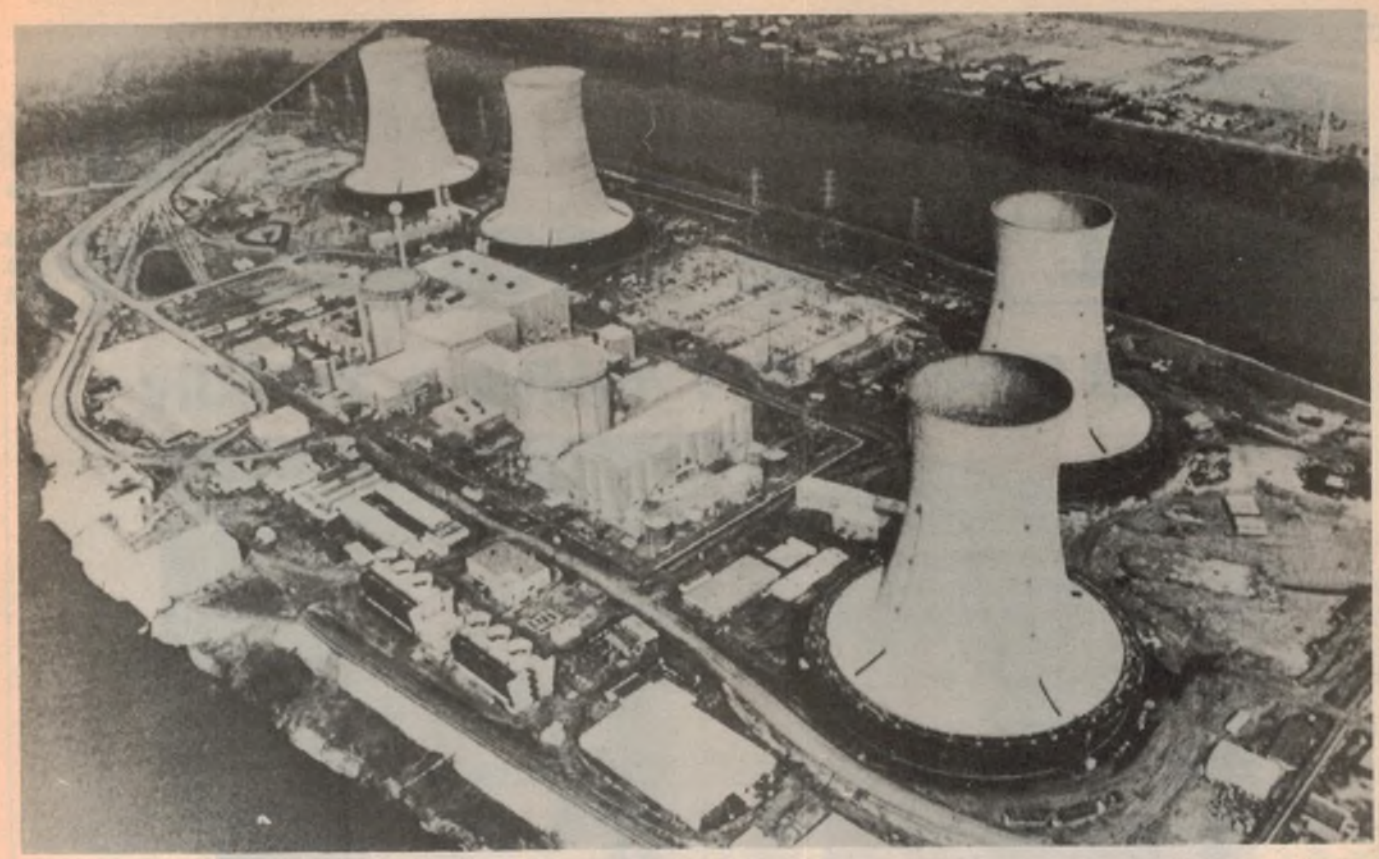
Human Factors Ignored

The vast majority of mistakes, however, do no harm because the system either compensates by itself or allows human operators time to correct the error. But whenever humans are involved, mistakes are bound to occur and do so with a frequency that some find disturbing. Even among commercial airline pilots, considered perhaps the best prepared of modern technicians, experts estimate an average of one to two errors – albeit minor, correctable ones – per hour.

For reasons made even more obvious than before by the near-catastrophe at Three Mile Island, the orchestration of nucelar power plants is the current priority among experts in "human factors" engineering. And at this point, their assessment of the state of the art might coincide with that of a critic who has just been forced to sit through a junior high school's rendition of Beethoven's Fifth Symphnony.

"The design of (nuclear plant) systems today is simply in an intolerable state," says Donald Norman, a University of California at San Diego psychologist who specialises in human performance in the operation of mechanised systems. "Good design and analyses of human factors are simply ignored at the design stage," he says.

The underemphasis on the role of humans in plant operation probably



The Three Mile Island nuclear power plant – scene of America's worst nuclear energy accident.

would still be a non-issue had the TMI accident not occurred. But some experts say it would only have been a matter of time before a similar accident exposed the deficiencies. "For years we have been relying on operator adaptability to overcome design deficiencies," says Gregory B. Minor of MHB Technical Associates. "There is an urgent need for a human factors research facility to evaluate control room changes . . . and provide hard data on their impact on operating effectiveness and safety before they are cast in concrete."

Unforeseen lapses

In the TMI aftermath, investigations by the Carter administration's Kemeny Commission and a Nuclear Regulatory Commission team, headed by Washington attorney Mitchell Rogovin, have depicted a scenario of system failure made possible only through a series of unforeseen lapses in judgment and communication. Such errors – primarily consisting of opening valves that were supposed to be closed and vice versa – are inevitable in any complex system that does not require its human performance standards to match those of its hardware components, according to some scientists. "As systems become larger and more energetic . . . error (becomes) of violent . . . lethal importance," says John W. Senders, an electrical engineer and psychologist at the University of California at Santa Barbara and the University of Toronto and a recognised authority in human performance in technology. "Nuclear power is far too important to be left to nuclear engineers."

The TMI analyses appear at least partially to support the contention of Senders and others that the near-meltdown could have been avoided through more commonsense plant design and improved training of workers. "Human factors engineering . . . has blossomed in the aerospace, defence and aircraft industries," says the Rogovin report. "But nuclear utilities, vendors and architect-engineer firms have done very little to incorporate such learning into their designs, and the NRC has done virtually nothing to require them to do so.

"This failure reflects the preoccupation of the industry and the regulatory agency with hardware systems. The NRC gives short shrift in the design safety review process to determining how well operators will be able to diagnose abnormal events, based on what they see on their instruments, and respond to them. In part, the failure is also due to a lack of expertise."

Apparently, seeing their instruments in the first place has been a major problem for workers not only at TMI but at other nuclear facilities as well. "There is evidence that the operators of TMI-2 were confused by equipment indications available to them on March 8, 1979," says Ronald M. Eytchison in a technical staff analysis report to the President's Commission on the Accident at Three Mile Island. "The confusion . . . may have resulted in part from the control room layout and design or from the equipment malfunctions. The control room was evidently designed more for normal operation than for accident conditions," he says. "The arrangement of controls and indicators for engineered safety features was not well thought out."

Design deficiencies

TMI design deficiencies cited in the reports of Eytchison and the Rogovin committee apply to a significant number of nuclear plants, according to the investigators. The problems include: controls located far from instrument displays that show the condition of the system; cumbersome and inconsistent instruments that often look identical and are placed side-by-side, but control widely differing functions; instrument readings that are difficult to read, obscured by glare or poor lighting or actually hidden from the operator; contradictory systems of lights, levers or knobs – a red light may mean a valve is open in one plant area and closed in another, or pulling one lever up may close a valve, while pulling another lever down may close one. In one plant examined by Senders, a blue valve was used to control the heat system while a red valve controlled the cooling system – "I call that criminal," he says.

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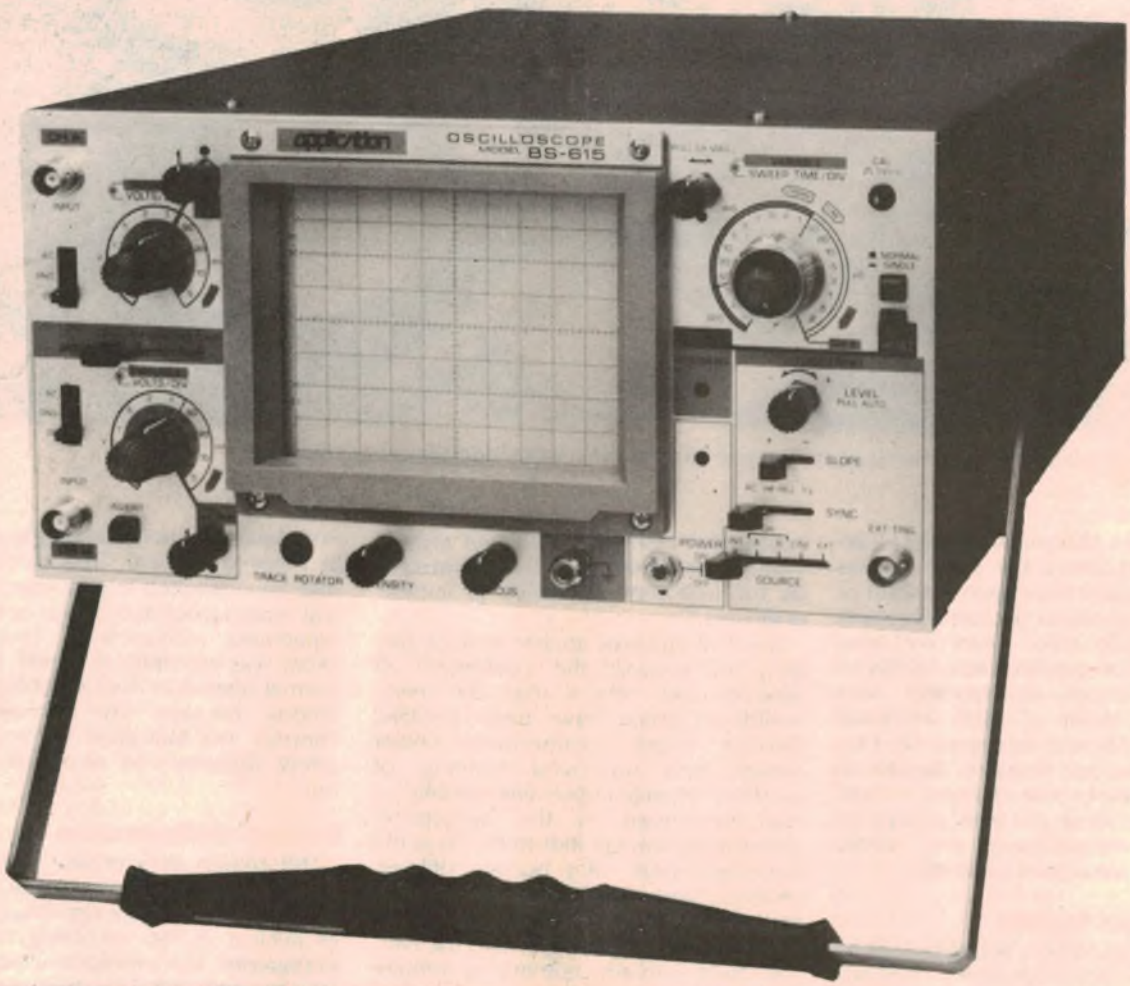

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Three Mile Island: haphazard control systems

Mile Island crisis, the TMI-2 control room was a cacophony of blaring alarms, accompanied by flashing lights. But because many of the more than 1500 plant alarms are triggered under relatively "normal" operating conditions, it is difficult if not impossible to detect a real emergency within a reasonable time after it occurs, the technical staff analysis suggests. Moreover, "a single 'acknowledge' button silences all of the alarms, making it likely operators could not comprehend the significance of all alarm conditions," says the report.

In some cases, emergency control systems at TMI are haphazardly scattered throughout various plant locations and may not even be visible to key personnel. "For instance," says Eytchison, "the high pressure injection (HPI) throttle valves are operated from a front panel but the HPI flow indication is on a back panel and cannot be read from the throttle valve operating positions."

Reports Rogovin: "No visual alarm signaled that the emergency feedwater system was completely blocked off. This was not discovered for some eight minutes into the accident, apparently because poor panel layout makes systems misalignment difficult to spot, and because a paper tag hanging from a handle on the control panel obscured an indicator light that would have shown the operators the position of one of the block valves shutting out this system."

In another confounding turn of events, the report continues, important visual alarms "that might have told operators the pressurise relief valve was stuck open, even though the control panel light showed it was closed . . . are on a panel remote from the central console that faces away from the operator!" Those particular alarms were also keyed to temperature and pressure in the reactor coolant drain tank, into which hot water from the struck-open valve was pouring for more than two hours after the accident started, the report states.

"Certainly, the initial meshing of this emergency machinery in the control room is something short of symphonic," Rogovin reports. "There is good reason for (the workers) to suspect that their operator training and years of experience are serving them badly in this event; none of the buttons they've pushed or the switches they've pulled have produced the needed magic. Intellect tells them they don't really know what is going on; ego tells them none of the rest of the guys do either; on the evidence, both are right."

Harrisburg, Pennsylvania, March 29, 1979 – residents near the TMI plant during the emergency. Note proximity of houses to the cooling towers.

Training problems

It is likely that such widespread design inconsistencies would have hampered even highly knowledgeable, stringently trained technicians. But according to Rogovin and a separate analysis report by Eytchison, the training of workers at TMI and elsewhere appears to fall considerably short of that in other high technology fields, such as airline operations.

"There is no regulation regarding operator selection and training; the NRC has no minimum eligibility standards for the qualification of operators," Eytchison says in the report. "Reactor operator candidates do not have to meet any requirements concerning minimum education, experience, reliability, criminal record or stress fitness. . . . There is a lack of emphasis on the comprehensive knowledge of theory, principles of operation, kinetics, thermodynamics and so on, which would enable operators to correctly interpret information available to them in the control room. Review of typical (licensing) examination contents indicates the examinations are consistent with the regulations; they do not ensure that license candidates have an in-depth knowledge of nuclear reactor theory, design and operation."

Rogovin compares the operation of an airliner with that of a power plant – much of the work is essentially routine, at times boring. But the major difference, he says, is that the airline pilot is trained not only to handle but to diagnose emergencies such as loss of an engine, sudden depressurisation and hydraulic failure. "It is here that reactor operator training has been seriously deficient," says the report. "Other than being required to memorise a few emergency procedures, reactor operators are not extensively trained to diagnose and cope with the unexpected – equipment malfunction, serious transients (temporary electrical oscillations), events that cannot be easily understood."

Ironically, it may be that the generally high reliability of today's nuclear plants is in part responsible for deficiencies among workers. "If a system breaks down once every 10 years, will people have enough practice to handle it?" asks Senders. "If an operator is never called upon to act, the system must be 100% reliable – and they are," he adds with a smile. "We haven't had a blowout yet;" then somberly: "God help us, we hope we'll never know what the reliability of systems really are."

Human problems

Even were unlimited resources available for upgraded operator selection and training programs, just how much improvement could be achieved in safety and performance is uncertain for two reasons: the variability of human beings, particularly under stress, and the

Myths exploded, says TMI operator

In an effort to reassure the American public following the Three Mile Island accident Metropolitan Edison, the operator of the plant, has taken out full page advertisements in a number of publications. This is what the company had to say in a paid advertisement in a recent issue of "Scientific American".

Think back. It hasn't been that long ago.

Pennsylvania looked like it might be blown off the map any minute, turned into a radioactive no-man's land forever. "Permanently uninhabitable" was the way they said it in the movie, *The China Syndrome*.

That's the trouble. A lot of people said a lot of things. And a lot of it just wasn't true. Not even close.

Take the hydrogen bubble that made all the headlines. Bubble, nothing. The implication was time bomb, ticking away. And that would've frightened anybody who didn't have a degree in chemistry.

The fact is, that bubble couldn't explode. Not by any stretch of the imagination.

To understand why, you have to understand how the hydrogen got there in the first place. And that takes some understanding of how the reactor at Three Mile Island was designed to work.

It's the pressurised-water type, meaning the fuel core was cooled by keeping it submerged in water. H_2O. Hydrogen and oxygen. Heated by the core to more than 550 degrees, well beyond the boiling point.

What kept it from boiling was pressure, approximately 2000lb worth. But on March 28, last year, a relief valve on the pressuriser stuck open, the pressure dropped, and the water — the H_2O — inside the reactor boiled into steam.

When that happened, the zirconium-alloy tubes housing the fuel underwent a chemical reaction. A kind of accelerated rusting that combined the zirconium from the tubes with oxygen from the water to form zirconium oxide.

That's important, because with all the oxygen used up by the chemical reaction, the only part of the water left was hydrogen. The bubble. And what nobody bothered to tell you at the time was that without oxygen, hydrogen can't explode.

On May 1, more than a month later, the Nuclear Regulatory Commission admitted the scare was all a mistake. Roger Mattson, Director of its Systems Safety Division, told a congressional committee there "never was any danger of a hydrogen explosion in that bubble".

That never made headlines.

And more than likely, neither will the fact that even if there had been a meltdown, it wouldn't have spelled disaster for Pennsylvania. It couldn't have.

First of all, the fuel core in the reactor vessel was surrounded by a containment building. Not just any building, an immense fortress with an enormously thick floor. Eleven feet of solid concrete reinforced with steel.

Second, for a moltent mass to eat through it, that concrete-and-steel floor couldn't be covered with water. But water is what's used to cool the core. And when the relief valve on the pressuriser stuck open, sending several hundred thousand gallons shooting out, the law of gravity gave it only one place to go.

Down to the floor, right under the reactor vessel. Right in the path a molten mass would take.

That's the fallacy of the meltdown theory. In spite of the overwhelming odds against it, if all systems failed, if the entire core melted, if it got through the foot-thick steel reactor vessel in one piece and dropped to the floor below, it would've been stopped right there. Cooled by an ocean of water inside the containment building, not 20ft from where the meltdown started.

As for any sudden burst of steam pressure that might be released when the molten mass hits the water, it wouldn't be nearly powerful enough to rupture the walls of the building. Walls capable of withstanding almost twice as much force.

In other words, there was no way for significant radioactivity to reach the atmosphere outside.

The point of it all is that Three Mile Island and nuclear power itself deserve a fairer shake. A second look minus the hysteria, the hyperbole, the half-truths, and the untruths. They deserve a close, careful reading of the facts.

True, we've experienced the worst accident in the 22 years America has been using nuclear energy to produce electricity. But it wasn't the apocalypse. No one died. And except for the stress of being scared stiff, no one was injured. Despite the equipment failures and failures in judgment, despite everything that went wrong, the safety systems worked.

What really exploded were myths.

present shortage of data on human error. "A human can fail in so many ways, it almost defies description," says Alan D. Swain of Sandia Laboratories. Specifically he says errors may be placed in any of five categories: omission, commission, extraneous action, sequential and time error.

The TMI accident, which experts say probably incorporated several types of error, is by no means the only instance in recent years in which mental lapses have played a role in technological disasters or near-disasters. "All accidents in one sense can be traced to the failure of human beings in complex systems," says Senders.

According to psychologist Norman, "human processing is lazy – we process with as little depth as needed." He cites the example of a crash of two large commercial jets on a runway in the Canary Islands several years ago. The tower told one of the pilots he was "cleared for takeoff"; the pilot, apparently eager to return to his home base after an extended tour of duty, misinterpreted the message as a go-ahead to actually take off at that moment, precipitating the crash with the other plane, Norman says.

Senders, who was among those who formulated the design of military aircraft in the early 1950s, concurs that the human mind at times can be less than 100% reliable – sometimes with tragic results. He recalls a succession of crashes around that time when military planes plummeted to the ground for no apparent reason. It was later discovered that during routine maintenance, workers had reversed the aeroplane's trim tab wires that controlled the flaps. To anyone less than totally familiar with the design of these specific planes, it may have seemed more logical to

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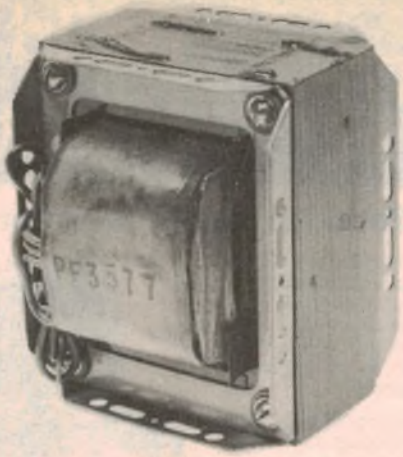

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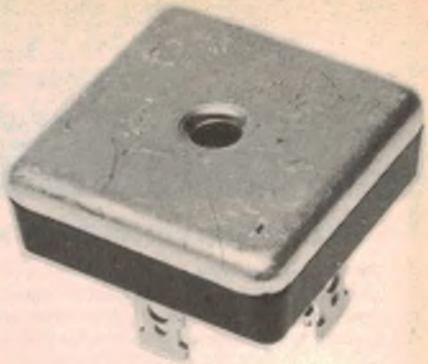

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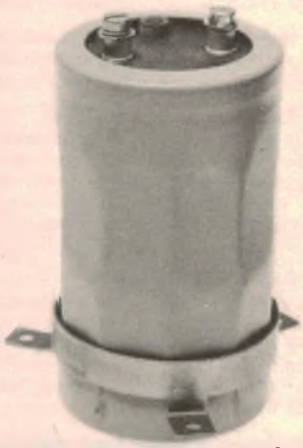

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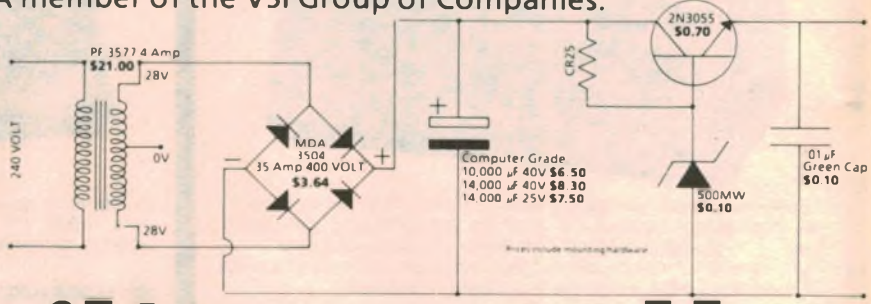

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reverse the wires – which is exactly what some of the less knowledgeable workers did. Unfortunately, the naive placement of the wires in this "logical" position sent the flaps up when they were intended to go down, and vice versa.

"Preventive maintenance, if not done correctly, can be worse than no maintenance at all," says Senders, who also cites one study reporting the increase in auto accidents after mandatory inspections of steering and brakes. In the case of the military aeroplanes, Senders says designers could have made it physically impossible for the wires to be switched by requiring that the wire ends fit only into specific receptors. Similarly, he suggests that the risk of human error at power plants could be significantly reduced through straightforward designing – including more standardised colours and sizes for valves and levers – that meshes with human thought patterns and anticipates potential errors. It has been estimated that the probability of a plant worker failing to reopen a valve after closing it for inspection is one in 100. "That's just not acceptable," Senders says.

But any new, human-oriented designs or training procedures must be based on the types and frequency of mistakes made in nuclear plants – and, experts concede, there are woefully few data in that area compared with what is known about technological reliability. Part of the problem may be traced to what Senders calls a "self-protective attitude" and a "reluctance to release data" by plant managers concerned with their own performance records.

"Lack of data is the single most important factor impeding the development of Human Performance Reliability (HPR) indices and the utilisation of mathematical models of human performance," says David Meister, senior staff specialist at the Naval Personnel Research and Development Center in San Diego. Adds Swain: "Human reliability analyses are rarely performed; it is assumed that either humans won't make a mistake, which is idiotic, or that humans do not contribute to the performance of the system."

Swain and his colleageus have developed the currently "most widely used" human reliability model, called THERP – Technique for Human Error Rate Prediction. Although THERP may be the most sophisticated method yet developed of predicting human error rates and evaluating "the degradation to a man-machine system likely to be caused by human errors," even Swain allows that its accuracy and value could be substantially improved if more solid, scientific data were available.

Senders stresses that models for obtaining data on human error have "been available for 25 years". Such study techniques – used primarily in the military up to now – could be applied to the operation of nuclear power plants, he suggests. "All that has been done (in relation to nuclear plants) is to count errors – and that information has been used to indicate a problem with the *equipment*," he says. "No one knows, in fact, what kind of errors *people* will make."

Senders proposes to study the combined effects of time stress and training level on the rate and types of error in power plants. This would be done by "synthesising a job" – as simulated by a computer – where the experimenter would have "complete and absolute control over the job. You would determine the percentage of errors generated from within the system and from outside of it . . . you look for consistency of errors and performance on the job."

Until a large-scale commitment is made to this and other types of investigation into human error, Senders says, "we will continue to get biased numbers . . . overestimating the safety" of nuclear plants because "most errors are absorbed by the systems, and very few actually result in accidents."

Even now, he says, probably enough is known about human factors to eliminate "a whole class of potential errors" – including some of those that contributed to the Three Mile Island accident. "At TMI, the cost of human error was made evident; it is clear that people in great positions of power do not always do the right thing," he says. "But when things fail you do need people – and things do fail."

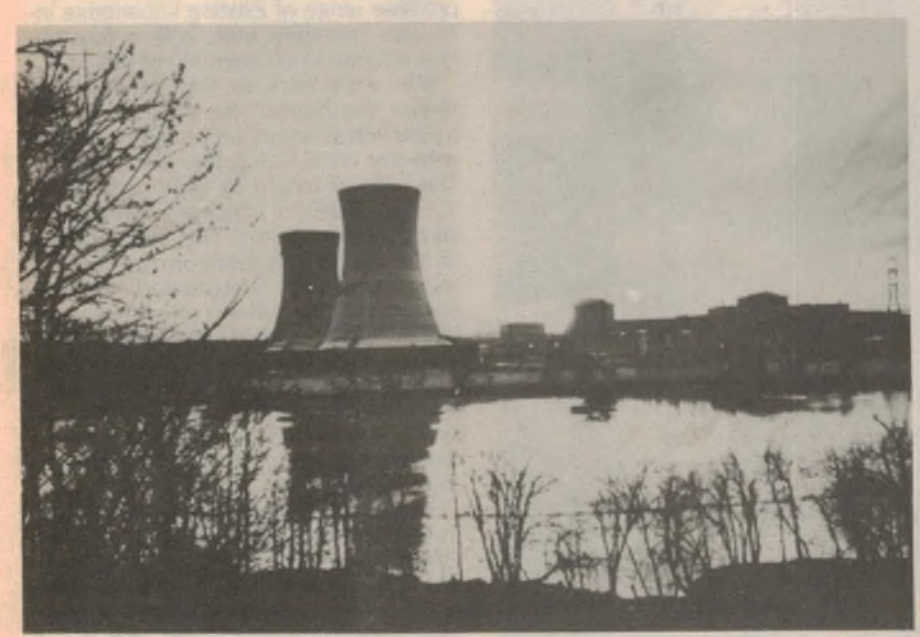
Three Mile Island & the press

In the aftermath of TMI, IEEE "Spectrum" (the monthly journal of The Institute of Electrical and Electronics Engineers) surveyed the opinions of 2000 IEEE members on the role of the press in reporting the accident. The following quotes are typical of those published in "Spectrum" for November, 1979.

"In general, I feel the news media — particularly TV — was bent on giving nuclear power a hatchet job. Inflammatory statements and one-sided reports were the rule rather than the exception." (J. Barnhart, Hewlett-Packard).

"The big value of the media was to explore the corporate cover-up, NRC ineptitude, and general bureaucratic bungling and stupidity surrounding this event." (J. V. McMillin, Consultant).

"The media loved it! They took every chance to cast fear into the situation. Nader types were hustled one after another in front of the TV cameras to preach apocryphal doom. Not since Watergate have I seen such biased reporting! (C. S. Pendergrass, South Central Bell Telephone Co).



The Three Mile Island nuclear plant as seen from Harrisburg – a lesson in plant engineering and a new cause for the opponents of nuclear energy.

Solar energy, windpower, and careful design

Michael & Judy have power to spare

In a quiet, picturesque Victorian country setting, Michael and Judy Bos have built what is probably the first totally energy-independent house in Australia. Included under one roof (and on top of it!) is the broadest range of solar energy and energy conservation technology available. For the Bos family, there are no more power bills.

Judy Bos sat back, smiling, in the kitchen of her new home at Pearcedale, Victoria. "I'll have to turn a few extra lights on soon," she confided. "We're storing a bit too much electricity today – it's been so sunny lately, you see."

It was ironic that Judy should be working out how to use more electricity while Victoria was in the throes of a recent power strike.

As far as they know, the house that Michael and Judy Bos have built is the first totally energy independent modern home in Australia.

It operates without outside electricity, gas, water and sewerage services. Solar energy provides their electricity for lighting and all appliances, central heating, cooling and hot water. Their coke-fired kitchen stove, which soon will be converted to methane gas produced at home, assists in water heating during winter. Water for the Bos' home is collected from the aluminium clad roof. The only concession they have made to the outside world is an underground telephone line.

Eight solar cell arrays each provide 2.5A at 14.5V, with a total capacity of 20A.

An industrial chemist, Michael Bos has been experimenting with solar technology for more than 20 years. He has an Australian patent pending on a solar panel for heating swimming pools and has established his own small company to manufacture the panels.

Like most home owners, Bos was becoming concerned about rising energy costs. His previous architect-designed home in Mount Eliza was an awful waste of energy, he says. "The south facing glass windows were like having a hole in the wall, in terms of energy efficiency." Despite scepticism from solar energy experts – mainly relating to cost – Bos set about designing his energy independent home in 1977 with Melbourne architects Cocks and Carmichael.

The radical feature of the final design was not that it contained new solar technology – in fact much of the technology has been around for years – but that Bos had included the broadest possible range of existing knowledge into one complete unit, with a few improvements of his own along the way.

"We went back to first principles to design the house," he says. "First, the house was oriented on an east-west axis with the front facing the northern sun. The ratio of length to width was set at 1.5:1 in order to maximise energy gain and to minimise loss. The thermal mass of the house can therefore be used at top efficiency in heat control. Keeping these basic principles in mind it is possible to construct an energy independent house almost any way you like."

The design of the house has received world wide attention. In fact the Bos family now keeps a visitors' book that resembles a who's who of people in the solar energy field.

Locally, the design won a $500 award from the 1978 Victorian Gas and Fuel Corporation's low energy competition. Bos has received $5000 from the National Energy Research, Development and Demonstration Council and $2500 from the Victorian Solar Energy Committee. The Committee's grant will be used

The house is oriented east-west with the front facing the northern sun to maximise energy gain and minimise heat losses.

to monitor each system in the house over a two-year period to accurately determine energy output and use.

It was essential to Bos that the new house should have all of the conveniences of modern living. The electrical system is perhaps the most interesting and innovative of the many energy saving concepts in the design.

Eight photovoltaic cell arrays each supply 2.5A at 14.5V with a combined rated capacity of 20A. Interestingly the combined output can increase to as much as 30A on clear winter days. According to Bos, this occurs due to the lower angle of the winter sun and reflections from the aluminium roof. "The choice of aluminium roofing was important due to its strength (the Bos family has many visitors to its roof), lightness and its reflective capacity."

Electricity is stored in 18 lead-acid batteries. Bos plans soon to double the number which will then provide a storage capacity of 1300 amp hours, or roughly a full month's supply. The batteries are unobtrusively located behind a wall panel on the first floor.

Most appliances in the house can be run from the 12V system. Lighting is provided by 80 eight-watt fluorescent lights

Rainwater is collected from the roof for domestic use and heated by conventional flat plate solar collectors. Hot water is stored in a roof-mounted 730 litre tank.

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of the type used in caravans. Bos has built a 12V refrigerator similar to a box-type freezer in appearance but with 7.5cm of insulation all around. The counter-top refrigerator uses about one-tenth the electricity of a conventional unit, he claims.

After extensive research, he is confident he has now even found a way to convert the automatic washing machine to the 12V system. Again, in answer to the sceptics, he has tracked down a 12V Japanese motor capable of carrying the high start-up load of the machine. A 240V converter will be used to provide power for the automatic controls of the washer. He is confident the machine will work – and surprise the manufacturers.

Colour television, a stereo system, and a wide range of electrical appliances are powered through the household system. Where appliances can't be purchased to run from 12V, the 240V converter is used.

All living spaces, including bedrooms, family room and living room, face north to enable maximum exposure to the sun. Eighty-five per cent of the north face (51.5m²) is glass to maximise passive solar energy collection.

According to Bos, the traditional way of building houses, with brick on the outside and cladding inside, is like building a house "inside out". The thermal mass of a house – walls and concrete slab floor – should be used to collect and contain energy, not repel it.

The floors and walls are insulated with 60mm urea formaldehyde. The roof is clad with aluminium decking and insulated with 100mm urea formaldehyde and double sided sisalation. U valves (the measure of ability to transmit thermal energy) range from 0.54 to 0.62. In comparison, an ordinary brick veneer house can have U valves ranging upwards from a minimum of five. An air lock at the south side entrance prevents excessive heat loss.

An artificial suspended ceiling in the living room can be rolled back to permit greater internal penetration by the winter sun. Adjustable aluminium louvres built on an aluminium tubing frame and positioned outside the windows control heat penetration into the house. The house has no eaves on the north side.

Bos has been selective in the use of carpets. Most rooms have ceramic tiles on the concrete base to permit maximum heat transfer from the slab. Ducts in the concrete slab take cold air from the south side to the warmer north side near the full length windows. By reversing the air flow in the ducting system (and using small 12V fans) a cooling effect can be achieved in summer.

An unusual passive use of solar energy is the "green house" located adjacent to the living room on the north side. It contains a unique solar heated circular "plunge pool" which serves a purpose other than being great fun for the three girls of the Bos family. Its more practical application is to provide a heat sink to augment the concrete slab. Cool air is drawn into the green house from the south side of the home and returned as warm air. On a clear winter day it can contribute over 10% to the heating load.

The indoor green house is ideal for beautiful tropical plants.

The house makes extensive use of active solar energy collection techniques. Hot water is supplied by eight squares of conventional flat plate collector. Storage is in a 730 litre tank which has 15cm of insulation. The Aga coke fired kitchen stove supplements water heating in winter by up to 410 litres per day. It consumes about two tonnes of coke per year.

Methanol gas, however, ultimately will be used to fire the stove, while a methane digester is planned to replace the septic sewer system. Gas production will be boosted with the addition of sugar beet. Bos has already commenced cultivation of a trial plot of sugar beets and plans to use these also to produce ethanol to fuel the family car.

Rainwater from the roof for domestic use is stored in a concrete tank of 46,000 litres capacity. In addition to the aluminium roof, Bos has used aluminium guttering and flashings to ensure water purity.

The house contains heat form fire places in the living room and den. Of special interest, however, is the solar chimney. Designed for winter heating, the chimney is a rectangular duct coated with heat absorbing black paint. The aluminium framed chimney has an area surface of 20 square metres double glazed with polycarbonate sheeting and has 5cm of foil-covered insulation. In slopes from the front of the house to the roof at an inclination of 40 degrees. The sun heats the air inside the duct, causing it to rise. Under ideal conditions the air temperature in solar chimneys of this type can be as much as 150°C.

The rising air is controlled to pass through a heat bank built in the centre of the house. It is insulated with 5cm of urethane. The heat bank consists of 68 round aluminium tubes five metres in length and 100mm in diameter. The sealed tubes contain a total of 1100 litres of water.

The system operates when a cold air duct connecting the bottom of the solar chimney to the heat bank is opened. Small 12V fans enhance natural circulation at night when the stored heat in the aluminium tubes is transferred to the circuating air. With only a 40°C temperature rise in the solar chimney the heat bank can store 232,000 kilojoules (222,000 BTU). The system can be used for cooling in summer by reversing the system – exhausting heat from the house at night and cooling the internal air by day.

At a total cost around $90,000, Bos is using his house to demonstrate that total energy-independent living is indeed a reality. How far the cost can be reduced is now the second step.

Bos is eager to talk with design and construction experts to devise ways of reducing building costs to affordable levels. In the meantime, he is happy to continue with his experiment and new way of life.

The carefully designed house is a demonstration of energy-independent living.

This article originally appeared in "Aluminium" (April, 1980), published by Comalco Limited, Victoria. It is printed here courtesy of Comalco and Michael and Judy Bos.

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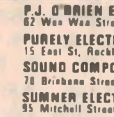

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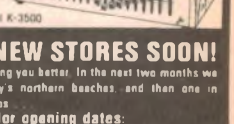

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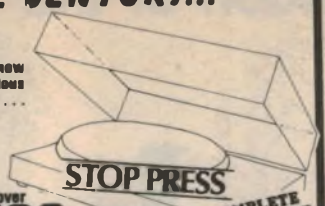

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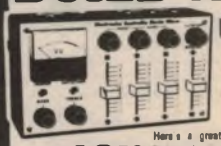

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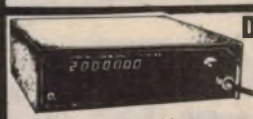

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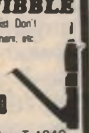

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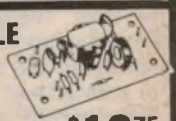

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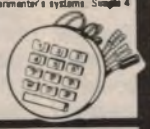

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Spectroscopy & the invention of the

Photophone

Alexander Graham Bell is best known for the invention of the telephone, but he was a man of many parts. This year marks the hundredth anniversary of his first successful transmission of voice messages via a beam of light. In the course of his experiments he also stumbled upon another very useful discovery — the photo-acoustic effect.

by DR CLIVE COOGAN*

"Mr Bell, if you hear what I say, come to the window and wave your hat." These words, heard by Alexander Graham Bell through a telephone earpiece connected to "an illuminated receiver" seem scarcely likely to be the introduction to a new branch of optical spectroscopy, but they were! Serendipity in science had struck again!

The words were spoken by Sumner Tainter, Bell's friend and assistant, from the top of the Franklin St. Schoolhouse in Washington DC, 213 metres away from Bell's laboratory in 1325, L Street. Tainter was operating the transmitter of a "photophone" which Bell had conceived and which was probably the first successful transmission of voice via a light beam.

The year was 1880 and August this year marks the centenary of that first voice transmission by light beam. Remarkably, this concept had been implemented only a few years after the first successful telephones; due of course to the same ingenious Scot, Alexander Graham Bell. What would Bell have made of current efforts, particularly in his own Bell Telephone Company, to convert all telephone communications to messages carried on light beams using optical fibres and lasers and the whole new gamut of electro-optic devices?

In the laboratory, Bell and Tainter had succeeded in transmitting spoken messages using oxy-hydrogen light and even the light from a kerosene lamp or a candle, but as they were in earshot of one another they regarded this as suspect, and so arranged the 213 metre test-track.

Selenium had only fairly recently been discovered to be a photoconductor (in fact selenium itself was not known until 1817 when Bezelius separated it from sulphur and tellurium). It was found that crystalline selenium had a very high resistance, and a certain Mr Willoughby Smith began using it as an insulator in shore-end tests of submarine cables. He cast bars with a resistance of 1400 megohms, which Bell points out was equivalent to the resistance of a cable from Earth to the Sun! However Willoughby Smith's assistant, Mr May, found that its resistance was lowered when it was exposed to light, which finding Willoughby Smith published in 1873. Rapid development then took place so that by 1875 the selenium photoconductor cell was fairly well established.

Bell realised that this might constitute a means of optical communication, so he made himself a selenium cell "about the size of a dime", which emigre Bell explained for the benefit of his English readers was "a small silver coin about the size of a *fourpenny* (sic!) bit. Its value is 10 cents". Bell proposed in 1878 the possibility of "hearing a shadow", or the transient change in current through the cell when the light falling on it was suddenly cut off. He passed the current through the selenium cell through one of his telephone earphones.

A few days later Willoughby Smith told the Society of Telegraph Engineers that he had indeed "heard a shadow", or rather the reverse – the removal of a shadow falling on a selenium bar in circuit with a telephone and a battery. Also, although unknown to Bell at the time, a letter to "Nature" a few weeks later asked whether anyone had experimented with the selenium cell in circuit with a telephone, as it seemed to the writer "not unlikely that sounds would be produced in the telephone by the action of light of variable intensity upon the selenium element in circuit with it."

Others were actively at work on the idea within weeks also. By September or October of 1878 (Bell had forgotten which), a Mr A. C. Brown of London disclosed confidentially to Bell the details of "a most ingenious invention of his, of which we may yet hear more" which converted various light intensities to sound. Also hard at work was a Mr W. D. Sargent of Philadelphia, who had a device in which the action of the voice caused a light to fall intermittently on a selenium cell causing, as we can see in hindsight, a hideously distorted voice signal.

However, Bell had a better idea. He had toyed with the notion of a rapidly rotating disc in which there were uniformly spaced holes near the circumference, so that light passing through the disc and falling on the selenium cell would be intermittently interrupted. He reasoned that this would produce a musical note. But on further consideration he decided that all the audible effects that were present in a telephone could be reproduced by cor-

*CSIRO Division of Chemical Physics, Clayton, Victoria.

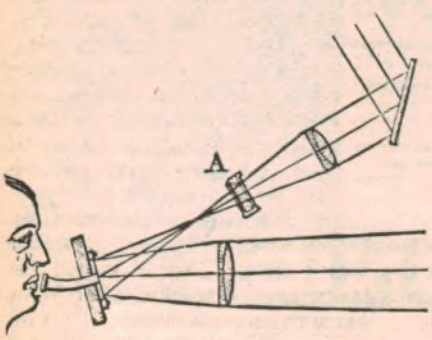
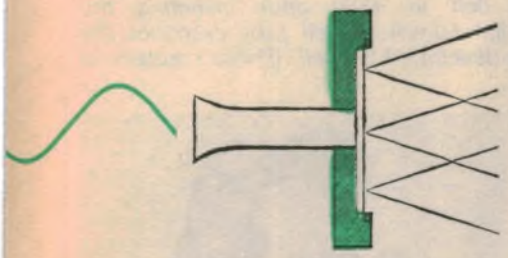


Fig. 1: in Bell's "Photophone", sunlight was reflected onto a mirror that vibrated in response to speech, causing the light beam to vary in intensity.



responding variations in the intensity of light falling on a selenium cell. To put this into practice he set to work to devise an apparatus which would produce variations in the intensity of a parallel beam of light.

After a few false starts, he finally settled for a very simple device, a silvered disc of mica or thin glass, vibrated by sound waves, which was used as a mirror. This is shown in Fig. 1, taken from Bell's paper in the Journal of the Society of Telegraphic Engineers of 1880.

Vibrations changed the diaphragm from a plane mirror into one of slight concavity or convexity, changing the intensity of light reflected from it as received at a selenium cell. For a light source he settled for the Sun, which meant that he had to use a heliostat mirror. He also produced an improved selenium cell. The complete apparatus is shown in Fig. 2.

Using this type of apparatus the photophone was born, and Bell waved his hat to Sumner Tainter. However, it has taken a long time for the photophone to gain much altitude, and we are only just beginning to see its potential realised.

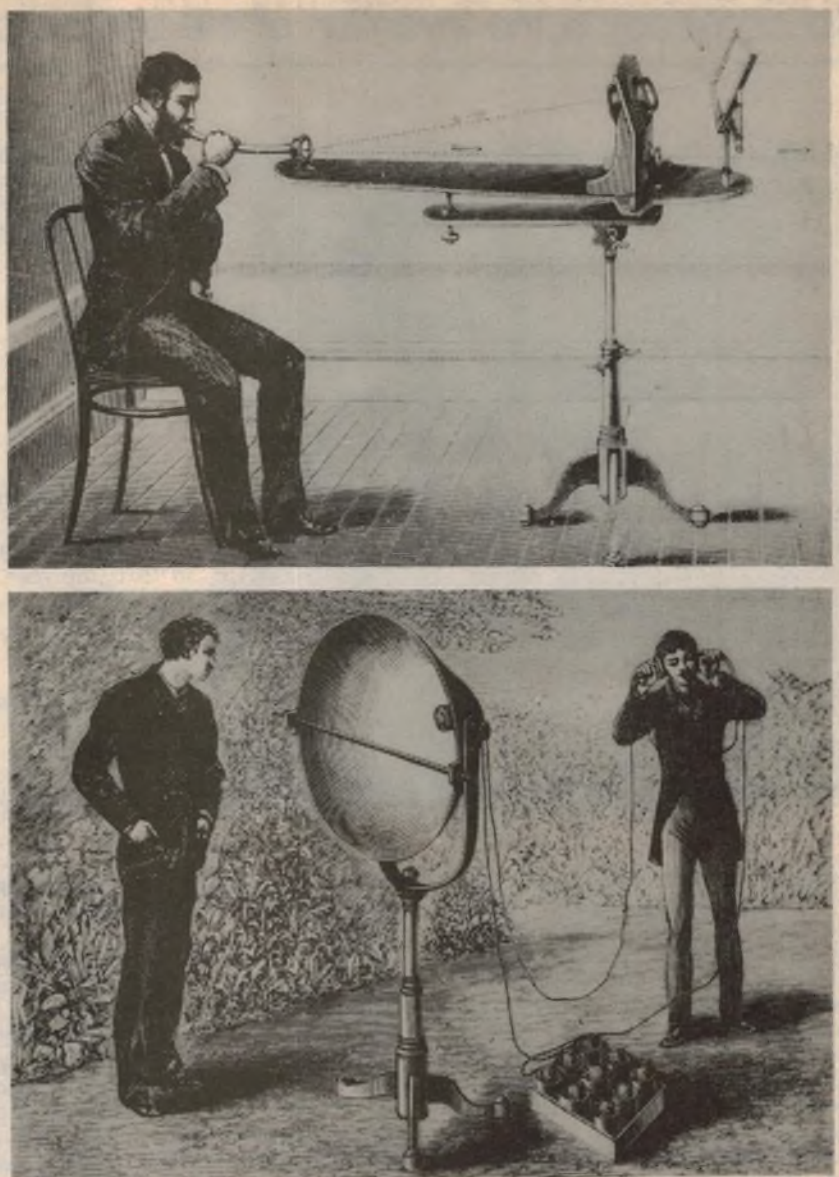


Fig. 2: these woodcuts from Bell's patent of December 1880 show the complete scheme for the Photophone. A selenium detector at the receiving end converted the light beam variations into electrical current to reproduce speech in a telephone handset. (Photos courtesy of Bell Labs).

Photo-acoustic spectroscopy

But in the course of seeking to understand more about the photophone, Bell also stumbled upon another very useful discovery which has taken even longer to be usefully applied but which has already yielded much of value. Bell set out to investigate, for all the wrong reasons, whether you could hear, without the aid of a telephone circuit, "the molecular disturbance" which he argued would take place when an interrupted light beam hit the selenium cell.

At first his efforts were not successful with selenium, but when he used a sheet of hard (and presumably black) rubber, he was rewarded with quite distinct sounds. These he intensified by making the hard rubber into a diaphragm and leading away the sound to his ear with a rubber tube.

He then substituted diagrahms of various other materials and found similar effects, except with white paper, mica and glass. Selenium in the form of a thin disc, gave a quite audible sound in this new apparatus as did virtually anything which Bell tried.

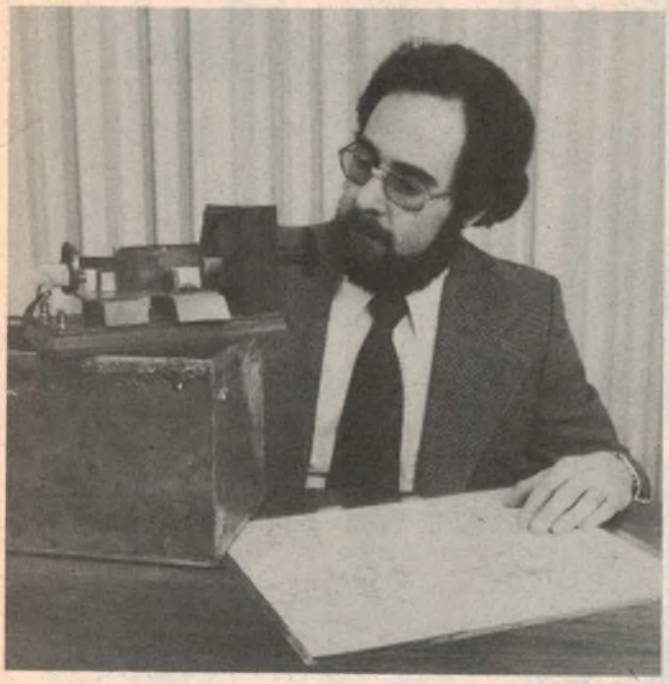
It was this discovery that has spawned the new science of photo-acoustic spectroscopy.

Bell reasoned that the sound was due to a rearrangement of molecules in the specimen, and, as this sound had to be transmitted through the substance in the apparatus he was using, it would be better to lead to the ear air that is in direct contact with the illuminated surface. So he used tubes of vulcanised rubber, brass and wood into which chopped sunlight was focused. Very perceptible musical notes were heard.

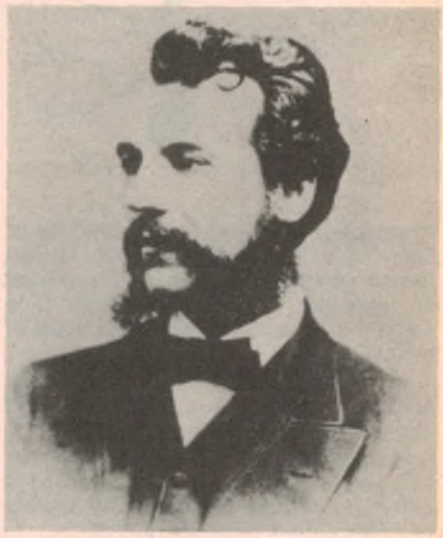
The logical next step was to focus the light directly into his ear. This he did in the very best traditions of intrepid investigators! Sunlight was chopped and some of the heat was filtered out of it by a filter comprised of an alum solution, but as Bell said, "a considerable amount of heat was of course perceptible, and the experiment was only continued for a sufficiently long period of time for me to satisfy myself of the reality of the phenomenon".

This latter discovery, called the non-electric photophone effect, excited more interest at the time than did the photophone itself. A number of eminent scientists of the time worked on the effect. At the Royal Institution, the Director Prof Tyndall, most famous for the Tyndall Effect (or the scattering of light by small particles), quickly took up Bell's discovery.

Spectroscopy & the invention of the photophone



"I have heard a ray of sun laugh and cough and sing", wrote Alexander Graham Bell in 1880 after inventing the Photophone. Here, Jim Lowell of Bell Labs examines the original photophone developed by Bell. (Photo courtesy of Bell Labs).



Alexander Graham Bell from a photograph taken in 1876, the year in which the telephone was patented. Bell once defined an inventor as a "man who looks upon the world and is not content with things as they are".

Tyndall had done considerable work on the absorption of infra-red light by gases, most of which had been greeted with disbelief. So he extended Bell's experiments to gases and vapours of liquids in a flask with a rubber tube leading to the ear. Chopping sunlight, limelight, a Siemens lamp, candle light and radiation from a red-hot poker, he found that quite intense sounds could be heard. In fact, he claimed that under some circumstances a sound as loud as an organ pipe could be obtained!

He also found that he could obtain audible signals from a poker which had cooled down to a temperature below the boiling point of water!

He had Bell at his side when he conducted his first experiments on chopped light passing through gases in November 1880, as he was convinced they would work, and support (as they did) his previous controversial results on absorption of heat rays in gases. Quite correctly he predicted that the absorption of heat rays would warm the gas, increase its pressure and, with intermittent heating due to absorption of chopped light, emit a note of the same frequency as the chopping.

In particular, he noted the high sensitivity of this technique with marsh gas (methane) and predicted a use for the effect in determining the concentration of this dangerous gas in coal mines. Independently, in Germany, Rontgen of X-ray fame, was also working on the effects of the absorption of heat rays in gases, in what might be called the "DC mode". He used a manometer to measure the increase in pressure of ammonia gas when it was exposed to infra-red light.

So, the increase in pressure in gases when they absorb light is therefore known as the *Tyndall-Rontgen Effect*, as distinct from the sound produced when light is absorbed in a solid, which is called the *Bell Effect*. Rontgen soon found his X-rays and Tyndall became interested in other matters, and so this field of study lapsed until 1939 when it was revived in Russia by Veingerov. It was later refined by Luft in Germany after the war, and turned into a very useful tool for analysing gases. It masquerades under various names, spectrophone, opto-acoustic effect and photophone being the most common.

Today, it is used throughout industry to detect methane, carbon dioxide, carbon monoxide and many other gases. It can detect down to levels of parts per billion, and has been sent aloft in satellites. It is also widely used in medical environments to measure anaesthetic and natural gases and is the basis of some alcohol vapour detecting "breathalysers".

Incidentally, in the course of these experiments Tyndall discovered another effect which has been the subject of much post-war work. He observed in a footnote to a paper he read to the Royal Society in London that "when I stand with open eyes in a flashing beam, at a definite velocity of recurrence, subjective colours of extraordinary gorgeousness are produced. With slower or quicker rates of rotation the colours disappear. The flashes also produce a giddiness sometimes intense enough to cause me to grasp the table to keep myself erect."

He was stimulating his brain at its dominant frequency, and this technique, and associated electrical signals from the brain, has led to a greater understanding of epilepsy and to how the brain works. Probably Tyndall was the first to observe this effect, which can be aroused at the appropriate frequency for the individual in all normal subjects, and which can trigger fits in epileptics.

Meanwhile Bell, Lord Rayleigh, William Preece (the President of the Society of Telegraph Engineers of London), and Mercadier in France all concentrated on solids. All found that black samples were the most effective and while almost anything they tried produced the effect to some degree, it was minimal in transparent materials. However, there was much confusion about the reason for the phenomenon.

Lord Rayleigh, one of the most powerful mathematical physicists of all time, produced a theory based on expansion of the surface exposed to light buckling the disc and thus producing mechanical motion at the frequency of the chopping of light. Bell believed it to be due to the noise of the rearrangement of "molecules" in the solid. Preece set to work to investigate the effect systematically, and came closest to the modern explanation – "any absorbent surfaces placed inside a transparent vessel will, by first absorbing and then radiating heat rays to the confined gas,

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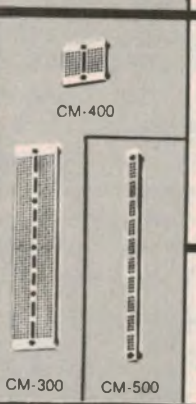

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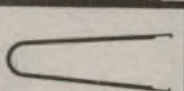
MOS-1416	14-16 PIN, MOS CMOS SAFE INSERTER
MOS-2428	24-28 PIN, MOS CMOS SAFE INSERTER

36-40 PIN CMOS-SAFE IC INSERTION TOOL

Aligns bent out pins. Includes terminal lug for attachment of ground strap.

GROUND STRAP NOT INCLUDED

MOS-40	36-40 PIN CMOS SAFE INSERTION TOOL



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emit sonorous vibrations."

He tested his theory by making a very fine spiral of platinum wire in a kind of earphone, through which he passed a current broken intermittently by a commutator switch. He heard a note at the chopping frequency. Professor Stokes nudged him greatly in the right direction by suggesting that the major effect was due to contact of gas atoms pinging on the solid surface and carrying away heat.

The modern phase of the Bell effect, now called the photo-acoustic effect (although variant names are also used) started, ironically enough, in the Bell Telephone Laboratories, when Alan Rosencwaig and his colleagues published the results of their work on photo-acoustic spectroscopy in 1973. The initiated now call it PAS.

PAS has a number of decided advantages over traditional spectroscopic methods. The most important is the fact that almost any kind of specimen will do. In the traditional methods the specimen has to be prepared in the form of a parallel-sided slab or film, and light is passed through it. The absorption is measured via the diminution of light passing through the specimen.

If the specimen is highly absorbing, then it has to be very thin indeed in order that a measurable amount of light can pass through it. Thus a small pinhole in the specimen can pass more light through it than the rest of the sample, in highly absorbent specimens, and lead to false results.

PAS only measures true absorption and is not at all choosy about the form of the sample. For example, biological samples contain cells which cannot be dragooned into appropriate traditional samples, and powder samples of solids are quite acceptable. Moreover, quite opaque samples may be used, so that the spectroscopy of a corrosion film on a metal surface can easily be examined, for example.

Another very valuable property of PAS is that it ignores scattered light which is not absorbed. It can thus measure the absorption in opal glass, which can be opaque due to scattering. Also smoke can be studied, as again only the light truly absorbed is measured.

Yet another stirling attribute of PAS is its ability to ignore the fraction of light which is absorbed, stored for a while and then re-emitted. This is called luminescence. When re-radiation takes place, it is always at a longer wavelength than the absorbed light — in other words some heat at least is left behind in the solid. When the chopping frequency is slow compared with the average storage time, or the re-radiation decay time, the effect of this residual heat input is observed. When the chopping is fast, the residual heat input is only minimally co-related with the phase of the chopping.

Thus, a study of the PA effect as a function of chopping frequency yields information about the average delay between absorption of light and radiation of luminescent light.

It also has a few bonuses which are of more interest to the solid state physicist than the spectroscopist. In order to look at this, we need to look at the form that modern PAS equipment takes, shown in Fig. 3. Light from an appropriate source, usually a high powered xenon lamp, is passed through a monochromator, so that light of a narrow wavelength band only emerges. Some of this is sampled by a PA cell which has in it a total absorber, such as carbon black, to monitor the intensity of the source at that wavelength, and the rest passes into another PA cell containing the specimen.

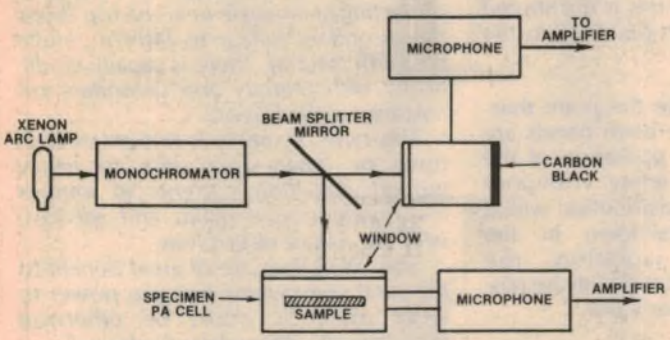

Fig. 3: basic scheme for a PAS spectrometer. PAS measures only true absorption and is not fussy about the form of the specimen.

The PA cells have a transparent front window and contain a built-in microphone, usually a small electret device, to pick up the intensity of the sound produced at the chopping frequency. Light absorbed by the sample turns into heat and raises the temperature of the front surface of the specimen. Some of this heat is conducted inwards into the bulk of the sample and some is conducted away by the gas in the PA cell.

The gas in immediate contact with the surface heats, expands and acts as a piston, pushing outwards while the light is being absorbed in the surface. When the light is cut off, the supplement of heat to the gas is cut off and the gas pressure falls as the additional heat is lost to the outer walls of the cell and to the absorbing solid.

A modern photo-acoustic spectrometer from Princeton Applied Research Corp, USA. Photo courtesy Technico Electronics.

Thus, PAS can be used to study the thermal conductivity of a powder sample, for example, in which it would be almost impossible to measure the thermal conductivity accurately otherwise.

What a hotch-potch of accidental discovery, human emotions, curiosity, sheer good luck and perseverence all this is, just like so many other stories in science! Berzelius puzzled by a queer smell arising from a sulphur specimen, Mr May perplexed by the variability of the resistance of his selenium insulator, Alexander Graham Bell riding on the crest of a wave of fame generated by his telephone a few years before, Tyndall annoyed by detractors who contradicted his earlier results on the absorption of infra-red light in gases, the amiable and verbose Preese bringing matters to a head, Rayleigh making a rare blunder, and Rontgen performing a characteristically simple experiment.

The applications of PAS to solids are rapidly multiplying. The analysis of gases via opto-acoustic techniques is well established. Communication via modulation of light beams seems set to revolutionise our lives.

The beginning of all this was signalled by a wave of Alexander Grahame Bell's hat one hundred years ago.

Mr Bell, we take our hats off to you!

FORUM

Conducted by Neville Williams

We live and learn: Single-wire power transmission is alive and well!

In the June issue, dealing with the earthing of power mains, we implied that single-wire-against-earth systems were a thing of the past, apart from certain very high voltage trans-ocean links. However, we have a number of letters to hand which say "not so"; they are still in common use out there in the mulga!

The paragraph which prompted the letters in the June issue was an elaboration of a statement made by the correspondent who originally raised the whole question of earthed power mains. It read as follows:

As G.J. suggests, it may well be that reticulation systems existed sometime, somewhere, in which the earth provided one of the active conducting paths. However, without getting involved in a lengthy research effort, I could find no reference to any such installation in the literature to hand. On the contrary, even the very early systems illustrated used multiple metal conductors merely referenced to earth in one way or another – much as we do now.

Basically, the matter raised by G.J. and referred to in the above paragraph had to do with ordinary street mains and the wiring which actually enters our homes. Earthing of such systems is so much taken for granted that the reasons for so doing seem seldom to be advanced. It fell to us to try to deduce them afresh, and this we did.

In the process, however, and by way of background information, we gave a couple of examples of non-domestic reticulation, where "earth" did actually provide an active conduction path: rail and tramway systems and certain very high voltage, trans-ocean DC links.

We did not mention single-wire high tension links, used in sparsely populated areas of Australia. In fact, we were unaware of them and they were not mentioned by any of the people with whom we discussed reticulation systems. That lack of awareness has now been corrected by a whole batch of letters and, while the matter is really incidental to the original subject, it is logical for us to take them into account.

The first letter to make this point came from R.C. of Berwick, Victoria, and I quote the relevant portion:

"From my observation in Victoria and South Australia, rural areas still make extensive use of the SWER (Single Wire Earth Return) method of power distribution. In this system, a single aerial wire runs at about 18kV (I think) with respect to ground. At each farm, a transformer has one end of the primary winding connected to the line, the other end to a secure earth connection. The secondary is a 240V winding and this is distributed to the house and farm buildings in the usual manner."

R.C. goes on to make the point that permanent and secure earth bonds are not only vital for the operation of the system but also for its safety. With poor earthing of the 240V distribution wiring and a possible breakdown in the primary/secondary isolation, the household wiring might suddenly be raised by up to 18kV above earth.

Very nasty!

J.D. of Kew, Victoria, was only hours behind in confirming the story. He says:

"Earth return reticulation is alive and well in Australia. It is used extensively in rural areas. I have noticed it in particular between Sarat and St George in Queensland."

As distinct from mere observers, R.S. of West Kempsey, New South Wales is able to speak as a one-time dispenser of power – electrical, not political:

"Reference recent Forum discussion; I was for many years proprietor of a country town electricity supply, (now confiscated by the SECV) and can reliably comment that there are many miles of earth return supply services throughout Victorian rural areas.

"The supply transmission is usually 22kV, Single Wire Earth Return. A special pole transformer resembling a large teapot due to the single HT insulator projecting at an angle near the top drops the secondary voltage to 240VAC, Multiple Earth Neutral. There is usually no difficulty with primary and secondary circulating earth current.

"This type of supply is not practical in town or urban areas due to heavy ground induction currents in various local underground mains and services, with the risk of electrolysis.

"The SWER lines are of great benefit to the rural community, bringing power to areas where it would be otherwise economically impractical to do so."

That accounts for systems in Victoria, South Australia and Queensland. What about New South Wales? J.S, now resi-

"The girls reckon that alternating current really hertz!"

dent in Rivett, ACT, fills that gap very neatly, complete with the kind of atmosphere that would do justice to a Lawson, a Paterson or a Dennis. He doesn't dismiss the significance of earth currents quite so lightly:

"The article in June Forum on MEN systems brings back memories of the headaches we had in "the good old days". Shortly after the last war I went to work for a North Coast Council as a District Electrical Mechanic. Rural reticulation comprised 11KV, 415/240V with the low tension neutral earthed through a driven spike at the transformer pole and another stake near the consumers switchboard.

"Installations were normally four lights and one power point in the house and a 2hp 3-phase motor in the dairy with perhaps one light over the bails. It was common practice for the transformer to be located to suit four or more consumers with the LT reticulation radiating outwards for three-quarters of a mile in four directions.

"Then, of course, the boom years began. Mum started buying electric appliances; additional power points were needed, more lights. Then the domestic refrigerator arrived, followed by the hot water system and out-of-balance transformers started to become a further source of nuisance. Some of we "bush" sparks began wondering what the world was coming to.

"My first run in with 'stray' earth currents was on a dairy farm in the Bellingen area.

Poor cows!

'I just don't know what's happening', was the way old Joe growled over the phone one afternoon, 'but lately I'm having the devils own job gettin' me cows into the bails. An' when I get 'em there, they get all balled up 'n tremble all over while they're waitin' to have the cups fitted to their teats. Never seen anythin' like it before.'

"It was almost impossible to measure the leakage voltage on the instruments the Council had then. It might only have been a few volts but it probably felt like a hundred to those poor cows waiting for the milking cups to be fitted their teats.

"This kind of trouble was more prevalent on marginal lands and seemed to increase in dry times, particularly when a dry westerly wind had been blowing for some days.

"Needless to say we overcame the trouble by better earthing of the MEN system. But this cost didn't always have the blessing of Shire Clerks or, for that matter, councillors who, often, were the dairy farmer whose cows were troubled by this new fangled business; electricity that seemed to be always wanting more money spent on it!"

On that subject, need I say another word?

CONTINUED: SWER TRANSMISSION

But, still in the area of rather wry humour, I have a letter from A.R. of Mudgee, NSW, who was motivated to write by recent references to TV "bomb" scares, house fires and all that. He has had no experience with TV set "blow-ups" but, apparently, plenty to do with refrigerators and other electrical machines which have been invaded by mice! He says:

"Your Forum brought to mind numerous motor burnouts, some years back, involving open unit refrigerators. For the most part, they resulted from mice entering the motors when stationary. Even so, I doubt that the blowouts would have caused the damage attributed to the TV sets unless extra heavy fuses had been installed (say, for welding) and subsequently forgotten.

"I had a repeat about a month ago, when a friend called me to a washing machine that had 'blown up'. Removal of the inspection plate revealed a mouse neatly bridged across the active and neutral junctions, exposed on a moulded terminal block. Removal of the remains plus scraping and cleaning still left leakage paths. I had to bypass the faulty block completely.

From "Radio News" December 1925

That letter stirred my own memories of the "bad old days" when one of my jobs was to look after the "too hard" service jobs for a small radio manufacturer.

Every now and again we would be called to a receiver with a "terrible smell". If it wasn't a blown power transformer, it would be a much-used rodents' nest, complete with the remains of one of the parents who had tangled with the 385-0-385V across the rectifier socket.

There were no backs on the sets in those days and, in looking for a warm, secluded spot in which to raise a family, the aforesaid rodents used to crawl down through dial cut-outs to the underside of the chassis.

Phew!

Quite unintentionally, this whole business of power mains, shorts and earthing has turned into something of a saga but, hopefully, not without interest. I round it off with two other letters, which raise aspects outside the experience of your average urban electrician. From J.S. of Woodville, SA comes the following.

"I refer to your paragraph on page 27 . . . if the system were allowed to float . . . &c.

"I have been in charge of diesel installations and, for some time, we were not permitted to bond the neutral terminal to earth. More recently, this ruling has been altered, because of the fear of stray currents.

"One could mention also the old delta secondary system, now out of use, due to imbalance in the three-phase system. Some electricians will remember it. The yellow phase could only be used where the three phases were required. The red and blue were at 210 volts from neutral. If the yellow phase became earthed, somehow, the neutral would assume a potential of about 360V relative to earth."

Last but not least from A.McC. of Hawthorn, Victoria, who confirms the existence of SWER reticulation systems, but who then goes on to talk about power systems which are floating, in a different sense:

"An interesting sidelight to the discussion is that most ship's electrical supplies are kept above earth. To ensure integrity of the earth isolation, earth detection indication is always provided. This usually involves three lamps connected by a push-button to the hull. The three lamps are connected to the three phases via transformers. If one phase is earthed anywhere, the fact becomes plainly evident.

"But even with a meticulously isolated system, electric shock is still possible. I speak from experience.

"Several years ago, a ship I was on went to dry dock in Taiwan. When the ship was shut down and shore power connected, we noticed a complete earth on one phase of the incoming supply. After some discussion, we learned that, in Taiwan, one phase is always earthed.

"As you said in the article . . . a very nasty situation!"

And that, I think, is an excellent place to leave the whole subject: right where we came in.

The original question: would not a mains supply, floating free of earth, obviate or reduce the risk of accidental shock?

The answer: no; in some circumstances it may even increase it.

And from Nimbin in NSW . . .

For the "down to earth humour" you sought in the June issue, one might think of the grounding problems that the North Coast "alternative life stylers" have in getting into electricity.

When kilowatts of power are necessary, they mostly have settled for a portable 240V generator. One such generator may be shared by a whole neighbourhood. As a result, extension leads start creeping through the lantana, over roads and underground, with the switches at the user end.

Although the generators are double insulated, increasing capacitance puts you at the centre of a capacitive voltage divider, which becomes evident if you happen to touch either lead.

Add cable from the city dump, amateur electricians, wet washing machines and a 100-inch rainfall, and a grounded neutral rapidly becomes a necessity.

My own neighbourhood system, spread over an area about 0.5km across, has a 60V battery bank, which absorbs the load and levels the voltage. Power comes in from various petrol generators, water driven generators and solar cells. It floats free of ground and, with a normal leakage of only 2mA, you can stand with your feet in the mud, touch anything and feel only enough to indicate that it is alive.

But a neighbour made his contribution to the system by connecting his welding alternator to the "grid" via a bridge rectifier. The grid helped stabilise his source voltage and, in return, he contributed 20A to the bank when he wasn't burning an electrode. But, when he welds any earthed steelwork, the whole system, including the tonearm of my record player swings plus and minus 70V at 50Hz!

K. McL (Tuntable Falls)

Sansui

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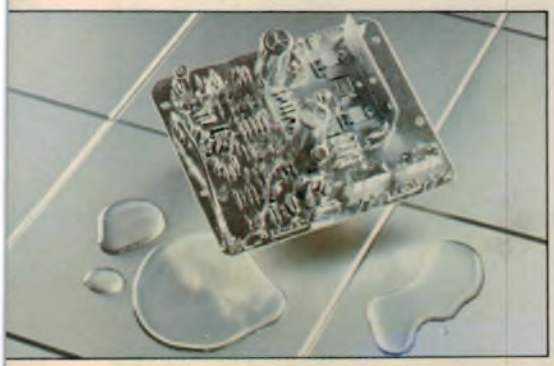
Saturation impossible.



Sansui's AU-X1 is the DC amplifier in which current saturation is impossible. So TIM and envelope distortion are virtually nil. And accurate reproduction of musical signals reaches new levels.

THD and TIM

You're probably aware that THD specs only indicate an amplifier's response to simple steady state signals.

But dynamic musical signals may generate music-smearing TIM.

TIM, transient intermodulation distortion, can be caused by pulsive musical signals which make ordinary amplifiers cry out in distress. And that means distressful music.

Sansui's powerful solution: the DD/DC circuit

The beauty of Sansui's exclusive DD/DC (Diamond Differential DC) circuit is it allows sufficient NFB for an ultra-low THD and — at the same time — stamps out TIM. The secret of DD/DC (PAT. PEND.)is driving power so powerful that current saturation is impossible. Slew rate: ±260V/μSec; Rise/fall time: 0.5μSec. THD: under 0.007% at full rated 160 RMS watts × 2 output. You hear unprecedented clarity and precision of detail.

Now look closely at the photo. What you thought were bass and treble controls, aren't. They are simply level controls. We admit the AU-X1 integrated amplifier is relatively austere. Because purity in reproducing the most demanding musical signals requires discipline.

SANSUI

AU-X1

SANSUI ELECTRIC CO., LTD.
14-1 Izumi 2-chome, Suginami-ku, Tokyo 168, Japan
VANFI (AUST.) PTY. LTD.
162, Albert Road, South Melbourne, Victoria 3205, Australia Tel: 699-5473
283 Alfred Street, North Sydney, N.S.W. 2060, Australia Tel: 929-0293

For those who appreciate simple virtuosity

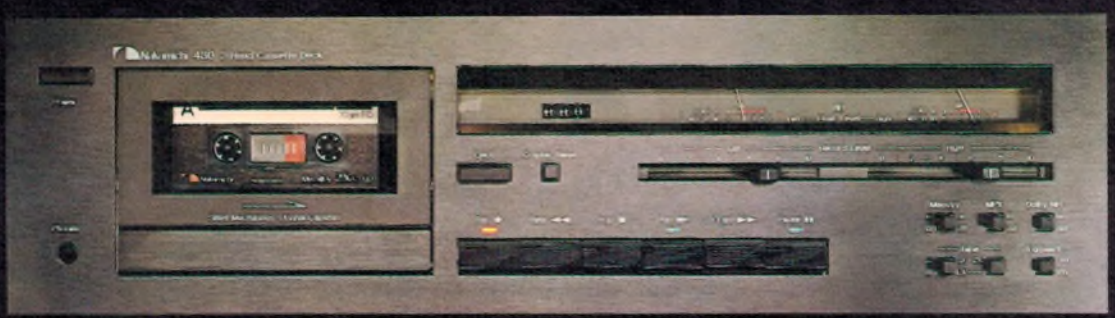
The 480 Series

With the 480 Series, Nakamichi again offers a more affordable cassette recorder – a deck that is simpler to operate, but that sacrifices neither Nakamichi sound nor Nakamichi excellence. The secret is simple. The Asymmetrical, Diffused-Resonance Transport – shared by all models and closely akin to that of the highly acclaimed 582 – is a 3-motor, dual-capstan drive so unique in its simplicity and elegance that it can be manufactured with virtually zero defects. Each 480 Series deck is factory calibrated to yield optimum performance with three types of tape – ferric, chrome-equivalent and metal. Use products of equivalent quality, and you can experience Nakamichi sound and Nakamichi specifications – response to 20 kHz – in *your* home.

Nakamichi

480

The 2-Head Model 480 – fully metal-compatible thanks to our special, narrow-gap, Sendust R/P head and exclusive Direct-Flux erase head. Wide-range, peak responding meters, professional sliding record-level controls, Dolby, and defeatable MPX filter, of course! Even an optional remote control.



482

Step up to the 482, a 3-Head deck utilizing Nakamichi's exclusive "Crystalloy" cores and "Discrete-Head" technology. For those who demand "off-tape monitoring", the 482 incorporates two complete sets of electronics and Double-Dolby so you can hear exactly what *has* been recorded *as* it is being recorded.

For further information contact Convoy International Pty Ltd 4 Dowling Street Woolloomooloo NSW 2011 Telephone (02) 3582088

DRAW SOMETHING LIKE THIS ▶ AND YOU CAN WIN THIS ▶

"And now for the steam train with 300 watts per channel!"

If you have a sense of humour and can draw — with or without help — then you could win this magnificent new Nakamichi cassette deck, as pictured on the right. All you have to do is to send in an original captioned cartoon, to do with audio/hifi, to the Electronics Australia — Convoy International cartoon contest. To the individual who sends in the best entry will go the 482 deck and remote control unit. But we also have 100 Nakamichi SXC-60 cassettes to serve as consolation prizes.

- A 3-head metal compatible Nakamichi cassette deck with remote control, supplied by Convoy International Pty Ltd, of 4 Dowling St, Woolloomooloo, NSW. Current value $634.
- Convoy International are also offering 100 Nakamichi SXC-60 cassettes for use as consolation prizes.

Rules and Conditions

(1) The cartoon must relate to some aspect of audio/hifi. It must be original, although not necessarily drawn by the entrant, and must not have been previously published. Drawings should be in black ink, ready for reproduction.

(2) All entries remain the property of "Electronics Australia". If subsequently published, a publication fee will be paid to the entrant.

(3) EA Editor-in-Chief, Neville Williams, will judge the submissions. His decision will be regarded as final and no correspondence will be entered into.

(4) Employees of Sungravure Pty Ltd, Convoy International Pty Ltd, or any associated companies are not eligible to enter. Entries postmarked or delivered by hand to the EA editorial office later than September 30, 1980, will not be eligible. The winner of the Nakamichi deck will be announced as soon as possible after the closing date. Cassette prizes will be distributed by post.

ENTRY FORM

Electronics Australia — Convoy International Hifi cartoon contest

Complete this form and attach it to your entry, posting them not later than September 30, 1980, c/o Electronics Australia, PO Box 163, Beaconsfield, NSW 2014. A letter may be used instead of the form in states where this requirement is illegal. Print your name and address also on the back of your cartoon.

NAME: . . . . . .

PLEASE PRINT

ADDRESS: . . . . . .

. . . . . **POSTCODE** . . . . . .

OFFICIAL: American FCC selects the Magnavox system of broadcast AM-stereo

Climaxing years of industry haggling, the US FCC (Federal Communications Commission) has nominated the Magnavox system as the one to be used for future AM-stereo broadcasting. The new technology could become a reality within a year — provided rival companies do not throw impossible legal spanners into the works!

Already beleagured overseas by FM, and facing a strong potential challenge here in Australia, AM broadcasting needs a shot in the arm, and stereo could provide it. Local station managements are monitoring the position closely – particularly those who have had the foresight to have had their studios readied for stereo.

The idea of transmitting a compatible mono/stereo signal from an AM broadcast station is about as old as the challenge from compatible mono/stereo FM. However, the technological problems of AM-stereo seemed to be of such magnitude and the end result so debatable, that no one seemed to have much heart for it. In consequence, AM broadcasters tended to focus attention on utility programming, for which mono was adequate, leaving the "beautiful sound" bit for the FM stations.

Since then, the position has gradually changed. The challenge from FM stations has broadened and AM stations overseas are having to "smarten up" in an effort to hold their ratings. The move to provide a stereo signal as a listener option is part of that process.

Significant also is the present trend towards more elaborate sound equipment in cars. Compared with FM-stereo radio and high-performance stereo cassettes, AM mono radio looks very much the poor relation. AM-stereo could help change that image.

Indeed, AM-stereo could offer a positive advantage, in that the signal may prove more durable in a moving vehicle than its FM counterpart. AM-stereo could be expected to have a greater effective range and be less prone to stereo loss and to multi-path distortion.

Success in the automotive market would be a boost indeed to AM interests. According to one marketing authority, US buyers account for eight million auto radios per year. Within about five years, at least half of all the automotive installations in the US could include AM-stereo decoders, with the number continuing to grow after that.

There could also be rapid penetration into top-end portable radios and into domestic hifi installations .... provided the whole thing is not gummed up by inter-company rivalry and litigation!

As we pointed out in our December 1978 issue (p29) engineers have been actively looking into AM-stereo for twenty years or more, partly as a research challenge and partly as a commercial precaution. As far as the US is concerned, the outcome has been five possible systems: Belar, Magnavox, Motorola, Harris Broadcast Products, and Kahn/Hazeltine. The systems were sum-

Compatible AM-stereo transmitter

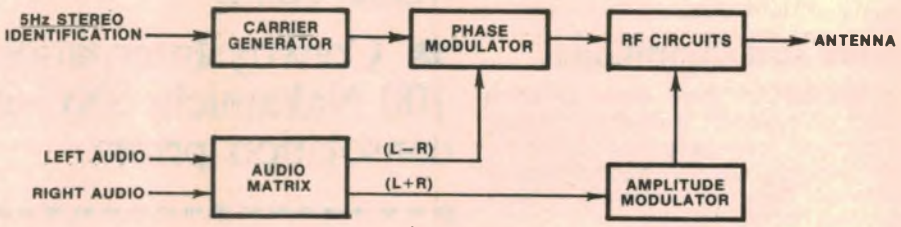


FIG. 1

Block schematic of a Magnavox style AM-stereo transmitter. It is compatible because it provides a substantially normal carrier, amplitude modulated with an L+R (sum) audio signal. A conventional AM radio ignores the phase modulation.

AM-stereo receiver

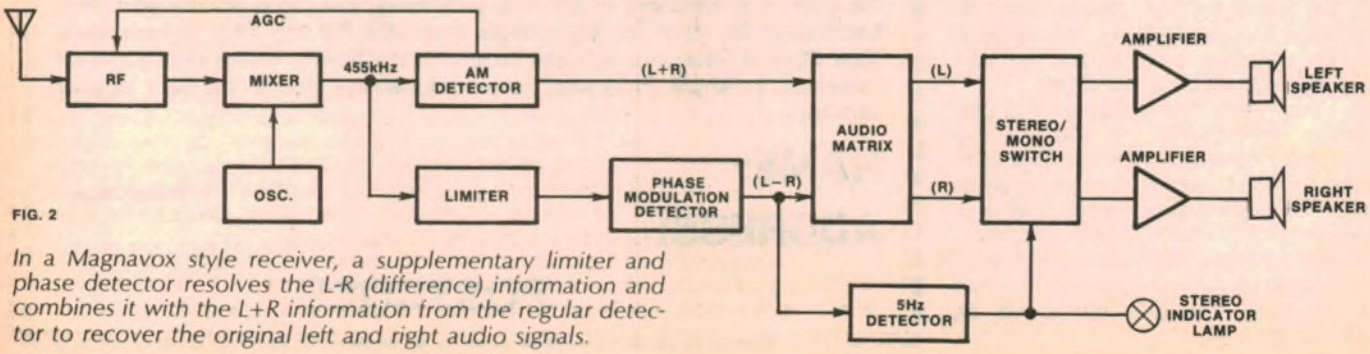


FIG. 2

In a Magnavox style receiver, a supplementary limiter and phase detector resolves the L-R (difference) information and combines it with the L+R information from the regular detector to recover the original left and right audio signals.

marised in the above-mentioned article.

By 1975, a stage had been reached where it appeared possible – and desirable – to resolve the rival claims and the NAMSRC Committee (National AM Stereo Radio Committee) was set up in September of that year for that purpose. Represented on it were such bodies as the NAB (National Association of Broadcasters), the NRBA (National Radio Broadcasters Association), the EIA (Electronic Industries Association) and the IEEE (Institution of Electrical and Electronic Engineers).

NAMSRC presented its report to the US Federal Communications Committee in December 1977, which took a further 12 months to digest it. Early this year, under considerable industry and Congressional pressure, FCC members opted for the Magnavox system in a far from unanimous vote: four in favour, two against and one abstention.

Because of the split vote, it was widely tipped that some or all of the losers would contest the decision but reports at the time of writing are to the effect that only one is likely to proceed to full litigation. What effect this may have on industry planning remains to be seen but one thing is certain: the industry generally is keen to avoid multiple standards.

In this, it is encouraged by reports that Magnavox is prepared to make its technology available to other radio manufacturers.

The system proposed by the Magnavox Consumer Electronics Co (Fort Wayne, Ind.) is relatively straightforward, although its rivals claim that its simplicity comes at the price of ultimate performance.

MAGNAVOX SYSTEM

Basically, the L & R (left and right) channel audio signals are matrixed and their sum (L+R) is used to amplitude modulate the transmitter in the normal manner. The L-R (difference) component is used to phase modulate (in effect, frequency modulate) the carrier. In addition, a subaudible 5Hz signal is phase modulated on to the carrier to indicate that a stereo signal is being broacast. Reportedly, this same 5Hz signal can be encoded to provide other information for sophisticated receivers, such as time, frequency and station callsign.

Conventional AM receivers, tuned to such a signal, tend to ignore the unaccustomed information and respond merely to the amplitude modulation, reproducing the L+R audio component as mono sound. This is equivalent to what happens when a stereo disc or stereo tape is played on a mono system.

On the other hand, a fully developed AM-stereo tuner would recover both the L+R and L-R information and matrix it to produce the original L and R audio signals. It would also respond, as appropriate, to the 5Hz signal. Magnavox stress that the tuner needs only a single

VSC SPEECH CONTROLLER

The VSC Speech Controller, being marketed in Australia by R. H. Cunningham Pty Ltd, should be of major interest to those concerned with recorded speech: lecturers, students, secretaries, etc, and the unsighted who depend on "talking books."

The VSC model A7 Speech Controller, as pictured, looks like a slightly oversize table-top cassette recorder, measuring about 26mm × 17mm × 6mm and weighing about 2kg. It is supplied with an external remote-control microphone and stand, miniature earphone, mains power supply and demonstration cassette. An optional extra supply cord allows it to operate from a 12V car or boat supply. A slide-away handle provides for ease of carrying, but there is no provision for internal batteries.

In its basic role, the A-7 can be used as a normal table-top record/playback unit, powered from the mains or external 12V source, and operating at 1-7/8ips (4.8cm/s) with the rate control slider set at 1.0. It has the usual mechanical action tape traverse keys, with rewind and fast-forward doing double duty for "Review" and "Cue" respectively.

No guidance is given as to the choice of tape for recording purposes but our own observations suggested that the internal DC erase could not be relied upon to cope with anything other than the "normal" ferric variety. Any tape can be played back, of course, but there is no provision for choice of compensation or Dolby decoding. In all these respects it is similar to most small cassette portables, but with the advantage of a somewhat larger speaker and a rated output of 1 watt.

Unlike other recorders, however, it has a rate control slider which varies the speed of the tape on playback within the range of 0.6 to 2.5 times normal. With the A-7 set for ordinary playback (there is a small slide switch on the side) varying the rate control has the expected result: the speech (or music) slows down or speeds up and, in so doing changes pitch from a bass drawl to "duck talk". However, with the slider switch the other way, the pitch of the sound reverts to near-normal, irrespective of the tape speed. How come?

The manufacturers provide no direct answer but, from a brief reference in other literature, it appears that the playback signal is chopped into segments, a proportion of which are simply dropped. The remaining segments are read into a "bucket brigade" chip and read out again at a different speed, such that they merge to provide a continuous signal. By co-ordinating the read in/out rates with the tape speed, the processed sounds retain normal duration and pitch.

It seems a harsh way to treat a signal and, in fact, one can sense that bits are missing, a well as hear an obvious deterioration in quality. However, one can edge up the speed to limits imposed by the material, by the original reading speed and, of course, by comprehension. The user can simply listen at above-normal speed, scan a tape quickly in search of wanted material, and even run at low speed for careful listening or note taking. One can imagine many potential applications for this very versatile unit.

We understand that the price of the VSC model A-7 Speech Controller is $220 plus sales tax, where applicable. For further details: R. H. Cunningham Pty Ltd, 146 Roden St, West Melbourne 3033. Phone 03 329 9633.

455kHz IF channel, as commonly used in existing equipment.

Figs. 1 and 2 illustrate the foregoing in simplified block schematic form. Not shown in the transmitter is response and delay compensation to ensure that the sum and difference signals are exactly in step in the final modulation envelope.

At the end of the chain, it has long been apparent that the success of AM-stereo receivers would depend largely on the availability of dedicated chips, much as has already happened with FM-stereo tuners. At the time of our previous article (Dec '78) little more could be said than that somebody, somewhere would have to design and produce them.

The position is now much nearer to resolution. The Sprague Electric Co and Signetic Corp have disclosed a joint development program for AM-stereo decoder chips. Their ULN-3800 IC is reportedly "well into the breadboard stage" and, allowing for a couple more refinements, should emerge as a finished product before the end of the year. It is being designed to be compatible with existing AM tuner front-end chips.

According to Oliver L. Richards, design engineer at Sprague's Semiconductor Division (Worcester, Mass.), the ULN-3800 promises a degree of compatibility that suggests it might even be substituted for the diode detector in existing AM tuners and receivers. Externally, the tuner/receiver would be unaffected but, internally, stereo audio would be available. Best of all, Richards is not talking about an expensive item. Quantity price should be $2 at most.

The JVC AX-4 integrated amplifier, one of four new models due to reach the Australian market this month. It features what they describe as the "Super A" power amplifier system, a 5-channel graphic equaliser, sub-sonic equaliser, LED level indicators, and a variety of other features. The vertical type switches and equaliser controls combine to give the JVC AX-4 a quite distinctive appearance.

What is the position in Australia?

It would appear that the management of local broadcast stations have had their eye on AM-stereo for some years. In a number of cases, when up-dating studios, they have taken the opportunity to equip for stereo, with stereo mixers, signal lines in pairs, and so on. For such stations, this hassle – probably the major one – is already behind them.

As far as the actual transmitter is concerned, those with modern designs can reasonably expect to obtain add-on "black boxes", which would provide the additional facilities.

To quote one commercial station engineer: "We made our first moves towards stereo seven years ago."

And another: "Our studios are already stereo equipped – not directly pluggable but easily changed over with a soldering iron. With a bit of luck, we could have AM-stereo on the air three months from the go-ahead!"

The ABC is already operating an interstate FM-stereo network and is gradually equipping its major source studios for stereo. It, too, could move into AM-stereo in the capital cities. Full stereo networking through regional stations would take longer, however, not only because of re-equipment costs, but because long-distance stereo program lines are about four times as expensive as for mono.

But, whatever the preparedness of individual broadcasters, it seems likely that AM-stereo could be on air more quickly than receivers to make use of it. Even allowing for the enthusiasm with which Japanese manufacturers might pursue a new product line, it takes a certain amount of time to evolve and prove new designs, to get production organised and to mount a sales campaign.

More than that, the major companies are not likely to move at a rate that will leave them with huge stocks of unsold mono tuners and receivers. They will want time to run down stocks to the point where transition to AM-stereo can proceed without financial traumas.

What about the inherent limitations of AM, whether stereo or mono? What about limited bandwidth? Distortion? Interference? Cross-talk? Fading?

These problems are not about to go away, and have not been helped by the multiplication of stations and the reduction of channel separation to 9kHz. In terms of potential quality, AM will always lag FM.

But AM can benefit to a greater degree than it has from modern technology, particularly in the shape of the RF and IF passband and the provision of a precise centre-of-channel tuning aid – be it manual or automatic.

It may well be that stereo will provide the motivation necessary to produce tuners which will better realise the potential of the AM system.

Hewlett-Packard's new model 8903A audio analyser is designed to take most of the tedium out of precision audio measurement. Its in-built signal source can provide signals from 20Hz to 100kHz with a 5-digit read-out of frequency and a 4-digit readout of level. Incremental changes can be programmed, as well as log sweeps, with drive available for a pen recorder. Measurements typically made with the 8903A include frequency response, swept distortion (0.003% or −90dB), hum and noise, gain, and power output. The 8903A has been designed for use with companion instruments for precision measurements on AM and FM tuners, special provision being made to smooth out the digital display of S/N and SINAD peformance, often rendered ambiguous by the "noisy" nature of the quantity being measured. (For further information: Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Vic 3130. Tel (03) 89 6351.

AUDIO ELECTRONICS — continued

AUDIO TELEX PTY LTD have added to their existing range of tapes a line of "mastering cassettes" loaded with double coated ferrichrome tape. While aimed initially at the institutional markets requiring cassettes for high speed duplication, Audio Telex are confident that they will also find a demand in the normal

consumer market. Compared with standard tape, the double-coated FeCr type offers improved electrical characteristics, including a 5dB to 8dB increase in the maximum output level (MOL). The cassettes are best suited to decks which have a "FeCr" provision, but nevertheless perform well on other decks if recorded with "normal" bias and equalisation and played back as "chromium". Manufactured in New Zealand, the new Audio Telex cassettes are supplied in normal boxes but, as an added feature, 10 cassettes come in a useful high impact plastic storage case with smoked, transparent lid. For details: Audio Telex Communications Pty Ltd, 1 Little St, Parramatta (or PO Box 421) NSW 2150. Tel (02) 633 4344.

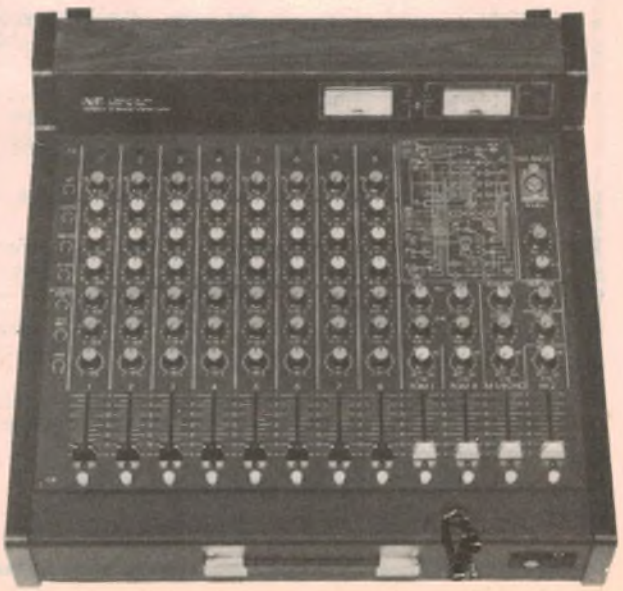
HAGEMEYER (Australasia) BV are all set (as we go to press) to unveil a variety of new hifi products at the Sydney CES Show, for market release during the current month. These include four new turntables: a budget model and three quartz locked types, one of which has a new type of tone arm. There will also be a new "budget" receiver plus two high performance models featuring "Super-A" power stages and a 5-channel graphic equaliser. "Super-A" features also in four new integrated amplifiers, two of which have a graphic equaliser in-built. (See photograph elsewhere). Power ratings are from 22W to 63W RMS per channel. Four new AM/FM-stereo tuners complement the amplifiers, the top of the line model having digital tuning with 14 preset station-select buttons. Add three graphic equalisers and seven new cassette decks and you have quite a range to choose from. (For details of JVC hifi equipment contact Hagemeyer (Australasia) BV in the various capital cities or at 25-27 Paul St, North Ryde, NSW 2113).

Pioneer's new CT-F1250 cassette deck.

PIONEER ELECTRONICS AUSTRALIA PTY LTD claim that their new CT-F1250 cassette deck allows the user to optimise bias, equalisation and level just as effectively as in a "computerised" deck – without the cost and complexity of an elaborate microprocessor! The deck has the normal tape selector switch but, to peak things up, the tape is loaded into the deck and a simple routine is followed, involving indicator lights, which fine tune bias, equalisation and level. The ap-

New Mixing Console

Pictured at right is a new A + F eight channel stereo mixing console, now available from Dynamic Musical Enterprises of 66 Gibbes St, Chatswood, NSW 2067. (Phone 02 406 5655). Provisionally priced at $885, the console provides for 8 mic and 8 line inputs, 2 aux and 5 sub-in; also 2 program and 2 monitor outputs, cue out and phones. Performance characteristics are excellent.



proach allows Pioneer to offer the deck for less than $700, despite its many other features: three heads, two motors, direct quartz controlled drive, multi-mode LED level indicators, timer, memory, stop and repeat functions etc. Wow and flutter rating is .03% (WRMS). The new CT-F1250 heads up a range of seven models, the least expensive being the CT-F650 at $299. (Pioneer Electronics Australia Pty Ltd, 178-184 Boundary Rd, Braeside, Vic 3195).

HAGEMEYER (Australasia) BV have announced the release of a top quality Maxell brand video cassette for the VHS system with an epitaxial cobalt-ferric oxide coating. They claim that, in association with a precision cassette housing, it offers to all VHS users a video tape that is "second to none". The new video cassette, they say, is a worthy companion for the Maxell range of audio cassettes: "Low Noise" for general use; "Ultra-Dynamic" for general hifi use; "UDXL I", premium quality cassette for "normal" bias and 120uS equalisation; "UDXL II", super premium quality for use with "Cr02" compensation. Contact Hagemeyer (Australasia) BV in the various capitals or at 25-27 Paul St, North Ryde, NSW 2113.

PIONEERS ELECTRONICS AUST PTY LTD say that, to date, AM/FM-stereo cassette combinations for cars have tended to be priced at above $200 for quality units. Pioneer claim that they have managed to break through this virtual price barrier with their new KP-1500, which offers full AM/FM-stereo cassette facilities but which carries a recommended retail price of only $180. The KP-1500 is also a very compact unit which makes it suitable for installation in most Japanese cars. In seeking to minimise the dimensions, the designers have arranged for the tuning dial to double as the cassette loading door. Locking fast-forward and eject buttons are to one side, and a LED indicator shows if the tape has stopped. A line of slim push-buttons above the dial provide for FM muting, mono mode, etc.

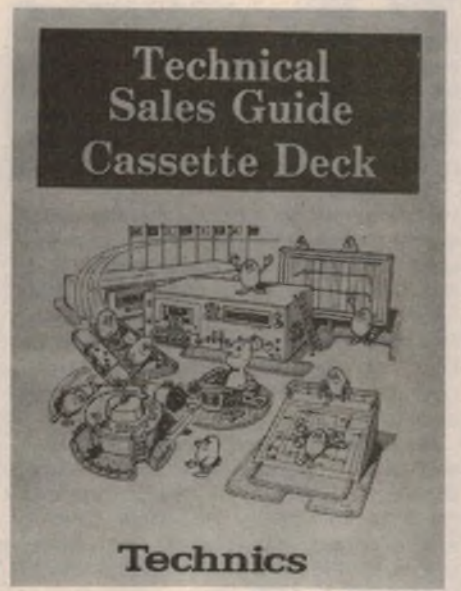
FREE BOOK — Limited offer

To assist those who may want to know a little more about the fundamentals of cassette tape decks, National Panasonic (Aust) Pty Ltd are offering, free, to the first 500 "Electronics Australia" readers who apply, a copy of an 86-page Technics handbook: "Technical Sales Guide — Cassette Deck".

The title sounds rather formal but the contents are quite the reverse. Cartoon figures are sprinkled liberally amongst the graphs and diagrams to make the contents both entertaining and readable.

The initial 14 pages traces the development of cassette decks. Then follows a section describing head systems, equalisation, the role of bias, considerations of frequency response, and tape transport systems. Succeeding sections deal with deck specifications, controls and functions, principles and how to make the best use of decks.

Application for your free copy MUST be made by post using the coupon below or, if you prefer it, on a separate sheet of paper containing the same request and information. Address your letter to "Book Offer", Electronics Australia, P.O. Box 163 Beaconsfield NSW 2014. Do NOT COMBINE your request with other correspondence, since book requests will not be handled through our normal mail facilities.



National Panasonic stress that the only copies of the book available in Australia are the 500 which are the subject of this free offer.

To: "Book Offer", Electronics Australia, Box 163, Beaconsfield 2014

Please forward me, free and post-free, one copy of the Technics publication "Technical Sales Guide — Cassette Deck". If no acknowledgment is received, I will understand that stocks were exhausted before my request arrived.

NAME .....

(Please print)

ADDRESS .....

..... POST CODE .....

Nakamichi 482 3-head stereo cassette deck

One of the best cassette decks available, at any price, is the Nakamichi 680 which we reviewed in April 1980. Now Nakamichi have produced a new deck incorporating the most important features of the 680. Called the 482, the new deck is half the price of the model 680.

When we reviewed the Nakamichi 680 in the April 1980 issue, we recorded the best frequency response curves we had ever seen, to that date. Clearly, Nakamichi had produced another world-beating deck but it was at a price which was well out of the reach of most high fidelity enthusiasts, especially if the companion noise-reduction unit, the High-Com II, was taken into account.

Nakamichi were evidently well aware of this and even at that stage, must have been well advanced with the 482 which will appeal to a much larger number of potential buyers. So with this implied promise of excellent performance for less money, we looked forward to reviewing the Nakamichi 482.

While the appearance of the new model is similarly styled to the more expensive model 680, that is where the resemblance ends. The 482 has far less controls, with the result that it is more attractive from a user's point of view. A lot of controls may mean that a piece of equipment has potential for excellent performance but it can also confuse even the most technically-inclined and oriented user.

So the 482 has an uncluttered front panel, finished in black anodised aluminium with control legends in white, for good legibility. Dimensions of the deck are 450 x 135 x 289mm (W x H x D) including front and rear projections and rubber feet. Mass is 6.4kg.

The transport mechanism appears to be very similar to, if not exactly the same as, the model 680. It has three motors, one to drive the dual capstan system and the third to actuate the mechanism. This latter feature provides exactly the same functions as a solenoid controlled deck. Each of the six transport controls operates a microswitch to provide fast and silent action.

Above the Play and Pause buttons are soft blue indicators (very suave) while the Record indicator has a more strident message, in orange. The same control functions are available on the cable-operated remote control module which is available as an accessory.

Three separate heads allow direct monitoring of the recorded signal off the tape (via the replay head). Naturally, the Nakamichi 482 features separate Dolby noise reduction circuits for the record and replay functions.

One feature of the model 680 which we would have liked to have seen retained on the 482 is easy head azimuth adjustments. While it is possible to perform these adjustments on the 482, it is not as easy as on the 680 and the instruction manual has no guide to the procedure.

Eight small pushbuttons on the right hand side of the panel provide the following functions: Tape selection of EX (ferric), SX (Cr02) or ZX (metal) formulations; Equalisation of 70 of 120 microseconds time-constant; Dolby Noise reduction; Memory rewind; MPX filter; and Monitor, between source and tape.

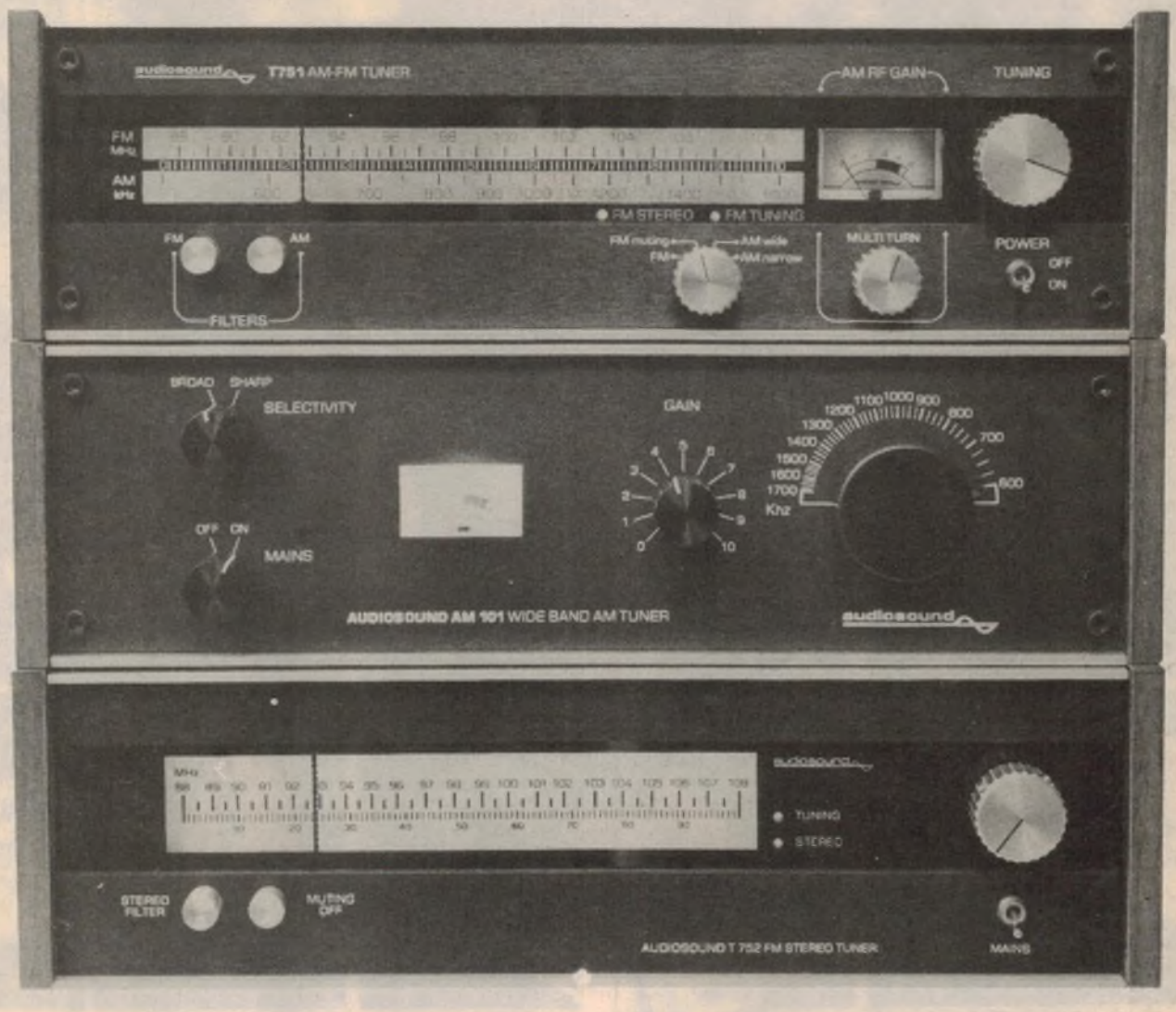
The MPX filter is used when recording FM broadcasts to remove any 19kHz residual pilot tone from the signal. This avoids any spurious effects the 19kHz residual may otherwise cause, such as incorrect operation of the Dolby noise reduction system.

Separate horizontally located Record Level slider controls are provided and these have seals to prevent dust entering the potentiometers. Directly above these level controls are the peak level meters which are calibrated from −40dB to +7dB.

At the rear of the deck are RCA type

Three heads and two capstans are features of the Nakamichi 482 shown here with the matching remote control.

AUDIOSOUND TUNERS
— SIMPLE AND SUPERB



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sockets for the left and right channel inputs and outputs. Another socket provides for the remote control. The 482 does not provide for an inbuilt microphone preamplifier and for live recording, a separate preamplifier, the Nakamichi MX-100 Microphone Mixer, is required as well as a PS-100 power supply. This will be seen as a disadvantage by those who are accustomed to plugging microphones directly into a cassette deck.

Lifting the cover reveals a large screen-printed PC board, containing most of the circuitry. Several smaller PCBs are located directly behind the switches to minimise wiring. The mains transformer is mounted at the rear of the chassis and the power switch mounted next to it and switched with a long plastic lever reaching to the front on/off switch. This keeps the mains wiring all in one place away from the amplifier circuitry to reduce hum pickup.

Unlike some other decks we have seen recently, the Nakamichi does not purport to be double-insulated. It is earthed via its three-core mains flex. However, it does not present any problems with earth loops. In fact, it performs impeccably, in all respects, as the results show.

Two tape types were used to test the 482: Nakamichi SX, a high coercivity tape equivalent to Cr02 and Technics RT-46MX, a metal formulation.

As can be seen from the graphs, the performance is exemplary at -20VU, the -1dB point being at 21kHz with metal tape. With the SX tape the performance is not as spectacular, but still very good, being -3dB down at 15kHz. With Dolby Noise Reduction, the response tapers off at a lower frequency being generally 2dB lower at 15kHz.

With these outstanding figures at -20VU, we were interested to discover the response at 0VU – a level that reveals unflattering results with most decks. We found, however, that with metal tape, the response was almost what would be expected from many lesser decks at -20VU – truly an excellent result. With SX tape, the response was not as impressive, being -10dB down at 15kHz.

The unweighted signal-to-noise ratio figures, with respect to 3% Total Harmonic Distortion at 400Hz, were -51dB and -52dB for SX and metal tape respectively. Both these figures were obtained with Dolby noise reduction. Without Dolby, the noise increased by 2dB in both cases. The subjective improvement with Dolby, is however, greater than the figures indicate.

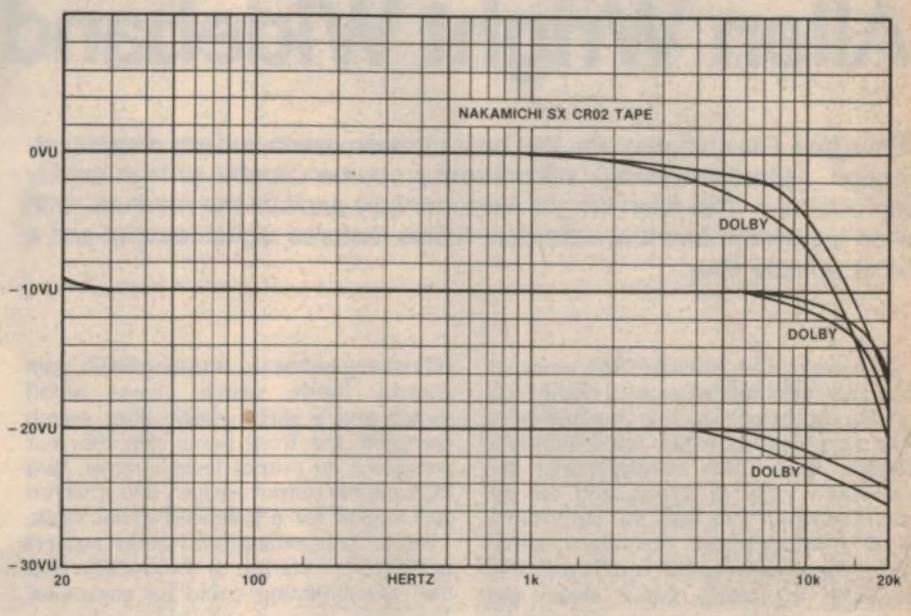
The Total Harmonic Distortion, at -10VU with Dolby was 1.2% at 1kHz, rising to 2.0% at 10kHz, with metal tape: with SX tape, the distortion was 1.5% and 2.5% respectively. The superiority of metal tape is apparent here. No discernible change in distortion was evident with Dolby noise reduction.

Separation between channels with respect to 1kHz and 0VU with Dolby was 52dB and 49dB with metal and SX tapes respectively. Without Dolby, the separation figures were reduced by 7dB to 42dB and 45dB respectively.

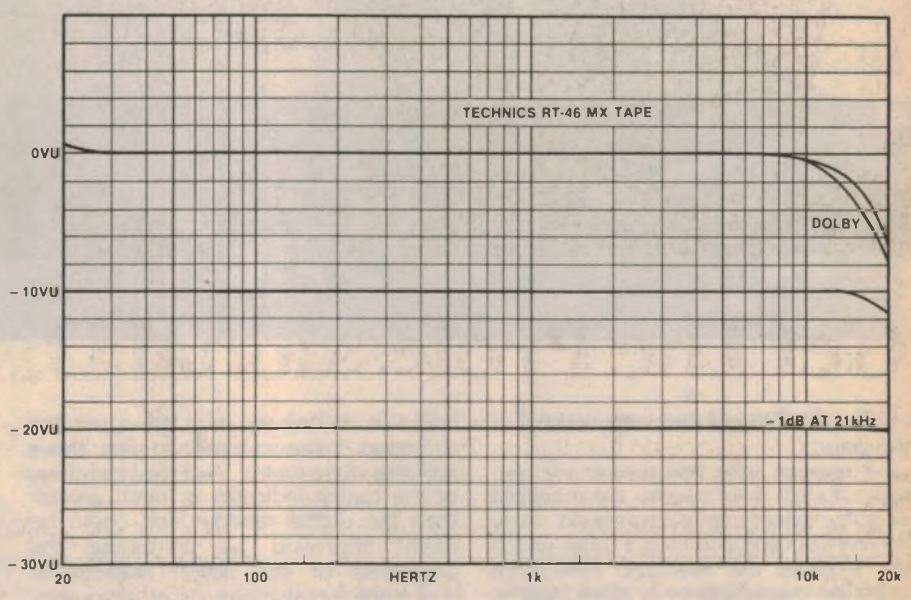
Wow and flutter was measured at 0.15% DIN weighted, a commendable result.

Subjectively, the Nakamichi is one of the best cassette decks we have heard. Whether using SX or metal tape, it gives very good results. Direct comparisons between source and tape, with Dolby noise reduction in use, show just how far cassette tape reproduction has come. Few listeners would be able to tell the difference.

Summing up, we are of the opinion that the Nakamichi 482 represents very good buying for the money. Few decks can match it in performance, regardless of price.



Above and below are frequency response plots for Cr02 and metal tapes, measured at the three recording levels of 0VU, −10VU and −20VU. The scale is 2dB/div.



Recommended retail price of the Nakamichi 482 cassette deck is $599 including sales tax, and for the remote control accessory, $35 including sales tax. RCA to RCA audio leads are supplied with the unit as well as head cleaning sticks and an instruction manual. Further inquiries should be made to Convoy International Pty Ltd, 4 Dowling Street, Wooloomooloo 2001. (J.C.)

Allen Wright Wideband AM Tuner

While new FM stations have just begun transmission and are drawing attention, AM transmissions still present a source capable of high quality reproduction. The Allen Wright AM tuner fully exploits this medium, with wide bandwidth and low distortion. It also features digital readout and a 9kHz whistle filter.

Listening to an ordinary AM tuner or radio gives no indication at all of the high quality reception which is possible from AM transmissions. Many hifi enthusiasts believe that AM transmissions are universally poor in quality and are astounded when they hear the output of a really good wideband AM tuner. Admittedly, these high quality results are only available in strong signal areas and reception can be adversely affected by thunderstorms. But most people are sadly unaware of the of the true potential of AM radio.

The reasons why AM tuners are normally of such poor quality are manifold but a few select manufacturers do "carry the AM flag" and produce a tuner which fully exploits the medium. One such Australian manufacturer is Allen Wright. He produces an AM tuner only, with no provision for FM reception. It is just AM, with no frills.

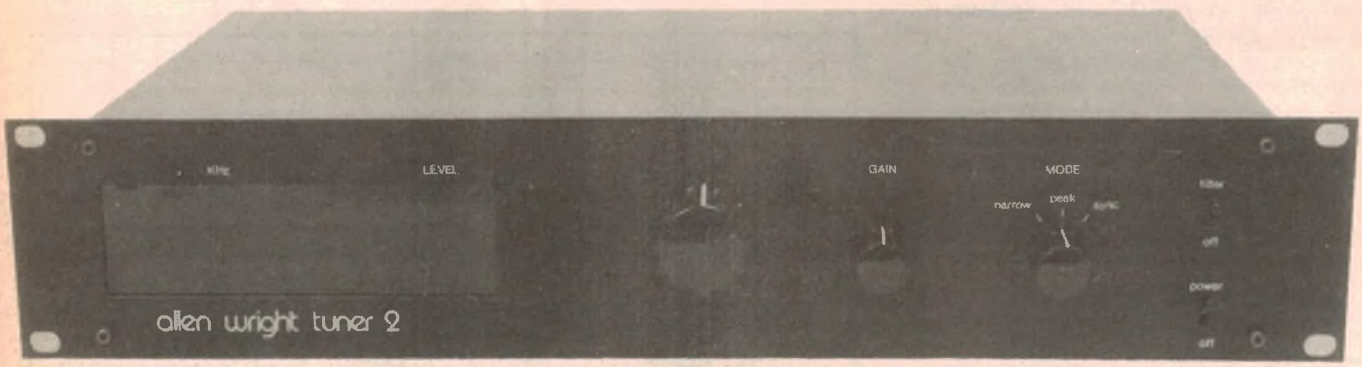
Housed in a black metal cabinet with unobtrusive styling, the unit fits in with audio equipment currently available. The front panel is the standard 483mm x 89mm, suitable for rack mounting. The depth of the unit is 267mm overall. The tuning dial is a digital readout set well behind the front panel. Alongside is a LED tuning indicator. A tuning knob, gain control, mode switch, mains on/off switch and a 9kHz whistle filter switch complete the front panel. On the rear panel are an output level control, two RCA phono output sockets and a stereo jack socket for a balanced aerial input.

Before proceeding with other aspects of the tuner, we are of the opinion that the overall styling could be improved. The digital readout and tuning indicator, being set well behind the panel, make it necessary for the operator to stoop inconveniently to see these facilities while tuning. And the brightness of the tuning indicator is much greater than the digital readout and could be easily improved by increasing the brightness of the digital readout to match the tuning indicator, or vice versa.

Another unfortunate characteristic of the digital readout is that it was designed with the former 10kHz separation of broadcast stations in mind. The last digit is fixed on zero and this means that the indication of frequency is only to the nearest 10kHz. We would have preferred a digital readout with 1kHz resolution even though the final tuning adjustment is made by referring to the tuning indicator.

Removal of the cover of the tuner reveals a spacious chassis with a tidy layout. But we were not happy about the exposed nature of the mains connections to the fuseholder and PCB. The method of direct termination of the mains cord to the PCB might also create a hazard if the cord was inadvertently pulled sharply. The PCB could be fractured if this happened.

Having disposed of the negative aspects, a closer look inside the case reveals that the major parts of the circuit are built on a PCB measuring 310mm x 107mm, with the digital readout and tuning indicator included on a second board, 162mm x 57mm. The main circuit board is double sided, with the top or component side being used as a ground plane. Tuning is by a standard 415pF per section 3-gang capacitor.



The circuit is all solid state. Balanced aerial input is via a balun transformer, into a bandpass tuner and then into a FET phase-splitter followed by a double-balance FET mixer. Oscillator injection is via a second balun transformer. Oscillator output is also fed to a counter for the digital readout. Output from the mixer is fed into two damped and over-coupled IF transformers. Output from the IFTs is passed through the gain control and into an IC IF amplifier. The amplified IF signal is then fed through a heavily damped single IF transformer and which feeds three detectors.

No automatic gain control is incorporated in the circuit. Instead, the manual gain control provided on the front panel must be set for each station,

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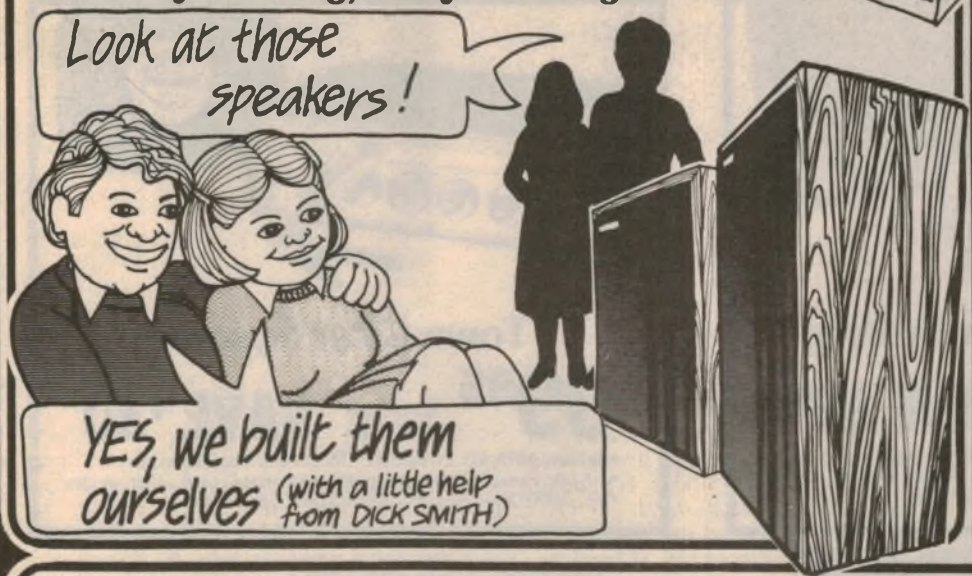

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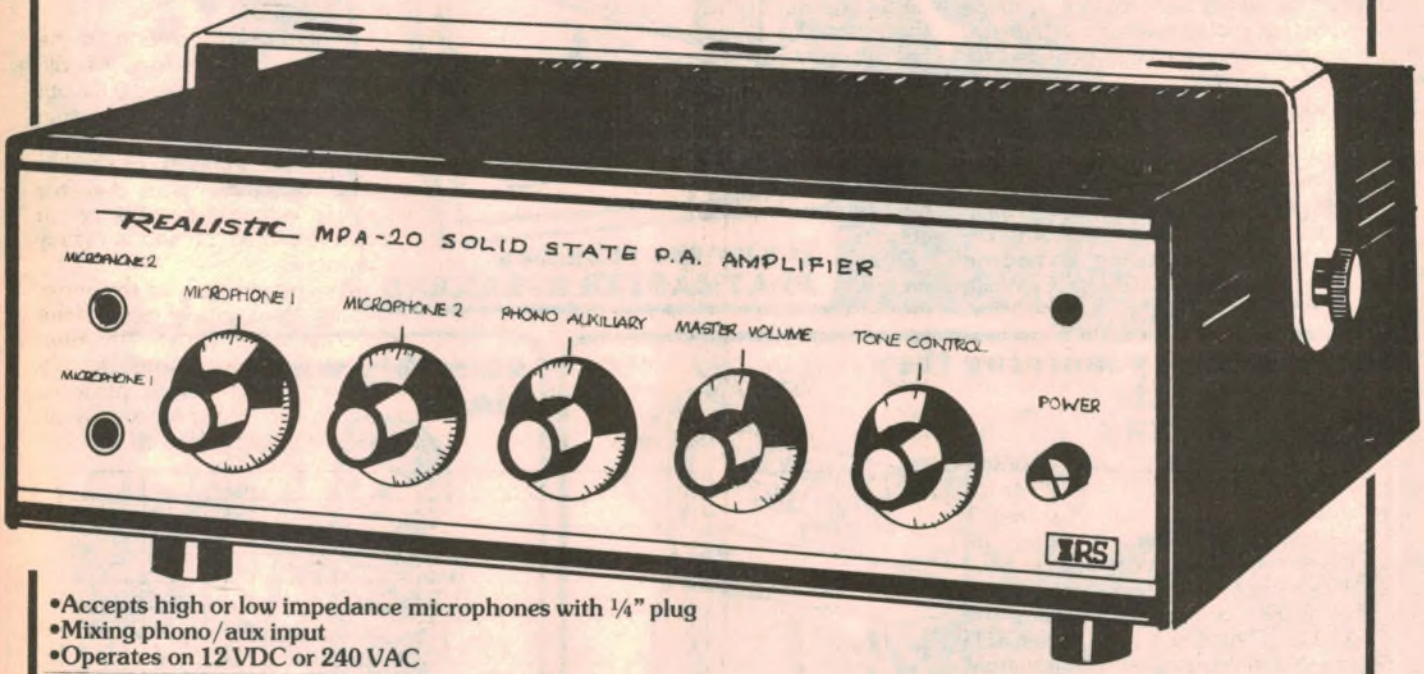

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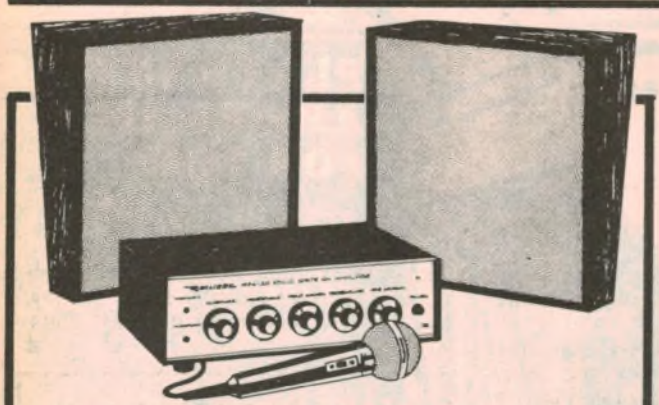

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against a level indicated by the tuning LEDs. This has been done because the designer considers that the use of AGC can distort the modulation envelope. The price one has to pay for this feature is the little extra inconvenience in the tuning procedure. No provision is made to avoid fading of distant signals but after all, this tuner is essentially designed for use on local stations.

The wideband and narrow band detectors each use a type CA3100 IC. In the case of the narrow band detector, a ceramic filter is introduced between the IF transformer and the detector which feeds the signal strength indicator circuits. The synchronous or homodyne detector uses a type MC1330 IC. While this detector gives a little more distortion, it can be useful at night to reduce "monkey chatter" from adjacent signals. Audio output is selected from the wanted detector with a switch on the front panel.

The rear panel audio level control follows the switch output and this feeds an audio amplifier capable of driving a 600-ohm line if required. A 9kHz whistle filter is also included, as this is essential for wideband reception in most cases.

The digital readout circuit uses the AY-3-8112 IC driving a multiplexed LED display. No multiplex hash was apparent in the tuner output which shows that the interface between the oscillator and counter circuitry and the general layout has been carefully engineered.

Easily the most important feature of the Allen Wright tuner is the low noise aerial system which is supplied with the unit. It consists of a large loop of wire which is connected to the tuner by means of a 6.5mm jack on the rear panel. The user orients this aerial (on a wall or around a window) for the strongest reception.

Compared with the reception via a long wire aerial, this low-noise loop aerial gives a reduction of static and other extraneous noise and interference which is little short of dramatic. For example, daytime listening in a city location where the electrical "noise" is severe, is normally a waste of time as far as quality reproduction is concerned, from any AM tuner. This is particularly the case if one wants to listen via the wideband detector.

Under good reception conditions, particularly when listening to ABC transmissions, the standard of reproduction is virtually equal to FM, without the advantage of stereo admittedly. Even in the narrow band mode, the reception is noticeably clean and even quieter than the wideband mode.

When listening in the wideband mode, the use of the 9kHz whistle filter is usually required and is mandatory for night time listening when propagation conditions improve. The 9kHz filter produces a slight but perceivable reduction in the bandwidth on good quality transmissions but the loss is not serious.

We did not make any specific tests for cross-modulation although some of the radio signals in our laboratory location are quite strong (The nearest radio stations are about 10km away). Under these conditions, cross modulation was not apparent.

Incidentally, the tuning range of this unit is somewhat greater than most AM tuners, from about 500kHz to 1800kHz.. The extended high frequency limit has the advantage that it includes 1750kHz, this service being available in some areas.

Some wideband tuners can present a problem when tuning in the wideband mode. The normal procedure is to tune to the station in the narrow mode and then switch to the wideband mode. With the Allen Wright tuner this is unnecessary. The tuning indicator circuit is permanently connected to the narrow band detector to give precise tuning in both narrow band and wideband modes.

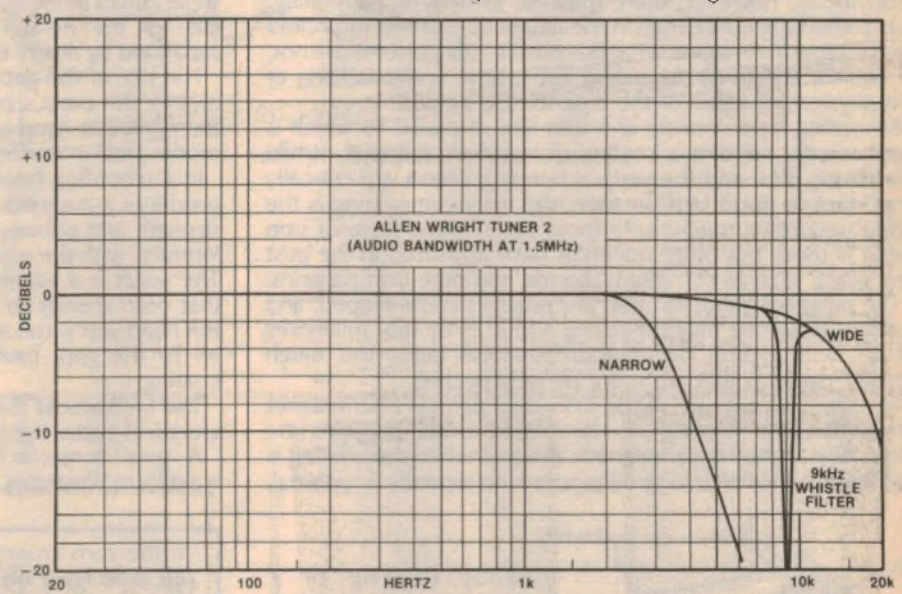
Laboratory measurements confirmed the high performance of the Allen Wright tuner. Sensitivity is quite high; for an RF input of 2uV, modulated 30%, we measured 25mV RMS audio output. Strong signals and the maximum manual gain setting, (explained in the supplied instructions) gave an audio output of about 190mV RMS.

Bandwidth measurements were rather interesting. Generally, wideband tuners are a little narrower at the low frequency end than at the high frequency end. In this case, the opposite applies. No doubt this is due to the characteristics of the bandpass tuner of the front end. However, the differences are not of any importance.

The graph shows measurements which we took at 1500kHz: In the narrow mode it is down 6dB at about 3.5kHz and 19dB down at 6kHz; in the wideband mode it is down 6dB at about 16kHz and 11dB at 20kHz. This is the widest bandwidth of any AM tuner that we have measured. The 9kHz whistle filter was very sharp; better than 60dB down at 9kHz, while only -2dB at 8kHz and -3dB at 10kHz.

While the harmonic distortion of the output appears to be very low, it is difficult to quantify. We measured 0.8% but this was largely noise – the true measurement would have been far less than this. The distortion is somewhat higher using the synchronous detector but we would estimate that the actual figure is still less than 1% and is mainly second harmonic.

So our overall impression of this tuner is very favourable, in spite of some of the reservations expressed above. The Allen Wright tuner does not come cheaply however, considering that it provides AM reception only. Recommended retail price is $442, including sales tax. For further details, contact Allen Wright Electronics, 13 Wentworth Avenue, Sydney, NSW 2000. Telephone (02) 235 8084. (I.L.P.).



These curves show the frequency response in the narrow and wideband modes.

How a tape re

Even though you've never cut a disc, you probably have some idea of how the sound gets into and out of a record groove. But do you know just how your tape recorder does its job? This article should make things a little clearer.

by ROBERT N. GREENE

For disc recording and playback, electronics is a refinement rather than a necessity (remember the acoustic phonograph?).

Tape recording, by contrast, is entirely electromagnetic in principle, and no physical changes representing the audio signal take place either in the tape or in the heads over which it moves.

Obviously, however, there must be something happening; that something is a change in the magnetic patterns imprinted on the tape. To imagine what this entails—the patterns are not, of course, visible to the naked eye—some understanding of the physical structure of the tape itself is helpful.

Recording tape consists of a thin film of plastic to which is permanently bonded a coating of magnetic material. While the plastic film and the various bonding agents are critically important to good performance, the magnetic coating is the actual recording medium. In most cases, some form of iron oxide is used, but other materials have appeared in the past few years, such as chromium dioxide and pure iron particles.

The magnetic particles used are usually needle-shaped, and a rather large one might measure about 25 by four millionths of an inch; typical high-output/low-noise tapes use much smaller particles that are more densely packed.

In order to make use of the individual particle's bar-magnet properties, the floating needle-shaped oxide particles are physically aligned by a magnetic process while the coating is still fluid so that their long dimension corresponds, in general, with that of the tape.

When the coating has dried, no further physical motion of the particles is possible, but they can be magnetised in one direction or the other, depending on the magnetic field that is applied to them.

In a typical tape deck, the tape is drawn across two or three magnetic heads, which perform the following functions:

- RECORD: Impressing the signal on to the tape in the form of a varying magnetic pattern.
- PLAYBACK: Recovering the signal from the tape for subsequent amplification.
- ERASE: De-magnetising the particles on the tape,if so desired, so that it can be re-used for another recording.

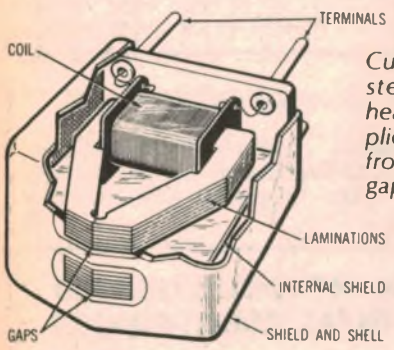
If you opened up a tape recorder head you'd find electromagnetic coils and pole pieces (with two sets stacked in a stereo head as in Fig. 1). The pole pieces terminate at the surface of the head, over which the tape passes, and are separated by a very tiny gap filled with non-magnetic material.

The size of this gap is measurable in microns (millionths of a metre), the exact size being determined by the use for which the particular head is intended and the investment (time and money) the manufacturer can afford to make in it.

In a recording head, the coil receives the audio signal and produces a magnetic field across the head gap that varies in strength and polarity with that signal. This magnetic-flux field interacts with the oxide on the tape as it crosses the head gap. The result is a varying magnetic imprint on the moving tape that corresponds to the varying audio signal. (Incidentally, if the head gap is too small, the flux field will tend to be confined to the gap, having only a minimal effect on the tape coating.

The field across the gap is a magnetic representation of the electrical audio signal fed to the coil.

A "pure" tone can be shown as a sine wave as in Fig. 2. This waveform illustrates how the signal changes in strength and

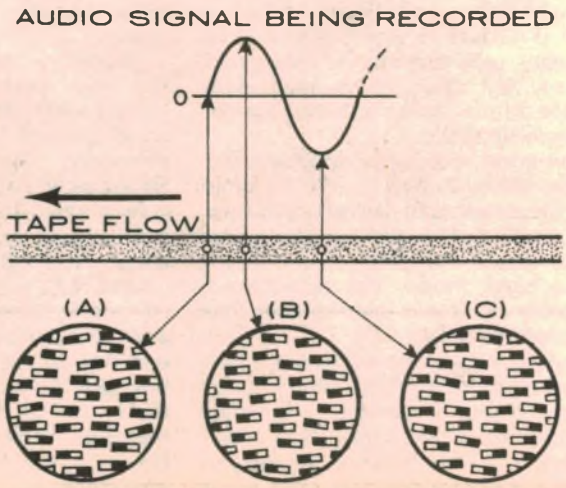


Cutaway drawing of a stereo record/playback head. Audio signals are applied to and also picked up from the tape at the head gaps.

◄ **FIG. 1**

FIG. 2 ►

At the zero crossing point of the signal, the particles on the tape have no special magnetic pattern (A). On the positive signal peak, magnetic polarities are all in the one direction (B). On the opposite peak, their orientation is reversed (C).



corder works

A modern open reel tape deck, the Technics model 1700. It employs a 3-motor transport system with quartz-locked direct drive to the capstan. It has six heads, allowing the deck to record and replay in both directions, with provision for automatic reverse and continuous play.

direction (polarity) over a time period determined by the frequency. The upper half of the sine-wave curve represents the variation in current strength as it rises, hits its peak, and then returns to zero. The lower part of the curve illustrates the same thing happening in the opposite direction when the current flow reverses. (The solid portion of the curve shows the alternating signal going through one complete cycle of change; in the dotted portion another cycle is beginning).

The magnetic field that such a signal develops in the gap of a tape head follows the signal's strength; it increases and decreases with the changing current and reverses its polarity as the current reverses direction.

As the tape passes over the heap gap, its magnetic particles (which at this point have a random magnetic arrrangement) pass through and are influenced by the head gap's constantly changing magnetic field; they will hold the magnetic imprint received as they pass the trailing edge of the head gap.

As illustrated in Fig. 2, the strongest magnetic flux will occur at the peaks of the curve. At those points the oxide-particle "bar magnets" will magnetically orient themselves with their "north" poles to, say, the left. The current then drops back to zero, reverses, and starts to rise again in the opposite direction.

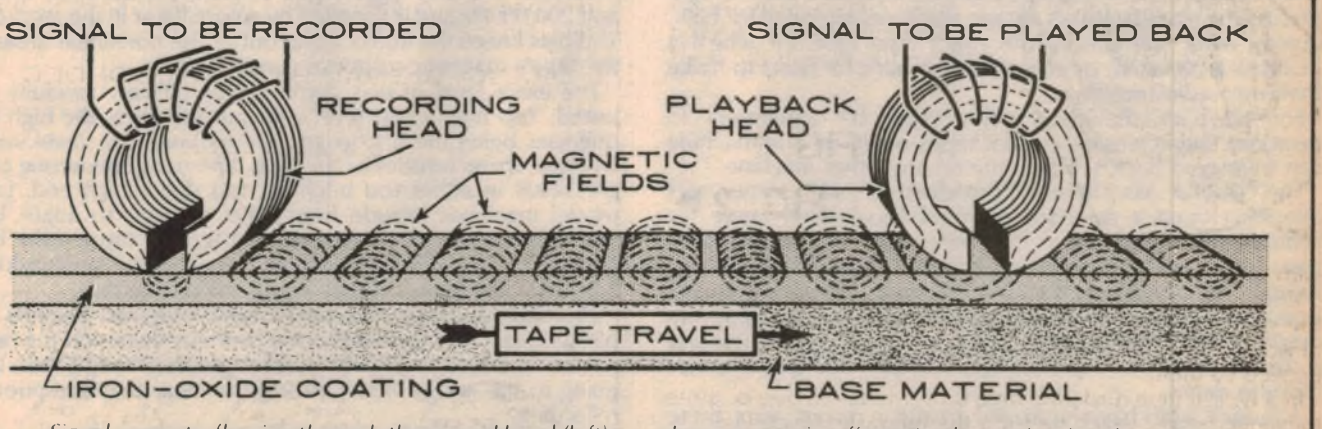
At this new peak, the magnetic poles of the oxide particles are reversed from their previous arrangement. (Keep in mind that the particles themselves don't move; just the polarity and strength of their magnetism changes.)

The end result, as the tape motion and signal continue, is a series of magnetic impulses imprinted on the tape, and these vary with the strength, polarity, and frequency of the signal. (For the sake of simplicity, only a single-channel—mono—tape recording is shown.)

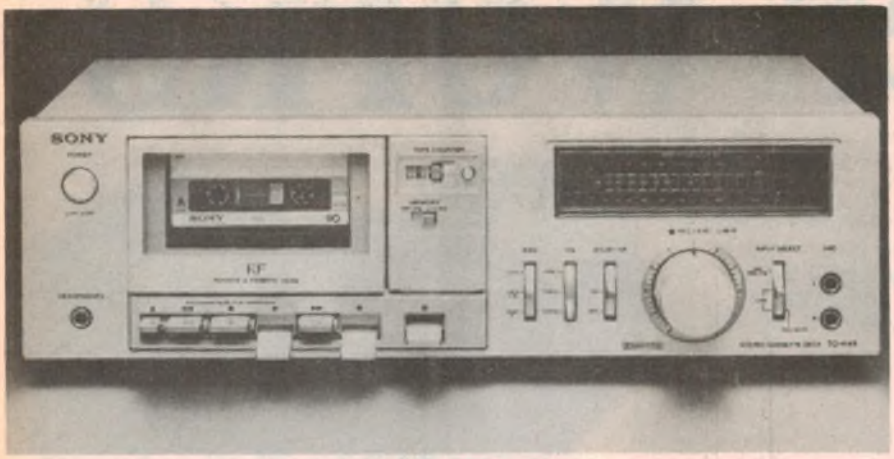
Your tape recorder may have a single head that serves both for recording and for playback (as do most cassette decks) or two different heads for the two functions (as do most open-reel decks). The latter arrangement is preferable since, for optimum results, diferent-size head gaps should be used for each function.

Many of the new and usually more expensive cassette machines now have either separate record and playback heads or both heads built into a single shielding shell.

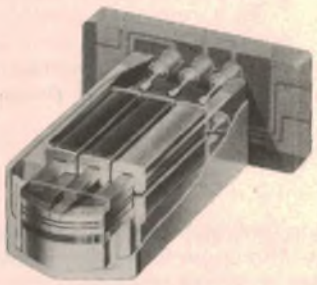
For example, let's assume that we have a machine with separate heads (see Figure 3), and let's also assume that the recorded tape has now reached the playback head. As with the record head, the functional parts are a (usually) laminated iron core (the pole pieces) around which there is coil of wire.



Signal currents, flowing through the record head (left) produce a magnetic field which is concentrated in the gap, creating magnetically charged zones in the oxide coating of the moving tape. These zones produce magnetic effects in the replay head, creating small currents in the winding equivalent to the original signal.



This TC-K45 is one of several cassette decks from the Sony range. The mechanics are scaled down but the basic principles are the same as for the open reel deck on the previous page. Recording level is controlled by the large concentric knob and indicated by an LED display in the panel directly above it. Rated frequency response is from 20Hz to 17kHz, depending on the type of tape in use.



From AKAI comes this cutaway (and over-sized) drawing of a stereo cassette head, combining record and replay systems in the one tiny assembly and housing. Since it performs two separate functions for two tracks, there are four gaps altogether – two for record and two for replay.

Playback is a direct reversal of the recording process. The playback-head core becomes magnetised according to the magnetic pulses imprinted on the tape, and the varying flux impinges on the coil(s), producing a signal voltage that is, with certain modifications, similar to that originally fed to the recording head.

That is the briefest possible explanation of how tape is recorded and played back. However, there are magnetic, electronic, and mechanical factors inherent in both tape and tape equipment that prevent the process from being quite as quite as clean-cut and simple as we've described. Tones of different frequencies will have waves of different sizes, low frequencies having long wavelengths and high frequencies having short wavelengths.

For various technical reasons, some reduction in the strength of the higher frequencies (compared with the middle and low frequencies) is inescapable in the recording process.

This can be offset to some extent by using better tapes and heads and higher tape speeds, but high-frequency equalisation during recording is nonetheless necessary to make up for the losses. This particularly true of cassette machines, whose tape speed is normally fixed at 1⅞ inches per second.

Playback also has problems at the other end of the frequency spectrum: the response diminishes as the frequency of the signal is reduced.

Equalisation for these high- and low-frequency losses is built into the recording and playback preamplifiers of each tape recorder. Recording equalisation must be adjusted to provide optimum results with the recording head in a given machine and with the electromagnetic characteristics of a specific tape (this is why manufacturers of tape machines intended for high-quality work will specify the exact tape type for which a machine is adjusted, or else provide means for users to make their own adjustments).

For playback, however, there must be agreement in response characteristics so that tapes made on any machine can be played back satisfactorily on any other machine.

The National Association of Broadcasters (NAB) some years ago developed a standard playback-equalisation curve for professional equipment in the United States to which open-reel home machines are also adjusted. Cassette machines, though not covered in the NAB standard, are also manufactured with equalisation curves standardised throughout the industry, different curves being used for various tape types. This is the reason for the equalisation switches found on the better cassette decks.

Although tapes have improved greatly in recent years, there is still a certain amount of noise, audible as hiss, inherent in the process of recording and playing back. This is largely circumvented in all but the simplest machines by boosting the low-level high frequencies before recording and then dropping them back, along with the introduced noise, in playback. Since the noise was introduced after the original boost, much of it drops below the audible level.

This is the operating principle of the virtually universal Dolby noise-reduction system and of others, such as JVC's ANRS system. Their action improves the signal-to-noise ratio up to about 10dB, which is generally adequate to eliminate audible background hiss.

Two limitations in the tape itself lead us to the last complications in this process. The first is that tape can be magnetised only up to a certain point; when this limit is reached, the tape is said to be "saturated." Any attempt to record a "stronger" signal will simply generate distortion.

The second problem is, in a way, the other side of the coin—a very weak magnetic field will have little appreciable effect on the tape. In other words, tape does not accept audio signals in a linear manner.

Going back to the sine wave in Fig. 2, you will see that the magnetic field is constantly shifting between a high level and zero level, so steps must be taken to keep the magnetic force within the tape's limitations.

A standard procedure is to add a second, very high frequency (and therefore inaudible) "bias" signal to the signal being recorded. The bias frequency is somewhere between 50,000 and 200,000Hz and is supplied by an oscillator in the recorder. The bias keeps the audio signal out of the non-linear areas of the tape's magnetic-response curve.

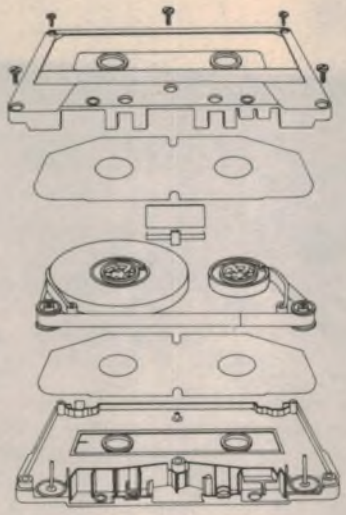
The exact level of bias current must be very carefully adjusted. Too high a bias level will cause erasure, the high frequencies being the first to go. The required bias level varies with the characteristics of the tape, and using the wrong tape can result in either too bright or too dull a high end. Late-model machines include front-panel controls to adjust bias and equalisation for more than one type of tape. If the bias control is not externally available, a machine's bias should be adjusted only by a properly equipped serviceman.

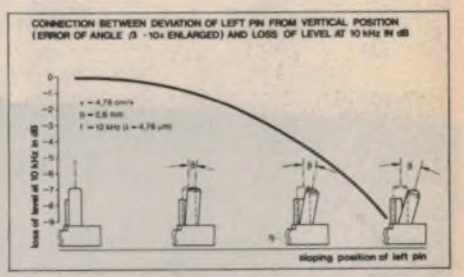
The bias signal serves another useful purpose. Since its application at a high level will erase previous signals on the tape, it is fed to the erase head (at a much greater strength than that going to the record head) in order to clear the tape prior to recording.

All tape recorders—open-reel or cassette, plain or fancy—operate as I've described. The manufacturer's instructions usually point the way clearly to good recording results, but perhaps you'll be able to do a bit better now that you understand what happens when the tape meets the head.

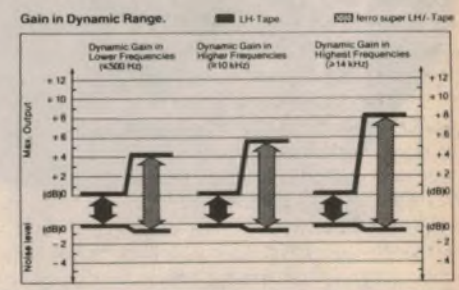
The new BASF high precision cassette. An unbeatable case for buying The Green One.

In the tough, screw-together polystyrene, precision moulded shell, slip sheets eliminate tape edge damage. A mu-metal shield blocks stray magnetic fields. A felt pressure pad on a phosphor bronze spring ensures precise head contact on any deck. Flanged roller guides on lubricated stainless steel pins provide precise tape feed and azimuth alignment. The patented BASF Security Mechanism (SM) prevents jamming and tape spill, and guarantees–assisted by precision moulded hubs–accurate winding. Clear visibility through large strong window to the best BASF ferro super I tape yet.





One common cassette fault. Imprecise azimuth alignment distorts recording. Minimum tolerances insure that no fault can occur with the new BASF ferro super LH I.



Gain in dynamic range. LH tape versus the new BASF ferro super LH I.

The precise story.

Dubbed The Green One for ease of identification, the new BASF ferro super LH I displays high precision and performance throughout.

In the mechanics of the cassette, BASF has achieved new standards of azimuth precision, dramatically reducing wow and flutter, noise and distortion and improving output in the highs.

A dense coating of super-fine ferric oxide particles has produced a mirror-finish tape with extremely strong magnetic direction preference.

The end result–true Hi-Fi in the normal bias position I (Ironoxide or Fe; 120 µs EQ). Plus higher volume levels with no distortion.

So spend a little more, and get more for your money.

Go for The Green One. Step up to Hi-Fi precision.

BASF

BAS40

A light chaser for 240VAC lamps

One of our most popular projects of all time has been the Musicolour. Since the last one was published in the September 1976 issue of "Electronics Australia" thousands have been built and are to be found in homes, theatres, clubs and discos throughout Australia. Now we have a great follow-up to the Musicolour, a Light Chaser for 240V lamps.

by RON DE JONG

Everybody has seen a "chaser" although they may not have heard them referred to by that name. They are most commonly used as an eye-catching border to street advertisements. They consist of a string of low wattage lamps around the sign or whatever which continually "chase" each other around the string. More recently, they have become popular in Sound and Light shows and some are capable of a wide variety of effects.

"Chasers" work by sequentially switching one mains output after another. Some units provide four individual outputs while others, like our own unit, provide three individual outputs. When these three outputs are connected to a string of lights in which every third light in the string is connected together to one of the outputs, the lights will appear to move around or "chase" each other as each output is turned on in sequence.

Up until recent years, chasers have been simply motor-driven rotary switches which, although reliable, produce a lot of electrical interference. By using electronics to do the job, this interference can be largely eliminated while also providing more variety in the display.

The controls provided on the front panel of our Light Chaser include a flash rate control, invert/normal switch and forward/reverse switch. The flash rate control merely sets the rate at which the lights appear to move while the invert switch can invert the outputs so that rather than one light appearing to move, two lights or one "hole" appears to move. The forward/reverse switch enables the direction of the light chase to be reversed.

To increase the versatility of the chaser we have also provided "auto-reverse" and "auto-invert" functions. Both of these controls are switch pots: when the controls are switched off the unit functions normally but when either of the controls is switched on the corresponding function of the invert or reverse switches is disabled and the unit will automatically invert or reverse the display at a rate set by the controls. This adds just that much more interest to the display.

Zero-voltage switching is also included in the design to eliminate the switching transients and hence the RF interference which can occur when switching Triacs. With zero voltage switching the transients are eliminated because the Triacs can only be turned on at the start of each half cycle of the mains voltage waveform.

The block diagram shown in Fig. 1 describes how the unit works. The heart of the circuit is the "modulo three" counter which has three outputs corresponding to the three output channels of the unit.

The outputs will turn on in sequence as the counter is clocked by the flash rate oscillator. We have labelled the three outputs A, B and C and the actual

Circuit is locked to the mains for zero-voltage switching

waveforms at these outputs can be seen in the diagram.

These three outputs from the counter pass to a normal/invert circuit using three exclusive OR gates which will either leave the three individual outputs unchanged or invert each one – this is how the "hole" effect is obtained. Next a "swap around" circuit, employing CMOS bilateral switches, is used to pass outputs B and C directly or swap them around depending on the forward/reverse control line. The result of this may not be immediately obvious but what it does is effectively reverse the apparent direction of the light chaser.

Finally the signals are enabled by three NOR gates with a trigger circuit. The trigger circuit generates a brief 1ms long pulse at the start of each mains halfcycle, so the outputs of the enable circuit will turn on only for that brief period if the corresponding input of the enable circuit is high. This is how zero voltage switching of the Triacs is obtained because they are turned on at the beginning of each half cycle by the trigger pulse. If any input to the trigger enable circuit is low however, the output will be low regardless of the trigger state and the Triac will remain off.

Looking at the circuit now in detail the counter shown in the block diagram is actually IC1 which is a 4017 decoded decade counter. As its name suggests, it counts to ten and each of the ten states of the counter is decoded into ten separate outputs labelled "0" to "9".

We want the counter to count from "0" to "2" continuously to give us three separate outputs which will turn on in sequence. This could be readily accomplished by simply connecting the "3" output of the counter to its reset input so that when the counter starts from "0" and reaches "3", output "3" will go high, instantly resetting the counter back to "0".

The disadvantage of this scheme is that output "3" of the decoder disappears as soon as the counter resets itself, hence the reset pulse width is determined only by the internal propagation delays of the chip. This could result in unreliable resetting.

Instead of this scheme, we have used an RS flipflop comprised of two NOR gates, IC2d and IC2c, which are connected so as to effectively latch the pulse from output "3" of the counter to generate a reliable reset pulse. The "set" input of the flipflop is pin 8 of IC2c, while the reset input of the flipflop is pin 13 of IC2d and the output is connected to the reset input of the counter. Normally the output of the flipflop is low so the counter will function normally counting from "0" to "2", until it reaches "3".

When output "3" goes high the flipflop will be set and the output of the flipflop resets the counter back to "0". In this case though, the reset signal to the counter remains latched even though output "3" is no longer high and it stays latched until the reset input of the flipflop goes high. The reset input of the flipflop is connected to the clock input of the counter and since the counter increments when the clock goes low the flipflop will not be reset until half a clock cycle later when the clock goes high again – leading to a reliable reset pulse to the counter of half a clock cycle.

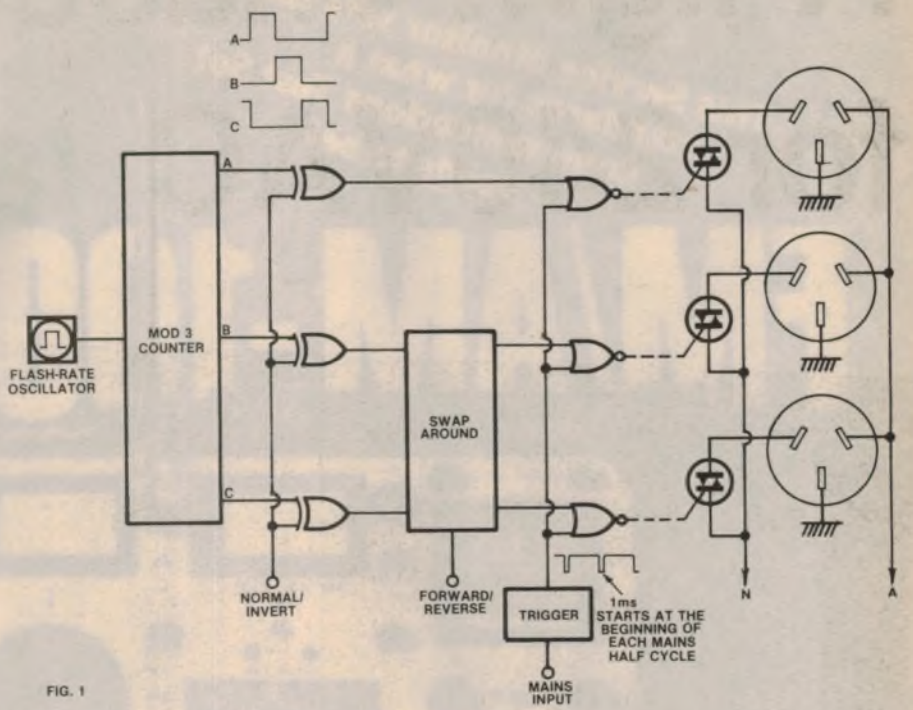


FIG. 1

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

$70

This includes sales tax.

The clock signal for the counter is obtained from a flash-rate oscillator, IC5f which uses a Schmitt trigger. The value of the 1M and 180k resistors was selected to give a reasonable range for the flash rate of about 1Hz to 25Hz.

The outputs from the counter are fed to three separate XOR (Exclusive-OR) gates IC3c, IC3d and IC3a which comprise the invert/normal functions shown in the block diagram. The output of an XOR gate is high when its two inputs are different (ie, 0, 1 or 1, 0) and low when the two inputs are the same, (ie, 1, 1, or 0, 0). Hence, if one of the inputs is used as a control which is low the signal at the other input will be passed unchanged to the output but if the control signal is high then the other input will be inverted. The control inputs of each XOR gate are connected together to form a common "invert/normal" control line.

The invert/normal control line is buffered by a spare hex Schmitt trigger, IC5d, which functions as a simple inverter. If the "auto/invert" switch (S2) is open, the input to the buffer is controlled by the invert/normal switch, S1, and the two 10k resistors. Depending on whether S1 is closed or open, the input to IC5d will be high or low and the outputs of the counter will be either inverted or not inverted. When the "auto-invert" switch S2 is closed however the output of IC5a swamps the signal from S1 and the invert function will be controlled by the auto-invert oscillator, IC5a.

Operation of the auto-invert oscillator is the same as the flash-rate oscillator except that it operates at a much lower frequency set by the 22uF capacitor and 1M pot and 100k resistor.

Following the XOR gates, IC3, is a switching circuit consisting of IC6 and IC5e. This is shown on the block diagram as a "swap around" circuit because that is just what it does. IC6 is a 4016 which contains four bilateral switches which each have an input, an output and a control line. When the control line for a given switch is low, the switch is off and when it is high, the switch is on.

The control lines of the four bilateral switches are connected together in pairs to IC5e which acts as an inverter, so that at any one time, depending on the input to IC5e, only one pair of switches will be on. The input of IC5e is thus the forward/reverse control and it is connected to an auto reverse circuit which functions in the same way as the auto-invert control discussed earlier.

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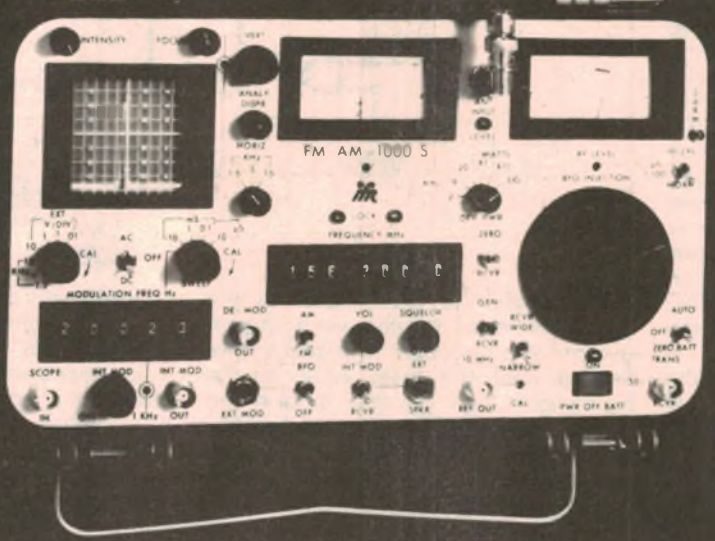

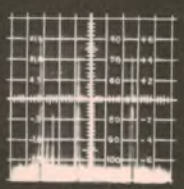

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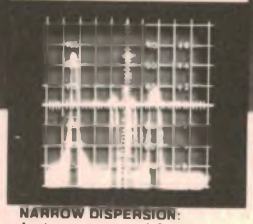

NARROW DISPERSION: Analyzer sweeps ±0.5 MHz from selected frequency (1 MHz span)

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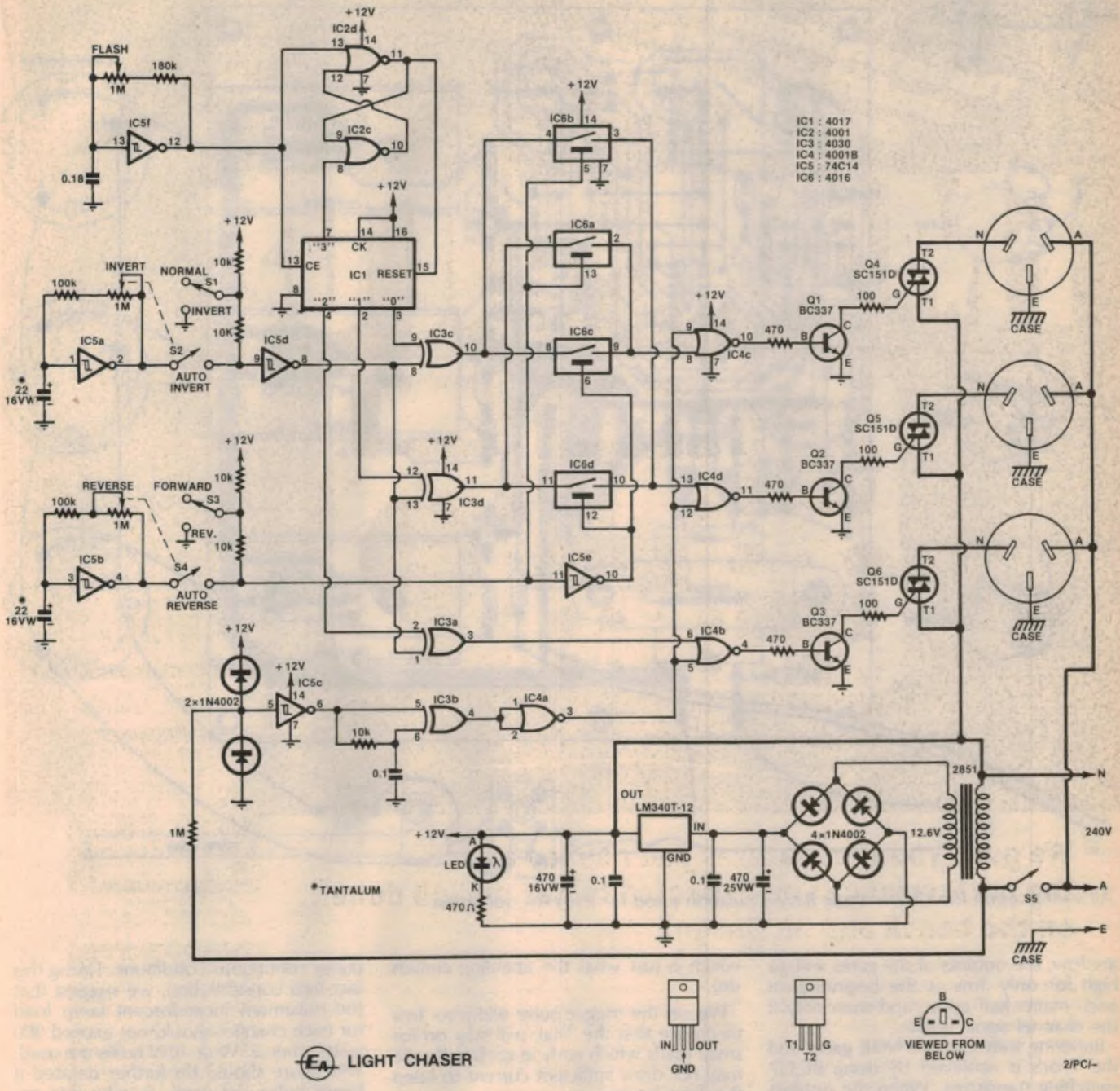


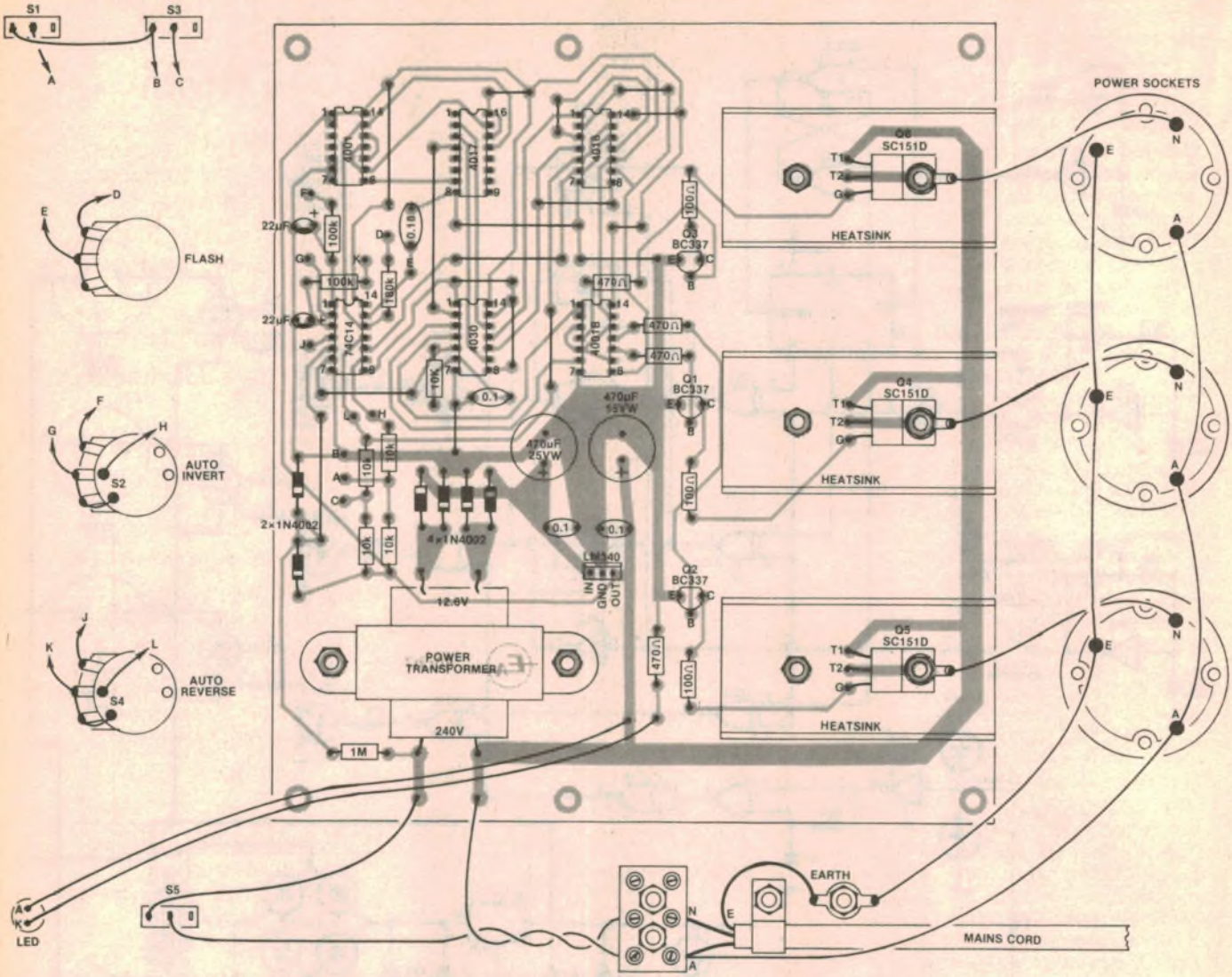
Note that IC4 must be a 4001B while IC2 may be 4001 or 4001B. The 4001B has a higher output current capability.

So far, we still have three separate outputs which turn on or off in some sequence determined by the forward/reverse and normal/invert controls. These signals are now processed by the trigger and enable circuits consisting of IC5c, which is a Schmitt trigger, IC4, which is a quad NOR gate and IC3b which is an XOR gate.

As we mentioned before, the trigger circuits ensure that the Triacs turn on at the beginning of each halfcycle of the mains voltage waveform, virtually eliminating the turn-on spikes which would otherwise occur. For this reason, the trigger circuits must be locked into phase with the mains which is why the input to the trigger circuit, IC5c, is obtained directly from the mains. When the large voltage excursion of the mains is squared up by IC5c and the two associated diodes, the resulting square wave output will lag the original mains by less than one degree, which is close to zero for our purposes.

The square wave output from IC5c connects directly to one input of IC3b and to the other input via an RC time delay circuit consisting of a 10k resistor and a 0.1uF capacitor. The time delay is roughly 1ms and because the XOR gate generates a high output when its inputs are different the output of the XOR gate will be a series of 1ms pulses in phase with the square wave input, ie at the start of each mains halfcycle.

The trigger pulses are inverted by IC4a and passed to IC4c, IC4d and IC4b where they gate through the three "channel" signals originally derived from the counter. Since the output of a NOR gate will only be high when both inputs



All wiring inside the Chaser must have insulation rated for 240VAC operation.

are low, the outputs of the gates will go high for only 1ms at the beginning of each mains half cycle, and then only if the channel signal is low.

Buffering between the NOR gates and the Triacs is achieved by using BC337 switching transistors. When the outputs of the NOR gates go high the transistors will be turned on via the 470 ohm current limiting resistors between the NOR gates and the bases of the transistors and the transistors will conduct a brief 1ms trigger pulse sufficient to turn the Triacs on for the remainder of each mains half cycle.

(Triacs are bidirectoinal switches which can be triggered into conduction on either half cycle of mains current and will remain "latched" until the current falls below the "holding" current for the device. Since the current through the Triac will fall to zero at the end of each mains halfcycle, the Triacs must be retriggered for each new half cycle – which is just what the enabling circuits do).

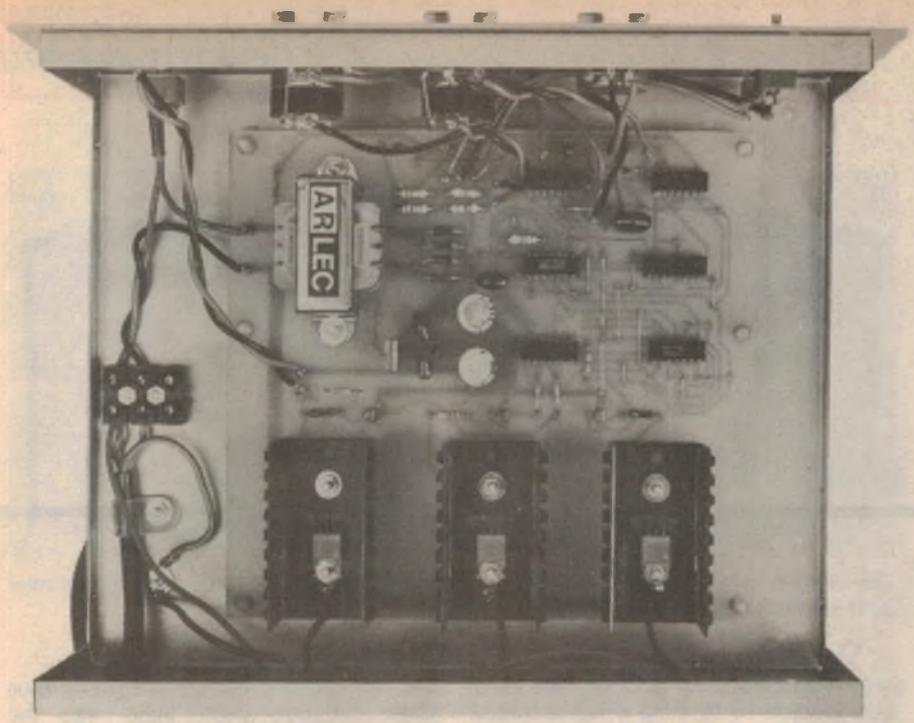
We set the trigger pulse width to 1ms to ensure that the Triac will stay on for small loads which early in each halfcycle may not draw sufficient current to keep the Triac latched.

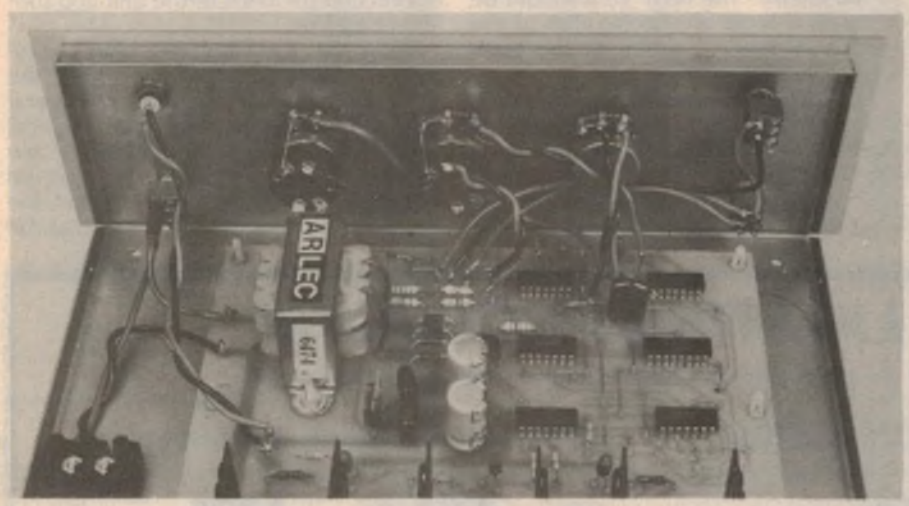
Since a maximum of two channels out of three will be on at any one time, the maximum load per channel is limited to five amps, giving a total of 10 amps, which is the maximum which may be obtained from a standard general purpose mains outlet. This results in a maximum dissipation of about 3.5 watts for each Triac which is well within ratings.

While the maximum load is thus five amps per channel, the incandescent lamp load must be derated to take into account the on/off cycling of the lamps. Since the lamp filaments do not reach their normal operating temperatures, they draw more current than if operated under continuous conditions. Taking this fact into consideration, we suggest that the maximum incandescent lamp load for each channel should not exceed 900 watts when 25W or 40W bulbs are used. This figure should be further derated if larger bulbs are used, to take into account the greater thermal inertia of the filaments.

We recommend that 25W bulbs be used. This results in a maximum of 36 bulbs per channel or 108 bulbs in total. Note that individual lamps should not have a rating in excess of 150 watts. Fluorescent lamp or other discharge lamp loads must not be used.

Power for the circuit is obtained from a 12.6V mains transformer followed by a bridge rectifier, capacitor filter and a 12V three-terminal regulator. The regulator provides a well regulated, low ripple 12V supply and its output is decoupled with a 0.1uF capacitor and a 470uF capacitor. The 0.1uF provides high fre-





Each Triac is restricted to 900 watts load to give a maximum total load current (any two channels on) of 10 amps.

PARTS LIST

HARDWARE
- *1 chassis with cover*
- *1 front panel*
- *3 knobs to match front panel*
- *1 mains transformer, A & R 6474, DSE2851, Altronics 2851,*
- *1 PC board, 181 × 164mm, coded 80ch7*
- *3 U-shaped heatsinks (see text)*
- *2 1m (log) rotary switch*
- *1 1M (log) rotary potentiometer*
- *3 SPDT miniature toggle switches*
- *3 panel-mounting mains sockets*
- *1 10-amp mains cord and plug*
- *1 LED bezel (see text)*
- *4 rubber feet*
- *1 3-way insulated-terminal block*
- *6 Richco CBS-6N plastic board supports*
- *4 solder lugs*
- *1 grommet*
- *1 cable clamp*

SEMICONDUCTORS
- *1 4017 CMOS decoded decade counter*
- *1 4016 quad analog switch*
- *1 74C14 hex Schmitt trigger*
- *2 4001B quad NOR gates*
- *1 4030 or 4070 quad XOR gate*
- *1 LM340T-12 three terminal regulator*
- *3 SC151D or SC141D Triacs*
- *3 BC337 or BC338 transistors*
- *6 1N4002 rectifier diodes*

CAPACITORS
- *1 470uF/25VW PC electrolytic*
- *1 470uF/16VW PC electrolytic*
- *2 22uF/16VW tantalum*
- *1 0.18uF greencap (metallised polyester)*
- *3 0.1uF greencap*

RESISTORS (all ¼ watt 5%)
1 × 1M, 1 × 180k, 2 × 100k, 5 × 10k, 4 × 470 ohms, 3 × 100 ohms.

MISCELLANEOUS
Screws, nuts, lockwashers, mains-rated hookup wire, solder.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used for our prototype. Components with higher ratings may generally be used provided they are physically compatible.

quency decoupling and ensures stability while the 470uF capacitor decouples the brief high current trigger pulses.

CAUTION CAUTION CAUTION

Before proceeding to the details of construction we must warn readers that **this project is potentially dangerous** if not assembled according to the text. Not only is the circuit powered directly from the mains but **all parts of the printed circuit board and all components within the case can be at the full mains potential.**

Do not work on the unit when it is switched on or plugged in. The mains switch does not disconnect the lamp outputs from the mains so that the circuitry is still **completely alive and dangerous even when switched off.**

Do not do what some have done in the past – buy a partial kit without chassis. Purchase the full kit so that the circuit can be safely installed in an earthed metal chassis.

All the main components are mounted on a single printed circuit board measuring 181 x 164mm and coded 80ch7. Mount the smaller components on this board first, ie links, resistors and capacitors using the wiring diagram provided. Then mount the CMOS IC taking care not to handle the pins and using an earthed soldering iron so as to avoid damage from static discharge. It is also good practice to solder the supply pins first, ie pins 7 and 14 or pins 8 and 16, to "enable" the internal protection diodes.

When all the smaller components have been mounted, the transformer and Triacs, plus their heatsinks, can be fitted. For each Triac, we used a U-shaped black-anodised heatsink of ribbed design available from Dick Smith Electronics (cat H-3401). Alternatively, constructors can make up their own heatsinks using 22-SWG aluminium.

A solder lug is attached to the case of each Triac to provide a connection point.

PC stakes are recommended and any type may be used provided they are a

tight fit in the PC board holes before soldering. These allow connections to the PCB to be quickly broken to remove the board from chassis.

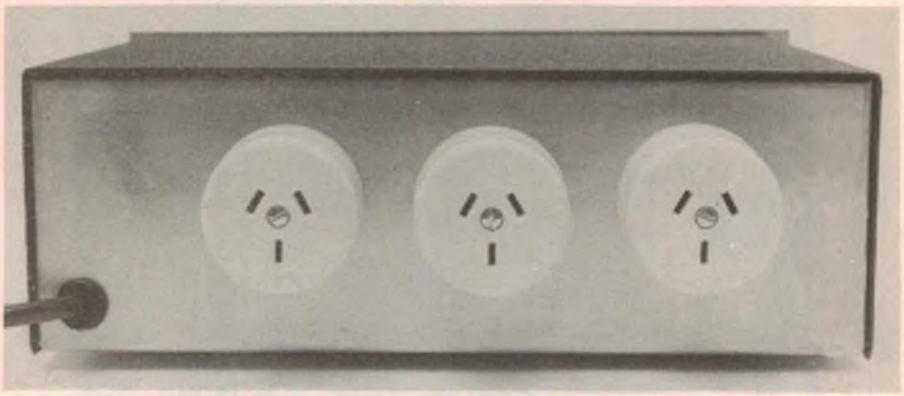
We used the same chassis as sold by Dick Smith Electronics for the Musicolour III. The PCB also uses the same mounting holes as that for the Musicolour.

A warning about wiring up the chassis. All wiring should have 240V rated insulation. This applies to the wiring for the three output sockets, as well as for the front panel controls and LED indicator. Do not use light-duty hookup wire or rainbow cable.

With the above proviso in mind, install and wire up the chassis hardware. Cut the potentiometer shafts to a suitable length before installation.

We used a LED with black plastic surround and secured by a nut, as the power indictor. Alternatively, a neon bezel with internal limiting resistor, could be wired up via the mains switch. We do not recommend the use of a LED which is simply a "push-fit" or set in place with adhesive. It may come adrift and short to chassis.

The mains cord is passed through a grommeted hole in the rear of the chassis and anchored by a clamp. The active and neutral wires are terminated in an insulated terminal block. The earth wire is soldered to a lug which is bolted to the chassis. The earth wire should be left with a loop of slack so that, if the cord is strained to the limit, the earth wire is the last to break.



This tantalising photograph shows the rear panel of the Light Chaser in glorious two-dimensional black and white reproduction.

Install the PCB in the chassis now, using Richco plastic supports and complete all corrections using the wiring diagram. At this point you should carefully recheck your wiring and the orientation of the ICs, diodes and electrolytic capacitors. If you are satisfied that all is correct, plug three separate 240V lights into the sockets on the back of the unit and turn the chaser on.

With the "auto-reverse" and "auto-invert" functions turned off, check the flash rate control. Now check the operation of the other controls. No electrical interference should be present at any setting of the controls. This can be checked by listening with a portable radio, in the near vicinity. (Note that the

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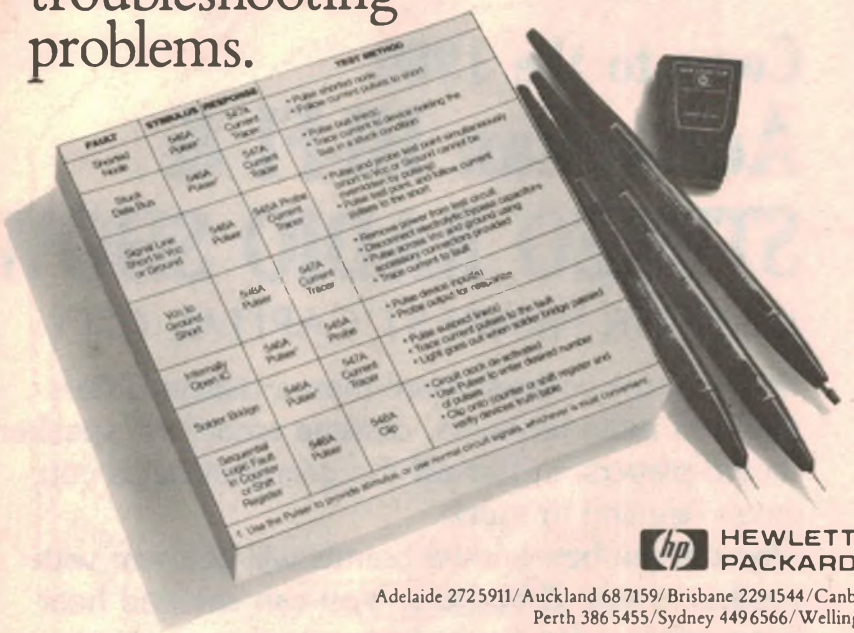

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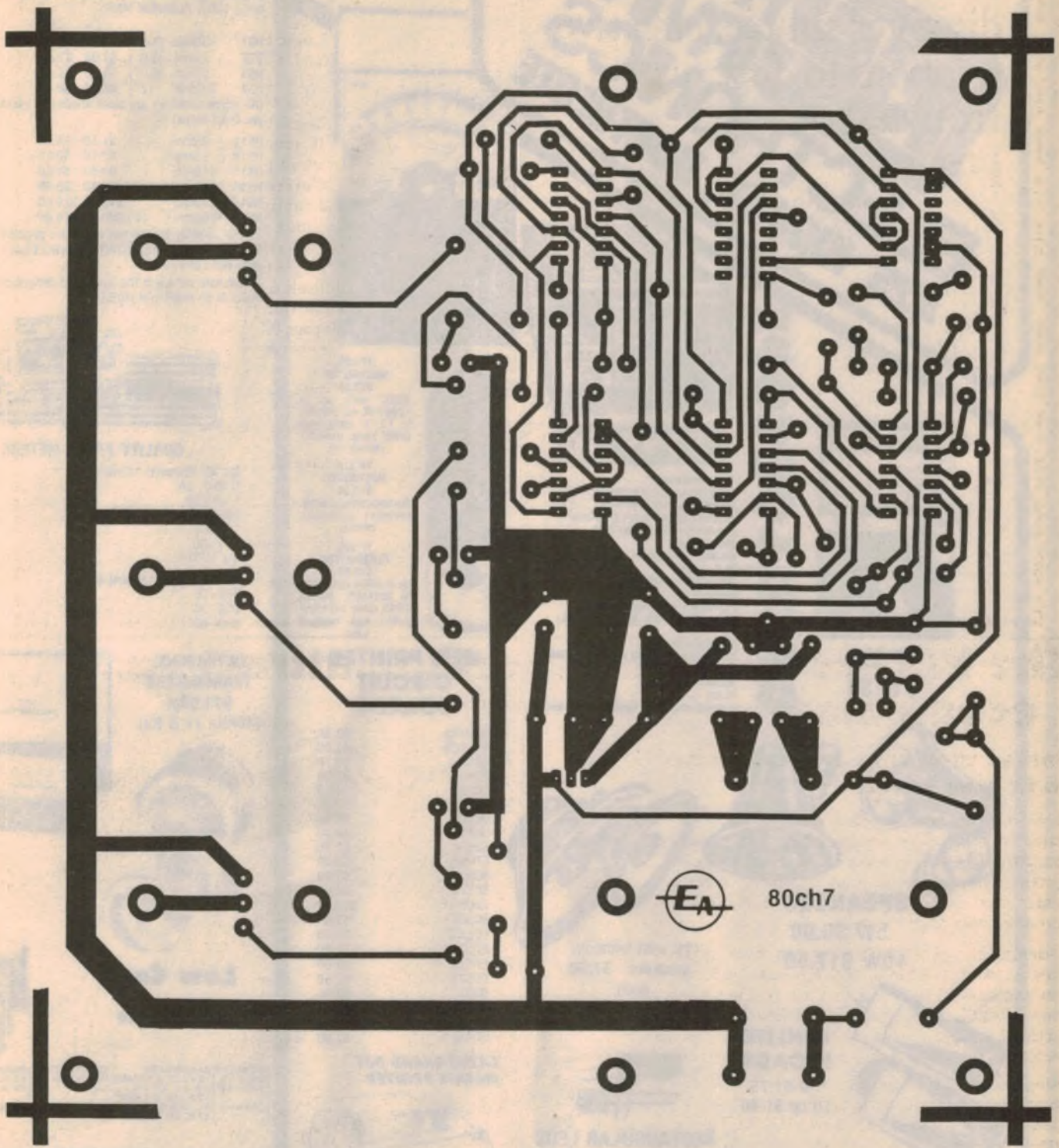
AMSTROL



This is the full size artwork for the PC board.

mains can radiate a lot of interference which should not be confused with any originating from the Light Chaser. A comparison, with the Chaser on and off, will clear up any doubts here.)

Note that if troubleshooting is necessary on the Light Chaser it can be made safer to work on. Just disconnect the lamp loads and check that the neutral side of the circuit is, in fact, at neutral rather than active potential. Then, provided you cover any remaining active wiring or connections with insulation tape, you can make measurements on the circuit with reasonable safety.

If all is well the unit can now be connected up to your own light chaser display. Commercial light chaser displays are available and consist of a series of lights wired up inside a plastic tube. These should be readily available from disco lighting retailers, but be sure to ask for a three-channel display not the more usual four channel arrangements.

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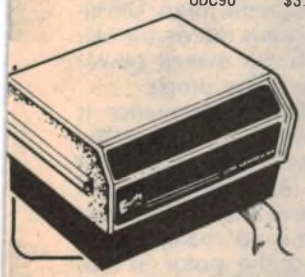

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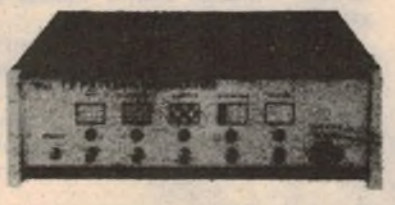

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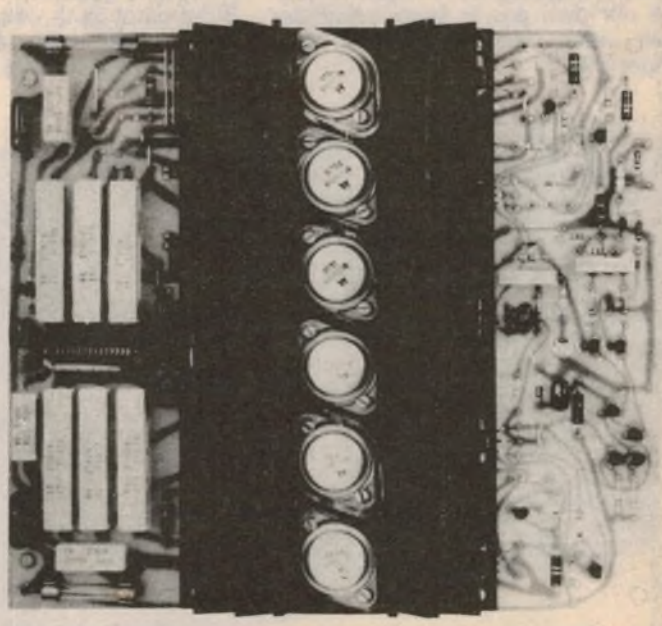

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An interesting approach to energy conservation

Power Saver

Concerned about the Energy Crisis? Interested in how induction motors can be made more efficient? If so, read on and learn about the NASA-developed power-factor controller and our power saver circuit.

by JOHN CLARKE and LEO SIMPSON

Much has been said about the power factor controller developed by Frank J. Nola at NASA's Marshall Space Flight Centre. His technique for reducing the power consumed from an induction motor is reportedly very effective, especially with motors running at low loads for long periods of time.

According to an article in our magazine titled "Energy Conservation and the Electric Motor" April, 1980 the power factor controller is claimed to give 40% to 60% power savings from unloaded one-half hp to 5hp motors. Similarly in "Popular Electronics" October, 1979 p39, an article titled "Motor-Control Circuit Cuts Costs" by Myles H. Marks claimed substantial power savings in one-third hp split-phase and one-quarter to three-quarter hp capacitor start single phase induction motors.

Suitably inspired, we decided to produce our own power factor controller circuit using readily available local components.

It is well known that when an induction motor is fully loaded it is highly efficient. Typical induction motors can achieve efficiencies of 70% or more. But when lightly loaded or running with no load at all, the efficiency is very low.

This stands to reason because if a motor is spinning but doing no useful work all the input power is converted to heat in the form of resistive and friction losses. In other words, the input power is wasted.

To explain how the power saver can actually reduce power consumption, a brief description of induction motor operation is necessary. Basically, induction motors consist of a stator winding, supplying the magnetic field, and the rotor winding which is electrically isolated from the stator and rotates with the shaft.

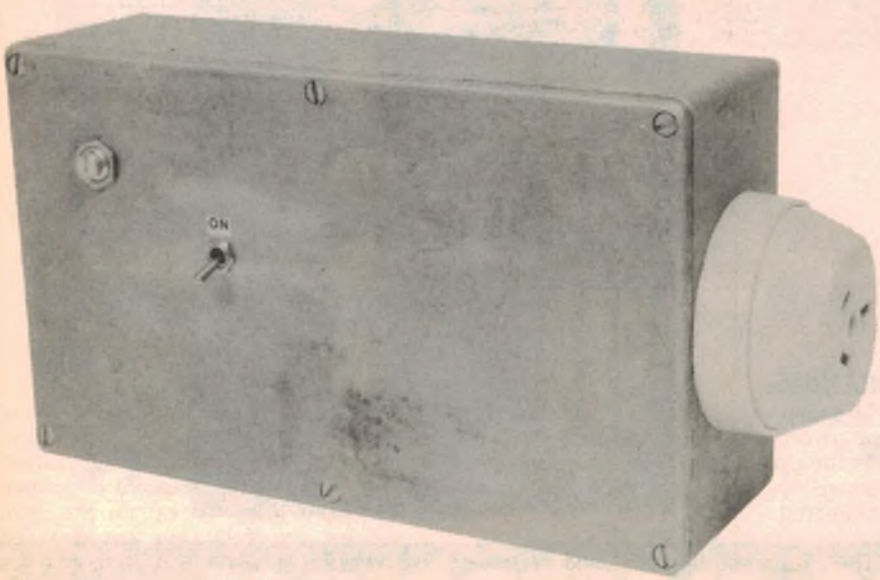
The only possible source of excitation is the stator input which induces current flow in the rotor by induction or transformer action. At no shaft load, the motor speed approaches synchronous speed (the speed of field rotation) and the angle between current and voltage waveforms approaches 90°. Consequently the cosine of this angle, the power factor, approaches zero.

The difference between the synchronous speed and the actual motor speed for an induction motor is referred to as "slip" and this is calculated as a percentage of the synchronous speed. For example, a typical 50Hz single phase motor has a synchronous speed of 1500rpm and a full load speed of 1440rpm. This means that the slip at full load is 4%. At less than full load, the motor slip will be less than 4%. At the same time, the efficiency will be markedly less than the maximum.

The power saver circuit monitors the phase difference between the motor voltage and current. If it senses a large phase difference, which is characteristic of a no-load condition, the circuit reduces the input voltage to the motor. This reduces the motor current and the available torque and so the motor slip increases. As this happens the motor efficiency rises and so the overall power consumption of the motor drops.

As far as the motor performance is concerned, the power saver circuit has negligible effect. As already explained, it does increase slip under lightly loaded conditions, so there is a very small drop in speed, but there is no change in the full-load operation of the motor. In fact, the speed regulation of the motor is slightly better with the power saver in circuit, although this is usually of no consequence.

Refer now to the circuit diagram which should be read in conjunction with the waveforms of Fig. 1. Heart of the circuit is the Triac which controls the average voltage to the load by firing late or early in the load voltage cycle.

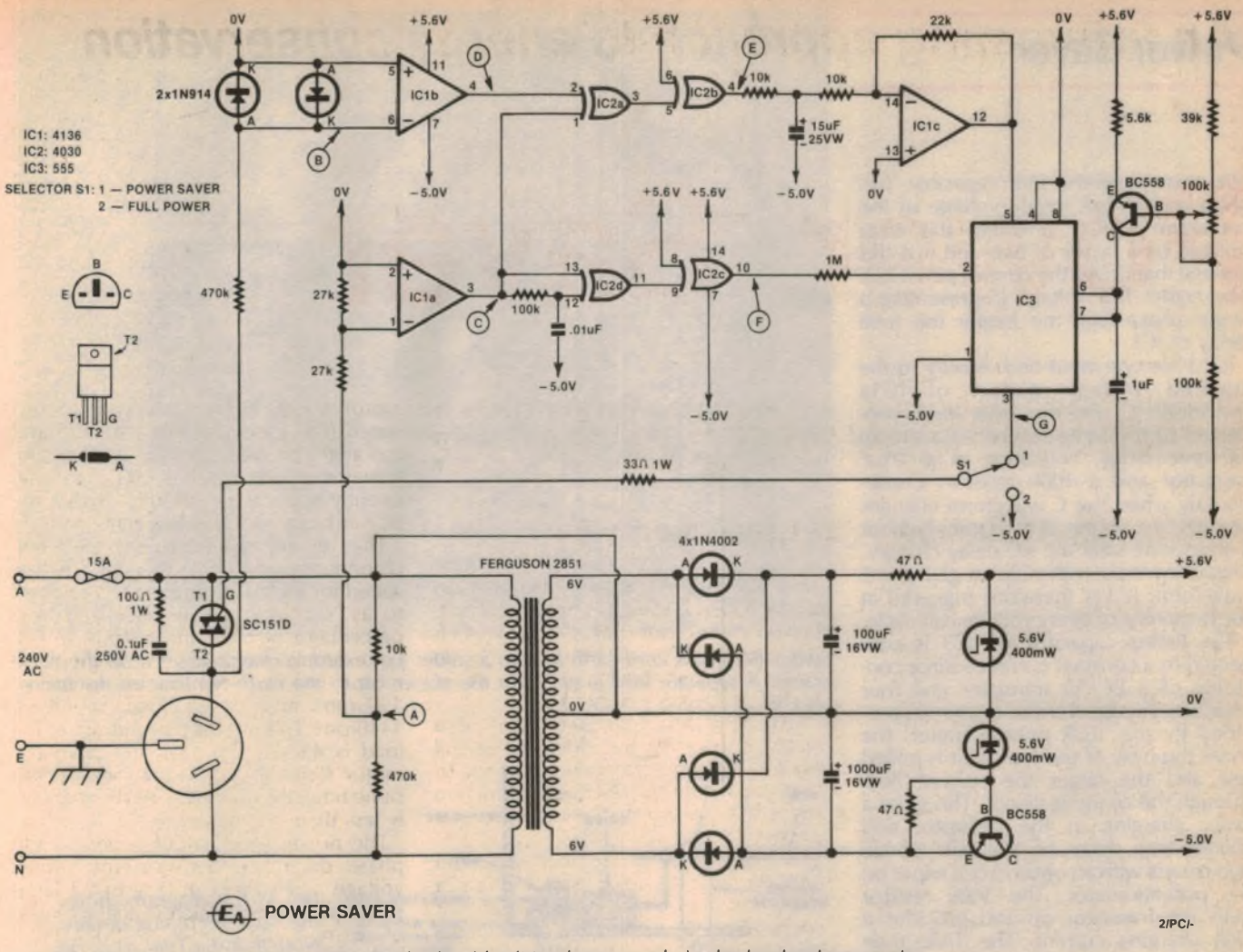


Looks are unimportant; utility is the name of the game.

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

$32

This includes sales tax.

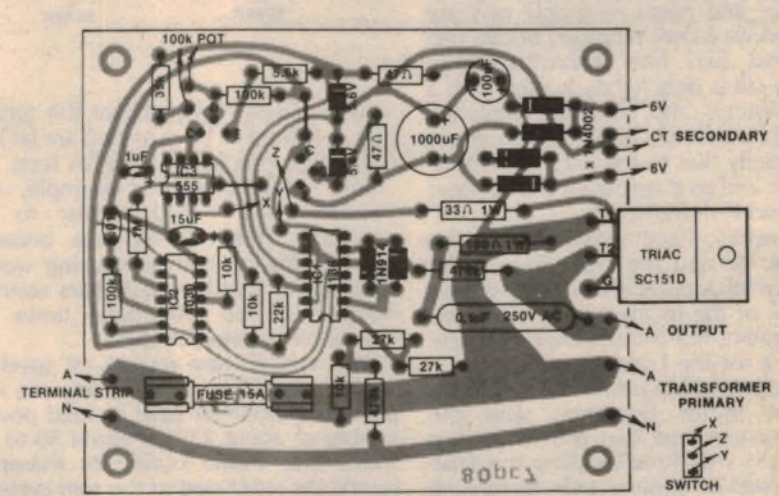


The Triac controls the average voltage to the load by firing late or early in the load voltage cycle.

The 555 timer, IC3, is connected as a monostable and is triggered at the zero voltage crossing point of the input voltage waveform, firing the Triac after a short delay period. The actual time delay between the triggering of IC3 and the firing of the Triac depends upon the error voltage at the control pin of IC3 (pin 5) and the setting of the 100k potentiometer. This error voltage is proportional to the phase difference between the current and voltage waveforms.

IC1a operates as a comparator detecting the voltage waveform (Fig. 1, waveform A) from the voltage divider formed by the 470k and 10k resistors. The output of this comparator is a square wave (waveform C) which changes polarity at the zero voltage crossing point and is in phase with the voltage waveform. This square wave therefore represents the voltage waveform.

Obtaining a square wave current waveform (D) is a little less straightforward. In this case the voltage across the Triac (waveform B) is monitored by IC1b which also acts as a comparator. This method of detecting the current waveform is valid since the Triac turns off at zero current, rather than at end of the voltage cycle.



Note that mains voltages are present on the PC board when the power is on.

The diodes across the non-inverting and inverting inputs of IC1b are to protect the op amp from an excessive input voltage when the Triac is off and a load connected.

The squared voltage and current waveforms are subtracted with IC2a, an exclusive-OR gate. The output of the gate is only high when the inputs are at opposite polarity and low otherwise. The greater the phase lag of the current to the voltage, the longer the positive pulses from IC2a. To obtain the right sense for the following circuitry the waveform is inverted by IC2b to give the waveform at E.

This waveform is integrated with the

10k resistor and the 15uF capacitor. This gives an average steady voltage of the waveform E. IC1c amplifies this error voltage by a factor of two and it is this voltage that drives the control pin of IC3. The higher this voltage (representing a larger phase lag), the longer the time delay of IC3.

IC2d has one input tied directly to the squared voltage output of IC1a (waveform C) and the other input connected to the same source via a simple RC time delay, consisting of a .01uF capacitor and a 100k resistor. Consequently when the C waveform changes polarity, the output of IC2d goes high for a short time until the RC delay charges. This is inverted with IC2c to give the F waveform. IC3 is therefore triggered at the beginning of every voltage half-cycle.

The timing capacitor for IC3 is connected to a constant current source consisting of a BC558 transistor and four resistors. The greater the resistance provided by the 100k potentiometer, the more the base of the transistor is pulled low and the larger the current flow through the charging circuit. This gives a faster charging of the capacitor and shorter time delay. (A "fail safe" condition occurs with an open circuit wiper on the potentiometer. The 100k resistor pulls the transistor on and provides a high charging current. The Triac then fires early in each half-cycle.)

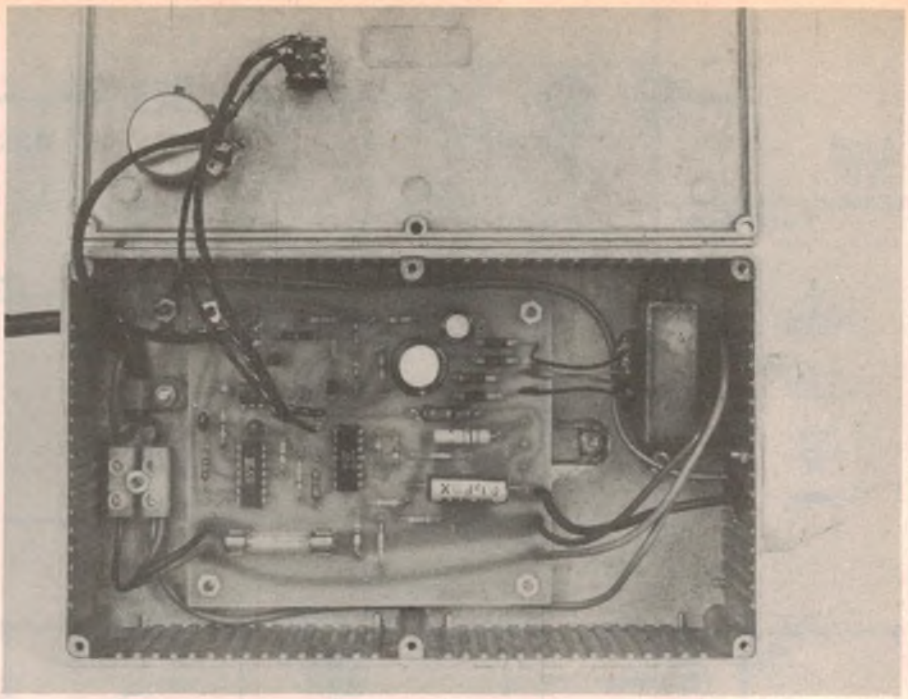
Positive and negative supply rails are provided via a centre-tapped bridge rectifier and two filter capacitors. The positive rail is only lightly loaded with a few milliamps and is zener regulated. The negative supply has a higher current load, chiefly due to the gate current for the Triac and so is regulated with a zener diode and PNP transistor.

IC3, the 555, is connected between the negative rail and the centre-tap of the supply which is also connected to the active side of the mains supply. With this arrangement, IC3 provides negative gate triggering for the Triac.

To enable comparisons to be made between motor operation with the power saver circuit and with full mains voltage, S1 was fitted to allow the Triac to be turned on continuously, by feeding −5V to the gate, via the 33 ohm resistor.

A commutating network consisting of a 100 ohm/1W resistor and 0.1uF/250VAC capacitor, is connected across the Triac to ensure reliable operation. Fuse protection is also incorporated, chiefly to guard against shorts between the circuitry and the case.

Now that we have described the circuit of the device, readers will want to know just what power savings can be expected. Well, unfortunately (or fortunately, depending on your point of view) our test revealed that the typical power savings to be expected are far less than those predicted by NASA tests.



Solder the mains cord earth lead to a solder lug bolted to chassis adjacent to the cord clamp. A separate lead is run from the solder lug to the earth terminal on the mains socket.

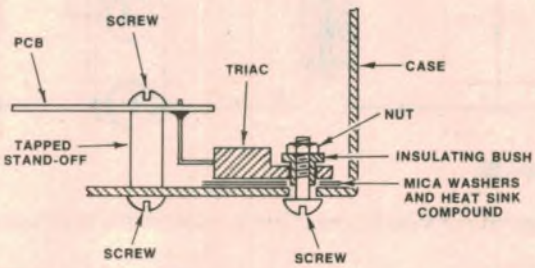


Fig. 2: This diagram shows the Triac mounting details. Note that the Triac must be fully insulated from the case.

With refrigerators, for example, any power saving would appear to be negligible. This is unfortunate, because even a small percentage saving would translate to worthwhile dollars savings, because of the long cycle times for typical refrigerator motors.

With typical ½hp motors as used in washing machines and drill presses, our power saver circuit gave no-load power savings of about 15% or about 50 to 60 watts. This would occur, for example, during the latter part of the spin cycle of a washing machine.

Part of the reason for these low power savings may be simply due to the fact that our domestic power mains run at 240VAC rather than 110VAC as used in the USA. Motors designed for use at 110VAC will have a much higher current drain (more than double) than an equivalent 240VAC motor. This means that resistive power losses will be more than four times as high.

Ultimately the USA could possibly save far more energy by simply converting its domestic power reticulation to 240VAC! We wonder if they have considered it. Anyone feel like writing to President Carter?

Seriously though, we have published this circuit, not because we expect it to pay for itself reasonably quickly in a domestic situation, but because it may have useful application in industrial situations anywhere where induction motors are used for long periods of time at a fraction of their rated load. Some applications which come to mind are metal presses, guillotines and lathes.

We built our power saver in a diecast box measuring 190 x 110 x 60mm. This provides a rugged and electrically safe case for the "live" circuit. All the components are mounted to the PC board coded 80pc7 and measuring 107 x 91mm.

Start construction by planning the layout within the aluminium box. It is easier to mark out the mounting holes for the PC board before the components are soldered into place. Drill the holes for the mains cord grommet, earth lug, cord clamp, terminal strip, Triac, transformer and mains socket. Wire and

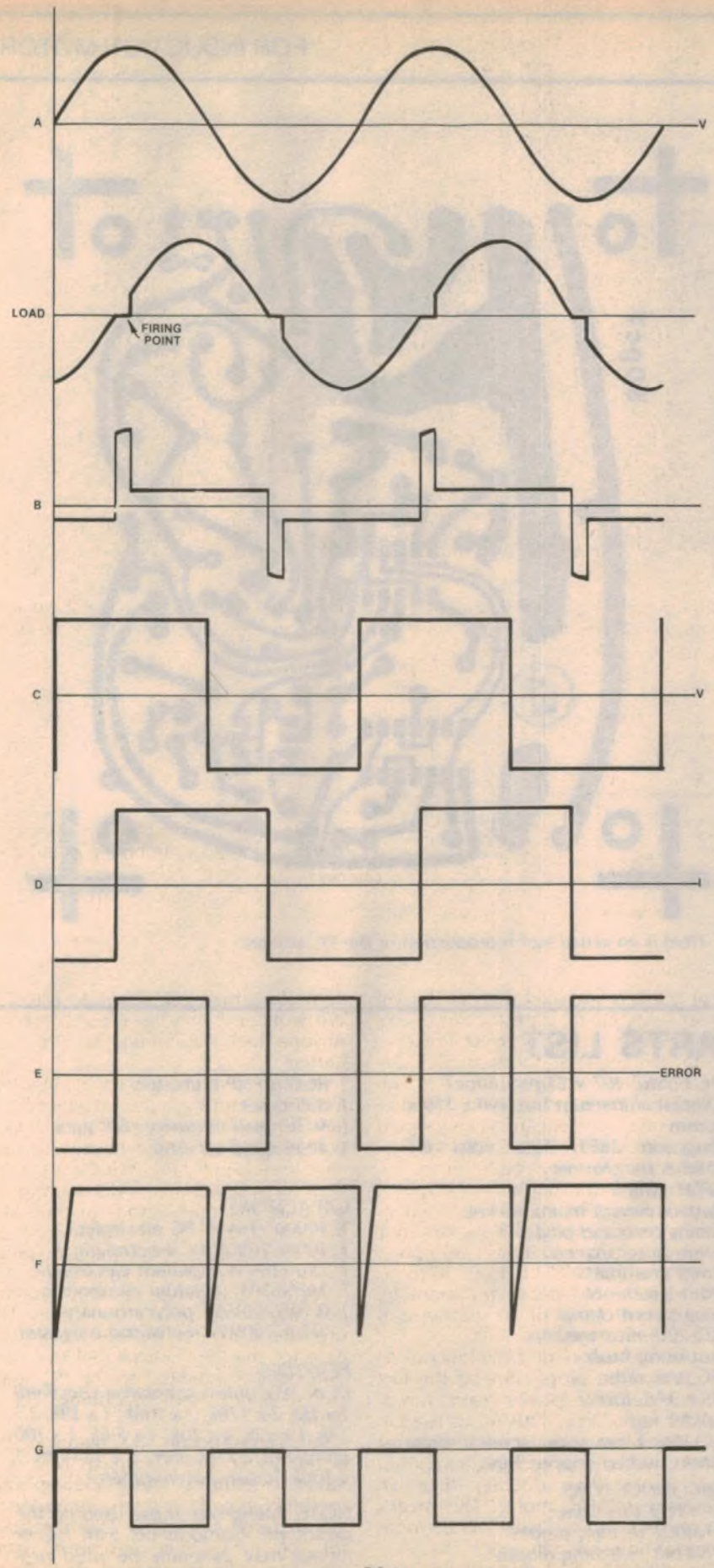


FIG. 1

Fig. 1: see text for an explanation of the various waveforms.

bolt the socket to the case and use grommets for the leads passing through the case. The mains cord, terminal strip, earth lug and transformer can also be wired at this stage and bolted into position ready for the PCB.

Place the resistors and links into position first on the PCB and solder them into place. At this stage you should decide whether the switch is necessary for your purposes, and if not place a link between "X" and "Z" on the PCB. This will permanently connect pin 3 of IC3 to the 33 ohm resistor and the power saver will always be in operation.

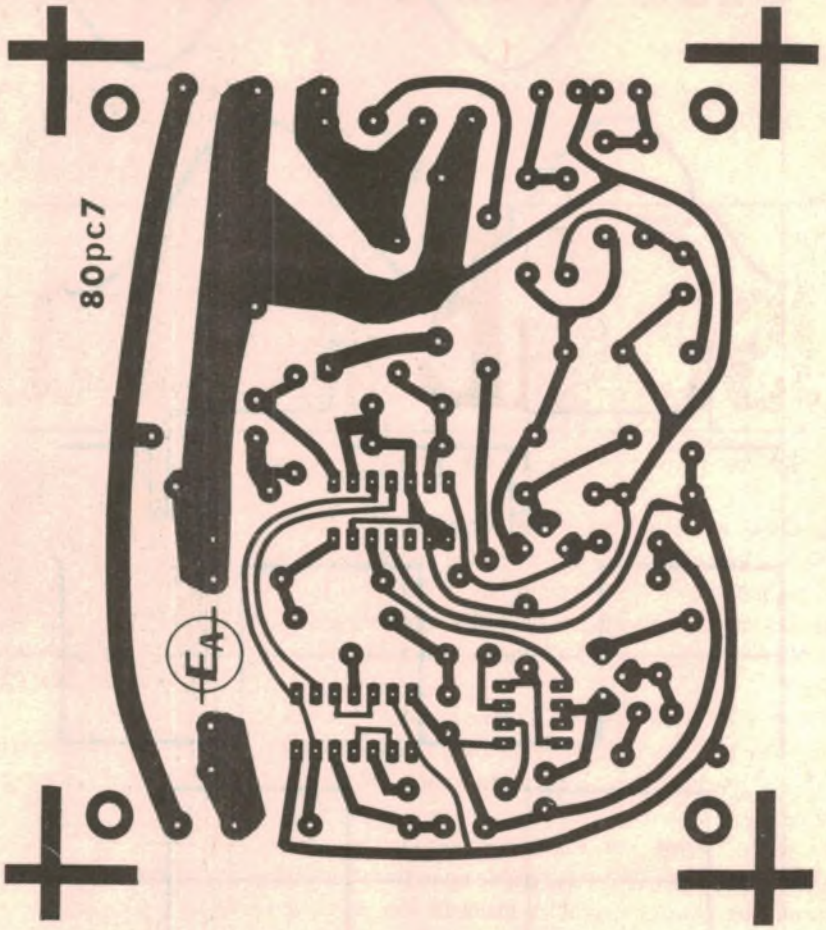
The capacitors, diodes, transistors and fuse clips can be now soldered into place, taking care with the polarity orientation. Next the ICs can be soldered. Start with IC1 and IC3, which can be soldered without special precautions other than to avoid overheating the pins while soldering. IC2 is a CMOS device and requires special precautions while soldering. Firstly the power supply pins, 7 and 14, should be soldered with the barrel of the soldering iron connected to the negative rail. Then solder the other pins.

Finally the Triac is soldered into place and the leads bent such that the metal heatsink tab is parallel to the base of the case. The PCB can now be positioned in place within the box and the mains wires connected as well as the transformer secondary leads. PC stakes are recommended for the potentiometer and switch connections. Bolt the PCB down to the box using standoff spacers on the four mounting holes.

The Triac is now ready to be bolted into place. A spacer and two mica washers are necessary to provide electrical insulation between the heatsink tab of the Triac and the case (refer to Fig. 2). Insulation is a very important factor for safety and operation of the circuit and it is necessary to check the insulation with a meter. Since the case acts as a heatsink for the Triac, it is recommended that heatsink compound be used between the surfaces of the Triac, the mica washer and case.

Connect the switch and potentiometer to the circuit and bolt them to the lid of the box, making sure that they are in a position where they will not foul the components on the PCB. Place the 15A fuse in position and screw on the lid after a final check of all the wiring.

The power saver is now ready to be tested. The power saver connects in series with the appliance power cord. With the motor running, adjust the potentiometer until the motor just audibly begins to reduce in speed. The setting, incidentally, will need to be adjusted for different motors.



Here is an actual size reproduction of the PC artwork.

PARTS LIST

1 PC board, 107 x 91mm, 80pc7
1 Diecast aluminium box 190 x 110 x 60mm
1 Ferguson 2851, 12.6 volts CT 150mA transformer
1 SPDT switch
1 surface mount mains socket
1 mains cord and plug
4 6mm brass spacers
3 3mm grommets
1 9mm grommet
1 mains cord clamp
2 TO-220 mica washers
1 insulating bush
2 PC fuse clips
1 15A 3AG fuse
1 solder lug
PLUS: hook up wire, screws, nuts, washers, tinned copper wire.

SEMICONDUCTORS
1 SC151D 15A Triac
4 1N4002 rectifier diodes
2 1N4148 switching diodes
2 5.6V 400mW zener diodes
2 BC558 PNP transistors
1 555 timer
1 4030 quad exclusive–OR gate
1 4136 quad op amp

CAPACITORS
1 1000uF/16VW PC electrolytic
1 100uF/16VW PC electrolytic
1 15uF/16VW tantalum electrolytic
1 1uF/16VW tantalum electrolytic
1 0.1uF/250VAC polycarbonate
1 .01uF/100VW metallised polyester

RESISTORS
(¼ or ½W unless otherwise specified)
1 x 1M, 2 x 470k, 2 x 100k, 1 x 39k, 2 x 27k, 1 x 22k, 4 x 10k, 1 x 5.6k, 1 x 100 ohms/1W, 2 x 47 ohm, 1 x 33 ohm, 1 x 100k (linear) potentiometer.

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible.

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This circuit makes EPROM programming & duplication easy

EPROM Programmer for the Exidy Sorcerer

Following on from last month's article on the Eprom Programmer, we present the interfacing and software details for use with the Exidy Sorcerer computer. To do this, we built a second version which matches the appearance of the Sorcerer remarkably well.

by GERALD COHN

No magic was used to match the Eprom Programmer to the Exidy Sorcerer! All that we did was to use one of the range of Pac-Tec cases distributed by Associated Controls. The case is type number CH325, in tan colouring. Although somewhat dearer than the Horwood case used in last month's version, at around the $30 mark, we think the extra expense is worth it.

Construction of this unit is essentially the same as that described last month. The front panel artwork for this second version was changed slightly to omit the hole markers for the handles of the Horwood case; and was also been made larger since the Pac-Tec case is slightly higher.

To avoid having hardware mounting screws protruding underneath the case, we did the following: We mounted the transformer, the terminal block and the PCB on a piece of perspex measuring 170 x 195mm; this then being mounted into the base of the Pac-Tec case using six small self-taping screws. The PCB mounting is the same as for the first version in that the small board is mounted onto the front panel using four screws. The main PCB is mounted on two 12mm tapped spacers which are located at the rear end of the board. The front end of the board is supported by the solder joints to the socket board.

Note that the transformer core must be earthed if this method of construction is used. Alternatively, an aluminium sheet can be used instead of perspex, in which case it should be earthed via the mains cord.

You may notice from the photograph that we have used a 37-pin connector on the rear of the unit, but this was only because it happened to be handy. A 25-pin connector will suffice. As mentioned in last month's article, there are some additional signals that have to be considered when interfacing the unit to a Sorcerer computer. These are the IOREQ, DBUSEN, DBUSDIR. The IOREQ line distinguishes an I/O operation from a memory read or write operation. The DBUSEN is the enable line for the external data bus.

Under normal operating conditions, with nothing connected to the expansion bus, the external data bus is set to high impedance. By pulling the DBUSEN line low we enable the data bus to communicate with programmer. The DBUSDIR line controls the direction of the data bus, and is taken low for a Read operation and high for a Write operation. The WR and RD lines correspond to

This dressy version of our new Eprom programmer matches the Exidy Sorcerer.

the IN and OUT lines of the Tandy TRS-80.

So much for the construction of the second version of the programmer. Let us now take a look at the Sorcerer driver software. The software consists of five routines, each of which can be called up at any time, either individually, or by further addition to the program. These routines are called by entering "GOSUB $", where $ represents the number of the routine being called. For example, if you wanted to call routine one then you would enter GOSUB 1 followed by a carriage return.

Routine one checks to see that the EPROM is erased. It does this by reading each address and comparing the contents against FF hex. If any of the data bytes do not equal FF hex then an error message is printed, informing you that the EPROM is not erased.

Routine two reads the data stored in the EPROM into a memory buffer located at 4000. When all the data has been loaded, the message "BYE FROM BASIC TO REVIEW" appears. This means that to review the data, you type "BYE" to exit BASIC and fall under control of the monitor. To see what data is contained in the EPROM, simply enter "DU 4000 40FF". The first 256 bytes will now appear on the screen for review. To see the next 256 bytes change the addresses in the DU command to 4100 and 41FF. I suggest this method since 256 bytes of hex is enough to fill the screen. You can, of course, review the whole 1K block at once by entering the appropriate start and end addresses.

To enter data into memory for subsequent burning into a EPROM use the Sorcerer's "EN" command followed by the starting address of the locations to be programmed. Keep in mind that the data to be burned into the EPROM must reside in the buffer starting from 4000 hex. Since the software here is for burning 2708s, the buffer will start at 4000 and end at 43FF.

Routine three fills the buffer with FF hex so that when you have only a short program to burn into the EPROM, the unused locations will remain at FF (erased). This allows the unused locations in the EPROM to be programmed at a later date, a very useful feature.

Routine four compares the data in the EPROM to that in the buffer, and if there are any inconsistencies, these are reported by a message on the screen.

Routine five is used to burn the data held in the memory buffer into the EPROM. You will note that it also makes use of routines one and four. When called, this routine starts by calling up routine one to check that the EPROM to be programmed is in fact erased. Having checked the EPROM it then calls up a machine language routine which burns the data into the EPROM. The decimal equivalent of the routine appears in the DATA lines at the end of the listing. We

(Continued on page 75)

Here is the listing for the SORCERER

```
0 PRINT CHR$(12):GOTO 15
1 GOTO 26
2 GOTO 32
3 GOTO 38
4 GOTO 41
5 GOTO 48
6 REM ************************************************
7 REM
8 REM SOFTWARE DRIVER FOR E.A. EPROM PROGRAMMER FOR
9 REM USE WITH THE EXIDY SORCERER COMPUTER.
10 REM
11 REM WRITTEN BY   GERALD COHN    -    22/05/1980
12 REM
13 REM ************************************************
15 PRINT"THE FOLLOWING ROUTINES ARE CALLED BY ENTERING"
16 PRINT"'GOSUB' AND THE CORRESPONDING ROUTINE NUMBER:"
17 PRINT
18 PRINT"     1. CHECK TO SEE IF EPROM IS ERASED":PRINT
19 PRINT"     2. LOAD DATA IN EPROM INTO MEMORY BUFFER."
20 PRINT"        BUFFER STARTS FROM 4000 HEX":PRINT
21 PRINT"     3. LOAD MEMORY BUFFER WITH FF HEX":PRINT
22 PRINT"     4. CHECK CONTENTS OF EPROM AGAINST BUFFER":PRINT
23 PRINT"     5. BURN CONTENTS OF BUFFER INTO EPROM."
24 PRINT"        THIS ROUTINE MAKES USE OF ROUTINES 1 AND 4"
25 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:END
26 PRINT CHR$(12)
27 PRINT:PRINT:PRINT:PRINT:PRINT"     CHECKING ......."
28 FOR X=0 TO 1023
29 Z=INP(1)
30 Z=INP(0):IF Z<>255 THEN PRINT"EPROM NOT ERASED":PRINT:END
31 Z=INP(2):NEXT X:RETURN
32 PRINT CHR$(12)
33 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT"      LOADING ........."
34 PRINT:PRINT:PRINT:PRINT"     BYE FROM BASIC TO REVIEW"
35 Z=INP(1)
36 FOR X=16384 TO 17407
37 Z=INP(0):POKE X,Z:Z=INP(2):NEXT X:RETURN
38 PRINT CHR$(12)
39 PRINT:PRINT:PRINT:PRINT:PRINT"     FILLING ........."
40 FOR X=16384 TO 17407:POKE X,255:NEXT X:RETURN
41 PRINT CHR$(12)
42 PRINT:PRINT:PRINT     "CHECKING DATA INTEGRITY ........"
43 Z=INP(1)
44 FOR X=16384 TO 17407
45 A=INP(0):B=PEEK(X)
46 IF A<>B THEN PRINT"DATA ERROR - BYTE # ";X-16384
47 Z=INP(2):NEXT X:RETURN
48 PRINT CHR$(12)
56 PRINT CHR$(12):PRINT:PRINT:PRINT:PRINT
57 INPUT"SWITCH TO READ MODE AND PRESS RETURN KEY";A
58 GOSUB 26
59 PRINT CHR$(12)
60 INPUT"SWITCH TO PROGRAM MODE AND PRESS THE RETURN KEY";A
61 RESTORE:PRINT CHR$(12)
62 FOR X=0 TO 48:READ D:POKE X,D:NEXT X
63 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
64 PRINT"PROGRAMMING IN PROGRESS - KEYBOARD IS LOCKED OUT"
65 POKE 260,0:POKE 261,0:S=USR(S)
66 PRINT CHR$(12)
67 INPUT"SWITCH TO READ MODE AND PRESS THE RETURN KEY";A
68 GOSUB 41
69 PRINT CHR$(12)
70 PRINT"PROGRAMMING COMPLETE - DATA CHECKED AND VALIDATED"
71 PRINT:PRINT:PRINT:PRINT:PRINT
72 PRINT"SWITCH OFF PROGRAMMER AND REMOVE EPROM":PRINT:PRINT
73 DATA 6,255,33,0,64,219,1,124,254,68,202,25,0,126,211,0
74 DATA 205,33,0,35,219,2,195,7,0,120,254,0,200,5,195,2
75 DATA 0,211,2,62,0,254,30,202,46,0,60,195,37,0,211,1,201
READY
```

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DICK SMITH

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1	CPU type	Z-80	Z-80	Z-80
2	Speed	1.7MHz	1.7MHz	1.7MHz
3	Amount of RAM	16K	16K	16K
4	Built-in cassette recorder	Yes	No	No
5	Built-in video modulator	Yes	No	No
6	Capacity of BASIC ROM	12K	4K	12K
7	Type of BASIC supplied	Microsoft 12K Floating point	Floating point	Microsoft 12K Floating point
8	RAM expansion on-board to:	16K	16K	16K
9	Machine language programs accessible from executing BASIC programs	Yes	No	Yes
10	Full ASCII characters	Upper case only	Upper case only	Upper case only
11	Programmable graphics characters	No	No	No
12	Graphics resolution (dots)	8192	8192	8192
13	Mixed graphics/text – any format	Yes	Yes	Yes
14	Text format	16 lines x 64 or 32	16 lines x 64	16 lines x 64 or 32
15	Number of cassette interfaces	2	1	1
16	Baud rate	500	250	500
17	Time to load 8k program	2 min 30 sec	4 min 50 sec	2 min 30 sec
18	Cassette file names	Yes	No	Yes
19	Number of cassette recorders	2	1	1
20	Motor control for cassette recorders	Yes (2)	Yes (1)	Yes (1)
21	Number of string variables	930	2	930
22	Maximum length of string variables	255	16	255
23	S-100 compatible (with expansion unit)	Yes	No	No
24	Supports disc drive system	Yes	Yes	Yes
25	**Cost of basic unit with 16K RAM including monitor and cassette recorder.**	**$844.50***	**$989.00**	**$1169.00**

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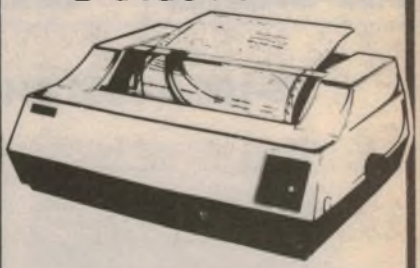

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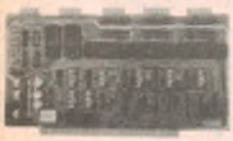

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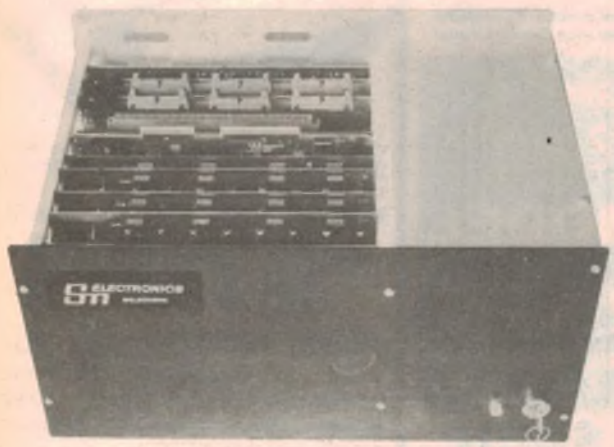

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Technical specifications are as follows:

4 Mhz Z80 CPU, 64K Dynamic memory with bank select to allow up to 8 pages of 64K each, and up to 256K of RAM on a single board, RS232 serial port and 8 bit parallel ports. Up to 16K EPROM which can be switched out after power up to allow a full 64K of user RAM per bank. Dual 8" SHUGART SABOIR drives running at single or double density. Density selection is automatically chosen by the use of double or single density formatted disks. External Mini drives can also be interfaced to the controller. The DOS supplied is compatible with standard CP/M and CDOS to allow a wide selection of software to be used, such as MBASIC, CBASIC, COBOL, ALGOL, PASCAL, FORTRAN, ASSEMBLY LANGUAGE, WORD PROCESSING, MULTIUSER, MULTITASKING, AND ACCOUNTING PACKAGES. All of which can be supplied from SME Systems

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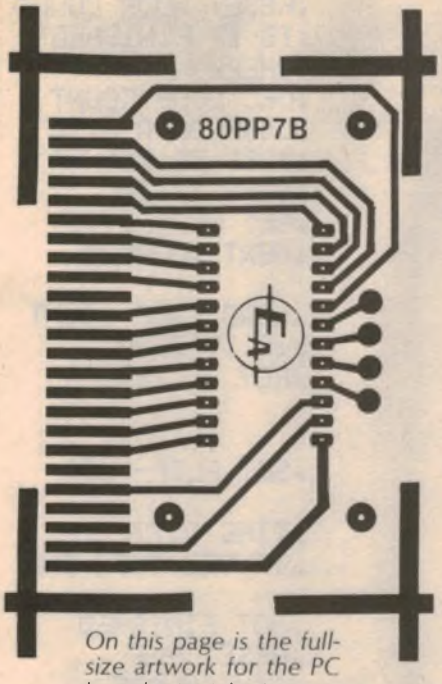
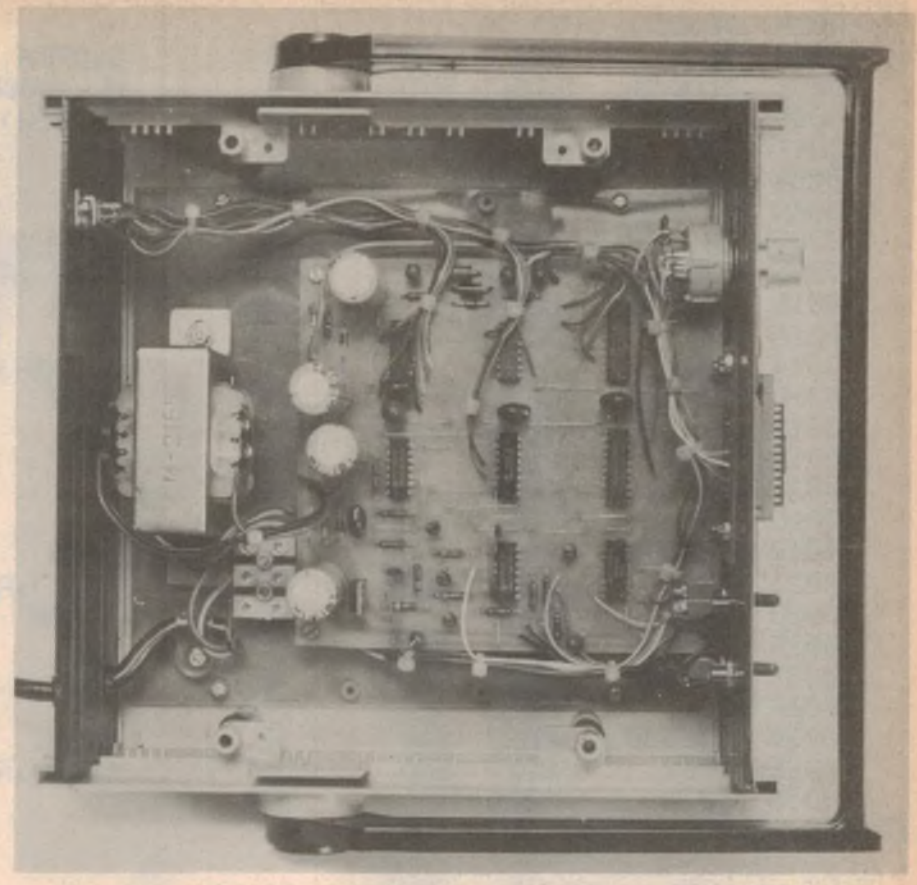
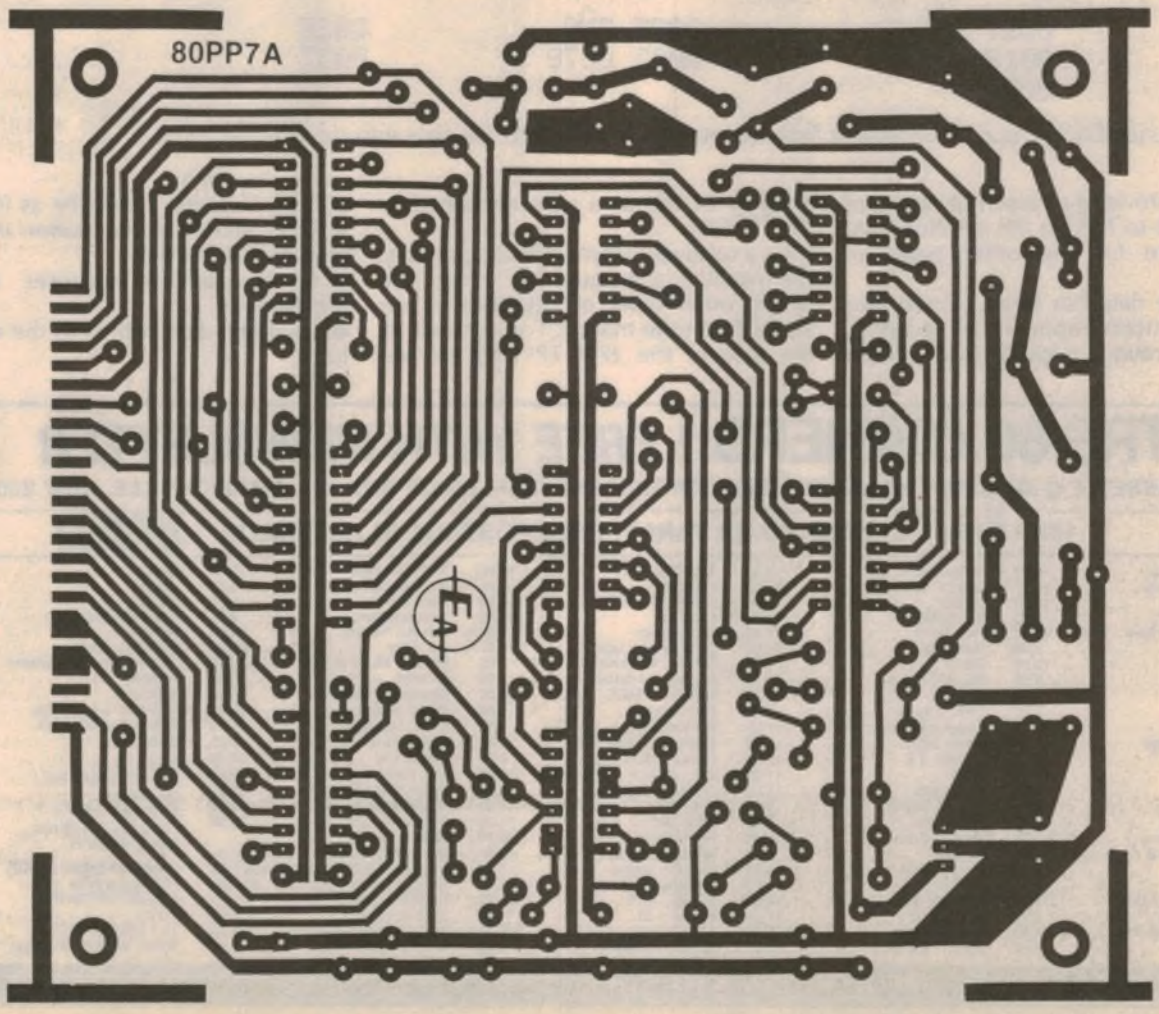


On this page is the full-size artwork for the PC boards. At right, is an inside view of the completed programmer.





```
 ADDR  OBJECT    ST #
'0000  06FF      0001  START   LD      B,0FFH      ;SET LOOP COUNT
'0002  210040    0002  OUTA    LD      HL,4000H    ;START OF BUFFER
'0005  DB01      0003          IN      A,(01H)     ;RESET ADDR COUNT
'0007  7C        0004  OUTB    LD      A,H         ;IS IT FINISHED
'0008  FE44      0005          CP      44H         ;CHECK!
'000A  CA1900    0006          JZ      LOOP        ;DEC LOOP COUNT
'000D  7E        0007          LD      A,(HL)      ;LOAD DATA BYTE
'000E  D300      0008          OUT     (00H),A     ;PASS TO BURNER
'0010  CD2100    0009          CALL    BURN        ;BURN IT IN
'0013  23        0010          INC     HL          ;GET NEXT BYTE
'0014  DB02      0011          IN      A,(02H)     ;NEXT ADDRESS
'0016  C30700    0012          JP      OUTB
'0019  78        0013  LOOP    LD      A,B         ;LOAD LOOP COUNT
'001A  FE00      0014          CP      00H         ;IS IT ZERO?
'001C  C8        0015          RET                 ;RET IF ZERO
'001D  05        0016          DEC     B
'001E  C30200    0017          JP      OUTA
'0021  D302      0018  BURN    OUT     (02H),A     ;SET FLIP-FLOP
'0023  3E00      0019          LD      A,00H
'0025  FE1E      0020  BURN1   CP      1EH         ;TIME OUT?
'0027  CA2E00    0021          JZ      END         ;IF YES THEN END
'002A  3C        0022          INC     A
'002B  C32500    0023          JP      BURN1       ;NOT FINISHED
'002E  D301      0024  END     OUT     (01H),A     ;RESET F/F
'0030  C9        0025          RET                 ;FINISH OFF
ERRORS=0000

BURN        0021 BURN1       0025 END         002E
LOOP        0019 OUTA        0002 OUTB        0007
START       0000
```

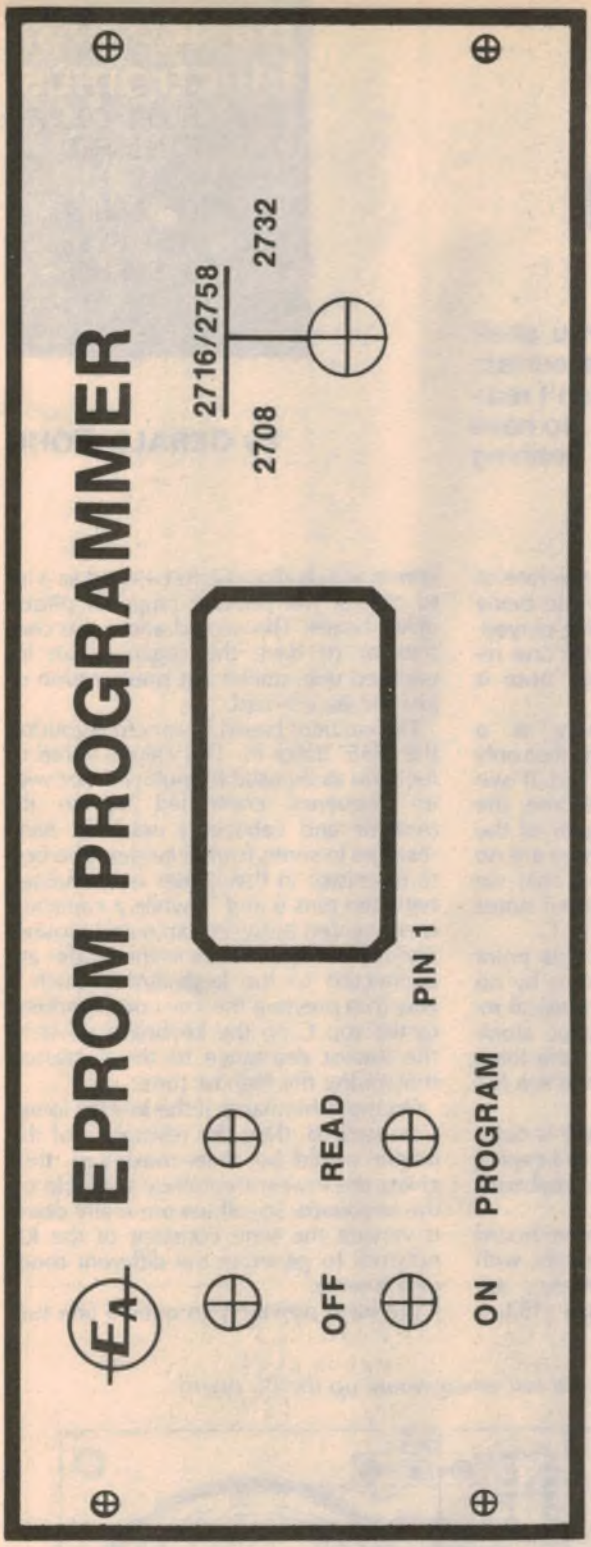
This is an assembly listing of the machine language routine which burns the data into the EPROM.

have also provided an assembly listing of this routine to help in the development of software for the other types of PROMS.

Once the data has been burned into the EPROM (after approx 120 seconds), the fourth routine is called to check the integrity of the data now contained in the EPROM.

It is a relatively simple matter to modify the machine language driver to suit any of the other types of PROMS that are available on the market. For instance, in the case of the 2716 EPROM, the sequence of events would be as follows:

- Load start of data buffer into any register pair (eg HL)
- Reset address counter in the programmer
- Load first data byte in to the eight bit latch



As it stands, this artwork suits the Horwood case featured last month.

- Burn in for 50ms
- Increment byte counter and test for last byte
- Return to main controlling program.

The major difference between the 2716 and the 2708 is the fact that we do not have to go through 256 programming cycles as is the case with the 2708. The other differences are that the programming is achieved with a 5 volt logic signal on the program input instead of 26 volts as in the case of the 2708. The other thing is the timing of the burn cycle: 0.5ms for the 2708 as opposed to 50ms in the case of the 2716 (and 2758).

(Continued on page 141)

The incredible EA Mini-Organ

Basic Electronics

"With rings on your fingers and bells on your toes, you shall have music wherever you go." Such was said about a certain fine lady on a white horse at Banbury Cross. Well, you don't really need bells on your fingers and rings on your . . . . er . . . to have music; you can use our Mini-Organ instead and it has flashing lights as well.

by GERALD COHN

From time to time we hear of certain product lines appearing on the surplus market. Often these can be used as the basis of a small project, which is the case here. The product in question is a keyboard of the type used in push-button tuners for TV receivers, selling for around $1.50.

The keyboard was sent to us by Ace Radio in Sydney with a short note asking us to find an application for it in one of our projects. Well to be quite honest, we were at a loss when it came to finding a use for it until one of the staff members came up with the idea of a miniorgan. OK, this took care of the buttons on the board, but what to do with the LEDs?

Finally we decided to use the LEDs as a chaser around the keyboard, the rate of which is determined by the note being played. When no note is being played, the LEDs stop chasing and only one remains lit. As soon as another note is played, away they go again.

The design presented here is a monophonic organ. This means that only one note at a time can be played. If two keys are pressed at the same time, the key corresponding to the higher of the two notes will be effective. There are no semitones; with the eight keys that we have, we can play all the natural notes over a single octave, from C to C.

We had better mention at this point that the organ presented here is by no means intended as a serious musical instrument. The keyboard layout alone makes it impossible to regard the thing too seriously, but all the same, it is a fun project.

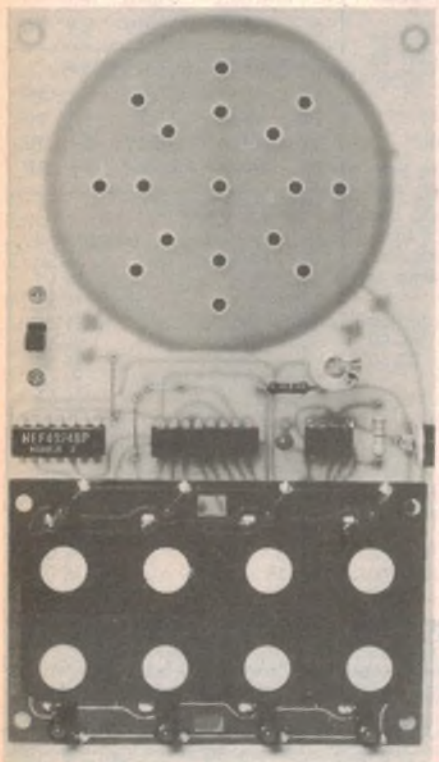
The cost of the whole project is quite low at around $10, this being in keeping with the low price of the keyboard ($1.50).

We designed a printed circuit board onto which all of the components, with the exception of the battery, are mounted. The PCB measures 153 x 90mm which allows it to be used as a lid to one of the popular range of plastic utility boxes. This would allow the constructor to have the organ as an integrated unit, unlike our presentation of just the bare board.

The circuit is based on an old favourite, the "555" timer IC. This chip is wired to function as an astable multivibrator with its frequency controlled by an RC (resistor and capacitor) network. Nine resistors in series form a ladder. The bottom resistor in the ladder is connected between pins 6 and 7, while a capacitor is connected between pin 6 and ground. The remaining resistors in the ladder are connected to the keyboard in such a way that pressing the key corresponding to the top C on the keyboard presents the lowest resistance to the oscillator, thus giving the highest tone.

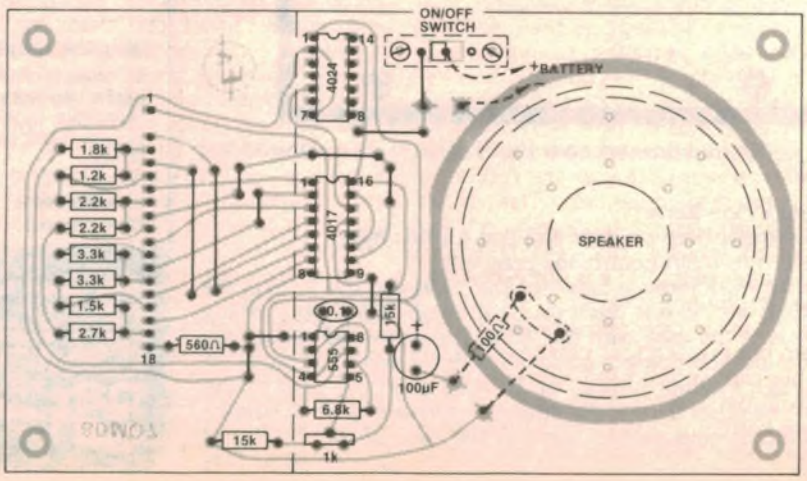
On the other hand, if the key for lower C is pressed, then the resistance of the ladder would be at its maximum, thus giving the lowest frequency available on the keyboard. So, all we are really doing is varying the time constant of the RC network to generate the different tones of the scale.

We have provided an overall fine tun-



View of the completed Mini-Organ. A single PC board holds all the components.

Leave the keyboard assembly till last when wiring up the PC board.



ing adjustment via pin 5 of the 555. The range of this fine tune control is small, sufficient to shift all notes by almost a semi-tone. The tuning is accomplished by shifting the thresholds of the comparators and thereby changing the frequency range.

The output from the 555 (pin 3) is fed to a miniature 8 ohm speaker via a 100uF capacitor and 100 ohm series resistor. Apart from being fed to the speaker, the oscillator output is also fed to the clock input of a CMOS 4024 counter IC. This chip performs the function of prescaling (dividing down) the output tone frequency before it is fed to the input of a 4017 counter that has 10 decoded outputs. The first eight outputs from the 4017 are connected to the anodes of the LEDs in the keyboard assembly, and the ninth output is fed back to the reset input so that the counter is reset after cycling through all eight LEDs, after which the cycle repeats.

PARTS LIST

1 keyboard (see text)
1 PC board, code 80mo7, 153 x 90mm
1 single-pole, double-throw miniature slide switch
1 65mm speaker

SEMICONDUCTORS
1 555 timer
1 4024 counter
1 4017 counter

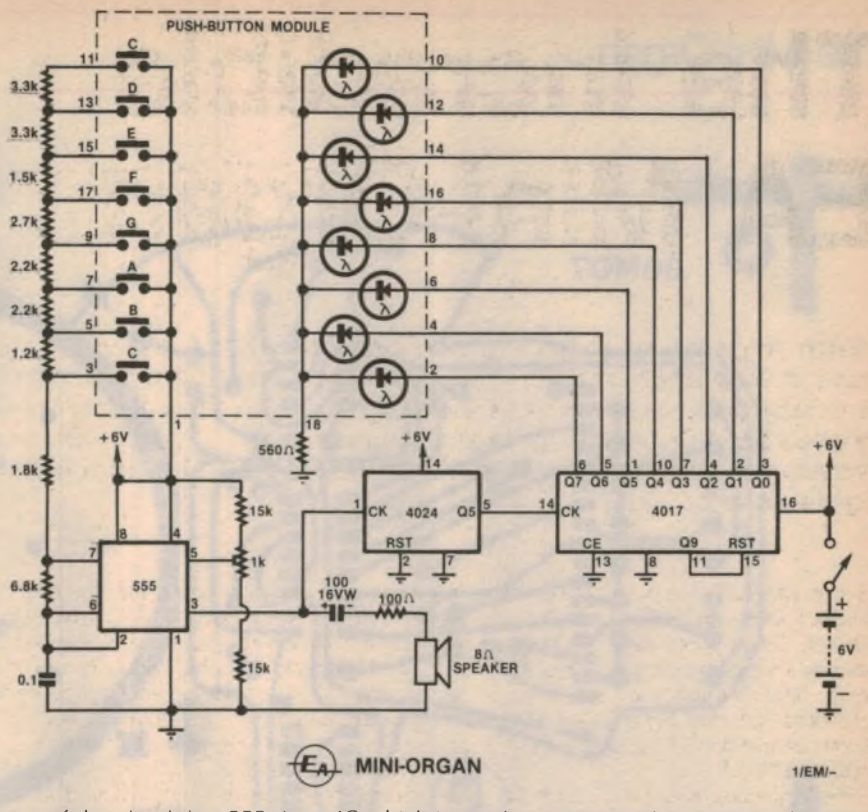
RESISTORS (¼ or ½ watt, 5%)
2 × 15k, 1 × 6.8k, 2 × 3.3k, 1 × 2.7k, 2 × 2.2k, 1 × 1.8k, 1 × 1.5k, 1 × 1.2k, 1 × 560 ohms, 1 × 100 ohms.
1 × 1k miniature trimpot.

CAPACITORS
1 × 100uF 16VW electrolytic
1 × 0.1uF metallised polyester (greencap)

MISCELLANEOUS
Hookup wire, solder, screws, nuts etc.

The cathodes of the eight LEDs are all connected together via a common 560 ohm current limiting resistor. At this point we have a problem on our hands; all the LEDs on the keyboard assembly have their anodes connected together. What we have to do now is to carefully remove them from the board and turn them all around so that all the cathodes are connected together. This is a relatively simple task but care is still required to ensure that the junction temperature of the LEDs is not exceeded in the desoldering process.

The organ is powered from a 6 volt lantern battery, but four penlite cells in a suitable clip can be used although their life will be shorter than that of the lantern battery. The current drain is quite low at about 5mA when the unit is just switched on without a note being played, and 16mA when top C on the octave is played.



Heart of the circuit is a 555 timer IC which is used to generate the 8 notes. The 4024 and 4017 counter ICs drive the flashing LED display.

Construction of the unit is a simple task that should take no more than an hour or so. The first step of course is to remove the eight LEDs from the keyboard and replace them so that they are configured for common cathode operation. This done, the next step is to assemble the main PCB.

Start by placing all the links on the board and soldering them into place. Next solder all the resistors into place, followed up by the capacitors. Having gone this far, we now turn our attention to the mounting of the slide switch and the loudspeaker. The slide switch is mounted directly on the PCB as can be seen from the photographs. The type of switch that we used here was a single-pole, double-throw type made by C&K Electronics. I mention this because other types of switches may have different mounting centres which will require you to adjust the mounting holes to suit.

The speaker can be mounted to the board in a number of ways. The way we chose to mount it was to solder it directly to the copper ring pattern provided on the board.

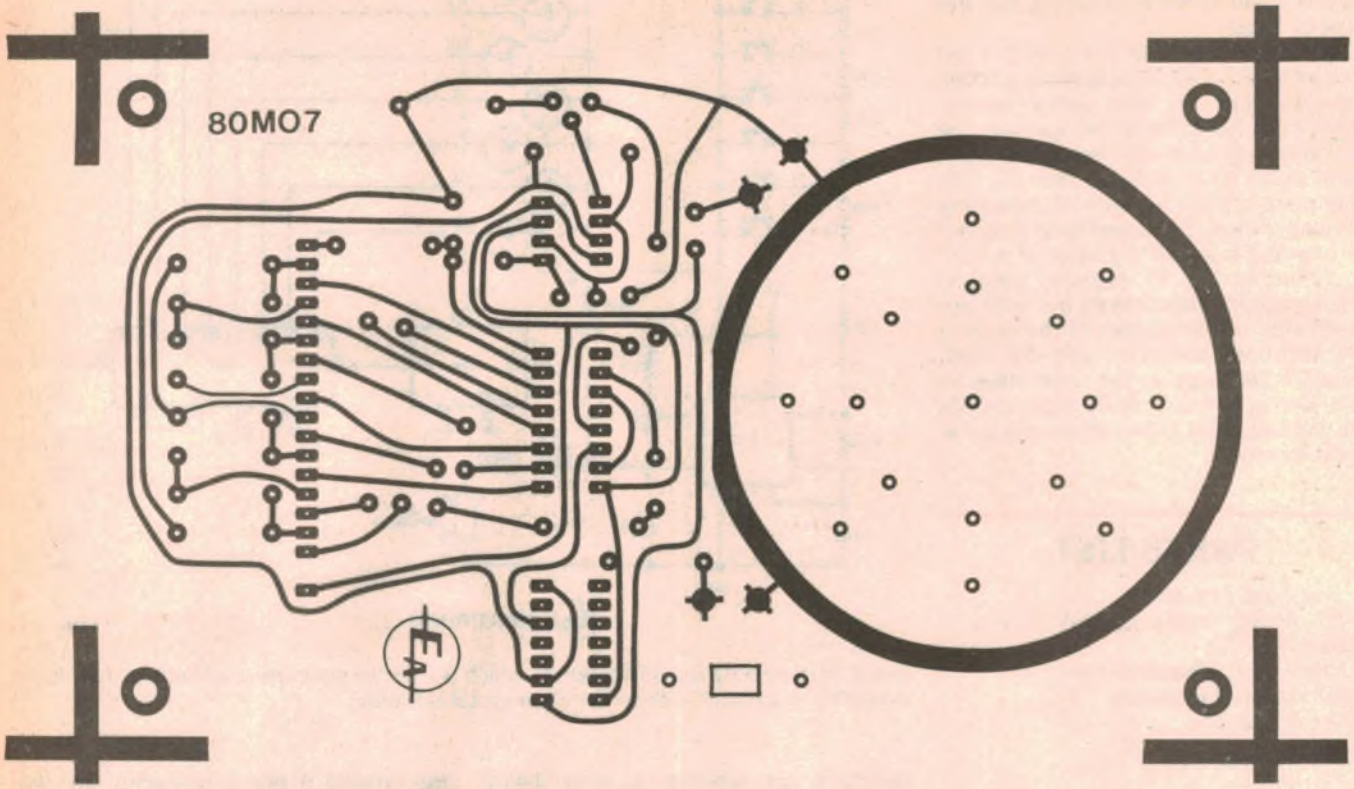
The wiring to the speaker terminals can be done at this point. A short jumper wire, approximately 3cm in length will be required to connect the one terminal of the speaker to the pad provided. The other terminal is connected to the other pad via a 100 ohm resistor. The value of this resistor can be increased to lower the volume if this is desirable, but we recommend that you do not decrease the value to below 100 ohms to protect the output stage of the 555 IC from being overloaded – and to keep the overall current drain within reasonable bounds.

The ICs can now be soldered to the board, but keep in mind that two of these are CMOS and the usual precautions should be taken to protect these from static discharges.

The last item to be soldered to the main board is the keyboard assembly. Locate the pins of the keyboard into the main PCB and then align these so that only about 2mm protrudes through the other side. Now solder the two outer terminals and check that the alignment is correct. Then solder the remaining pins.

All that remains now is to wire the switch and battery to the PCB. Before you apply power to the unit, go back over it and check that the resistors are all in their proper places, that the ICs are properly oriented and that the 100uF output capacitor is correctly polarised. When you have satisfied yourself that all these points are in order, apply power to the board. The first thing you should notice is that one of the LEDs is on. If this is OK, then press one of the keys. A tone should be heard and the LEDs should rotate in an anticlockwise direction for as long as the key is held down.

If you start pressing the keys, starting with the leftmost one in the bottom row and then progressively work along, you should hear the notes of the octave. You should also notice that the rate of rota-



Here is an actual size reproduction of the PC artwork.

tion of the LEDs changes with each different note played. The higher the note, the faster the rate of rotation, and vice-versa.

Tuning can be done by comparing the lower C with that of another musical instrument, such as the family piano. Almost any instrument will do, as long as it is in tune itself. When the bottom C has been tuned by adjusting the trimpot, the other notes of the octave will fall into place providing you with a tuned scale. We might mention at this point that the resistor tolerances can lead to some notes being just a little out of tune, but this is generally nothing to worry about, particularly when you keep in mind that this is not meant to be a serious musical instrument.

Just a final note regarding the availability of the keyboard: The sample keyboard came to us from Ace Radio, 136 Victoria Road, Marrickville, NSW 2204, but we understand that they are also available from Classic Radio, 245 Parramatta Road, Haberfield 2045 and Radio Mart, 338 Pitt Street, Sydney 2000.

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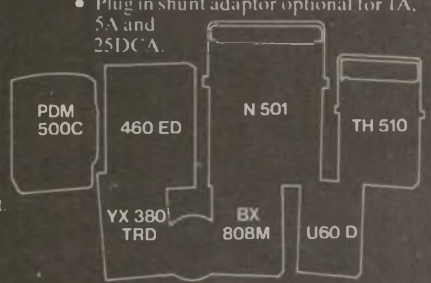

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Novel LEDs & Ladders Game

Basic Electronics

Here is a low cost electronic game that will test your patience and sense of timing. Seemingly simple, you may find to your dismay that literally hours of patience are required before you can reach the top. Why not build it and discover a new frustration?

circuit design by GERALD COHN

The idea for this fiendish device was originally hatched in the fertile imagination of one David Edwards, and a suitable circuit published in our March 1976 issue. Now, four years later, the time has come to present an updated version that is both lower in cost and easier to build.

As you can see from the photographs, the game consists of a small box, fitted with a switch, 16 small light emitting diodes (LEDs), and an illustrated front panel. The illustration is a schematic drawing of a well, with a ladder reaching from the bottom to the top. The LEDs are arranged on the rungs of the ladder, representing successive foot positions as the ladder is climbed, with the topmost LED on the ground at the top of the well.

When the CLIMB switch is pressed, the bottom LED commences flashing at a 0.75Hz (approx) rate. The object of the game is simply to light successive LEDs on the ladder by appropriate manipulation of the CLIMB button. Success is signified when the topmost LED is illuminated.

The trick in the game is that the CLIMB switch can only be operated when a LED is on. When this condition is satisfied the LEDs illuminate in turn, to simulate the effect of a light climbing the ladder.

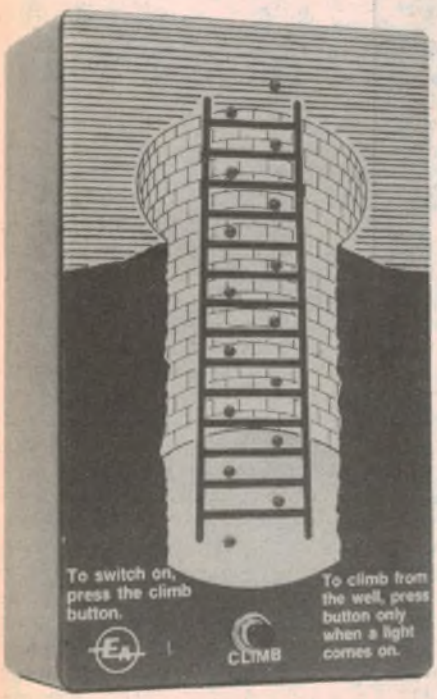
If, however, the CLIMB switch is pressed when no LED is illuminated, the player is surprised and infuriated to find that when a LED comes on again he has slipped back towards the bottom of the well. Just how far down the well the player slips depends on how long the button is pressed while the LED is off, and how far he has progressed up the ladder!

So, having limbered up his wits, as well as his switch operating finger, our player attacks the infernal machine again. With his eye glued to that first LED, and his finger poised, he waits for that light to come on. Flash! the LED emits, his finger stabs the button, and the light commences to climb!

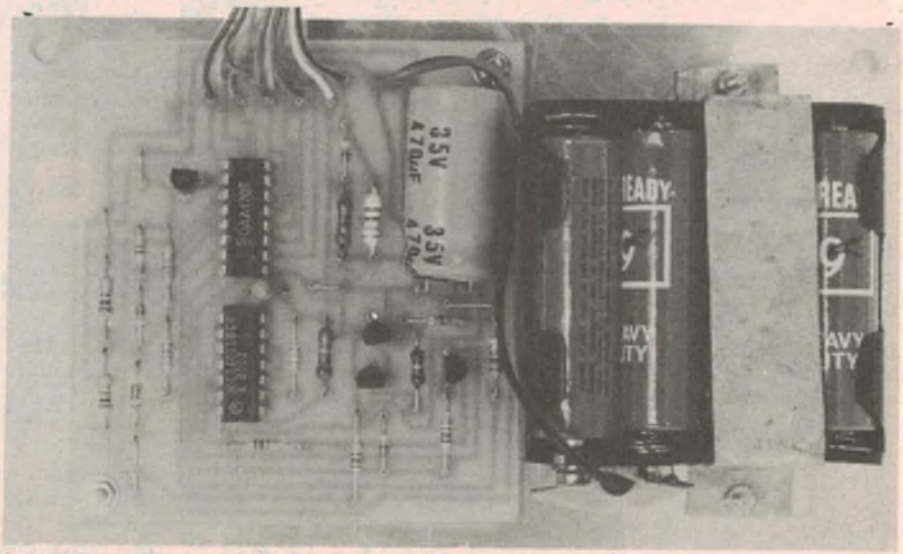
One! two! three! four LEDs emit in turn, the button is released, and a fraction of a second later, the LED goes out. With bated breath, our player scans the LEDs, and is rewarded by seeing the fourth LED come on again. Once more he stabs at the button, once again the light commences to climb.

Some time later, the 15th LED casts a ruddy glow over the perspiring face of our player, who decides to stop for a short time to wipe his brow. Those last few steps had seemed to be harder to climb than the earlier ones; in fact, he'd only just managed to go from the 14th to the 15th rung in one go.

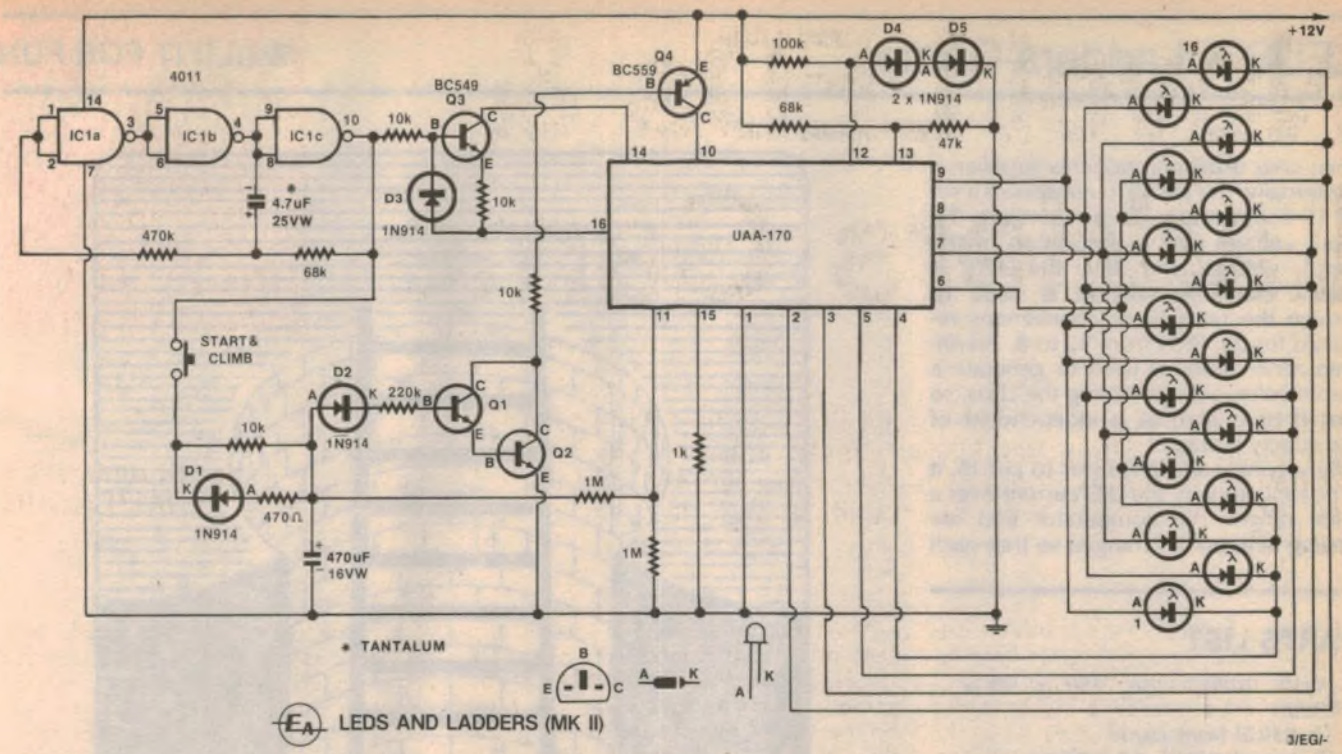
Directing his attention back to the game, our hero is horrified to find that he's slipping back down the ladder. Now



What could be easier? Just press the CLIMB button to light successive LEDs on the rungs of the ladder.



View inside the completed prototype. Virtually all components are soldered to a small PC board which is mounted, together with the battery holder, on the lid of the case.

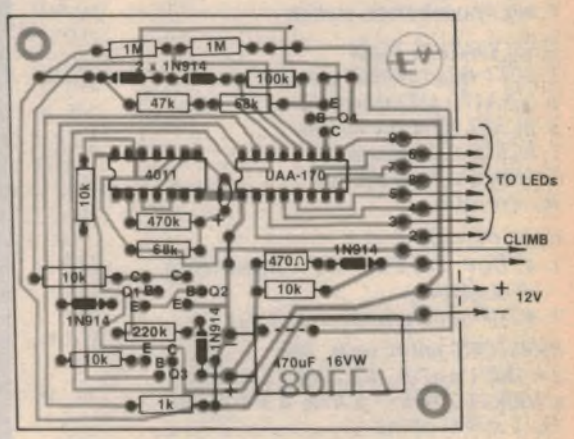


The circuit basically consists of a CMOS clock oscillator (IC1a, IC1b and IC1c) and a UAA170 LED driver IC.

only the 14th LED is alight. Desperately, he punches mindlessly at the button, the LED climbs up higher, just reaches the top, and then goes out. And he's still pressing the switch!

With a heart-rending groan, he releases it, and then watches dejectedly as a LED near the bottom of the ladder flashes merrily. Some minutes later, he musters his courage, and once more commences to climb.

Just in case you're wondering whether or not it is possible to reach the top, we can assure you it is. In fact, the 1976 version had a little man at the top waving to show that he had managed it. We haven't been quite so corny this time!



This wiring diagram shows the PC board as viewed from the component side. Make sure that all polarised components (ICs, transistors, diodes & electrolytic capacitor) are correctly oriented.

HOW IT WORKS

Let's now take a look at the circuit diagram and see exactly how the game operates. It's really very simple and consists essentially of a CMOS clock oscillator and a UAA170 LED driver IC.

The clock circuit uses a 4011 quad NAND gate IC with gates IC1a, IC1b and IC1c arranged as a standard three-inverter CMOS oscillator. The frequency of oscillation is set by the 68k resistor and the 1uF tantalum capacitor and is about 0.75Hz. Output from the oscillator is derived from pin 10 and takes the form of a square wave with an amplitude only slightly less than the supply voltage.

This signal is fed to a large (470uF) electrolytic capacitor via the CLIMB switch and a diode/resistor network.

The charge on the capacitor is used to represent the distance up that ladder that the player has climbed. It works like this: If the CLIMB button is pressed when the oscillator output is high, the diode is reverse-biased and the 470uF capacitor is charged via the 10k resistor. When the button is released, the capacitor slowly discharges through the two 1M resistors and the base-emitter junctions of the Darlington transistor pair (the time constant is very long so that, for the moment, we will assume that the capacitor retains its charge indefinitely when the button is released).

If, on the other hand, the CLIMB button is pressed when the oscillator output is low, the diode is forward biased, and the capacitor discharges rapidly through the 470 ohm resistor.

Since the capacitor is charged from a constant voltage, the voltage across the capacitor follows an exponential law with respect to time. This means that the initial rate of change of voltage is much higher than the rate towards the end of the charging period.

Thus a given closure time of the CLIMB switch will propel the "player" quite a few rungs up the ladder if he is near the bottom, but only one rung or less if he is near the top. This is why our hypothetical player found the going harder towards the top of the ladder.

A second feature arising from this exponential curve is that the rate of discharge is greatest at the top of the ladder, so that an error in timing there produces a greater fall down the ladder than a corresponding mistake at the bottom. Now you can begin to see why the game is so infuriating.

The second section of the circuit monitors the capacitor voltage and uses this information to drive a LED display. Heart of this is the UAA170 IC, a 16-pin DIL plastic encapsulated device distributed in Australia by Siemens Industries. It should be readily available

from your usual components supplier.

Internally, the UAA170 consists of a set of 15 comparators. These compare the input voltage with a proportion of the supply voltage, and drive the LEDs. A matrix encoding scheme is used to reduce the number of connections required for the LEDs from 32 to 8. An on-chip zener diode is used to generate a stable voltage for powering the LEDs, so that their brightness is independent of the supply voltage.

By varying a single resistor to pin 15, it is possible to vary the LED current over a wide range. The comparator and encoding network is arranged so that each LED is illuminated in turn, so that when they are arranged in a line, the effect is of a point of light moving along the line.

PARTS LIST

1 plastic utility case, 150 x 90 x 50mm
1 Scotchcal front panel
1 PC board, 80LL7, 81 x 76mm
8 1.5V penlight cells
1 8-way battery holder and battery clip to suit
1 N/O pushbutton switch

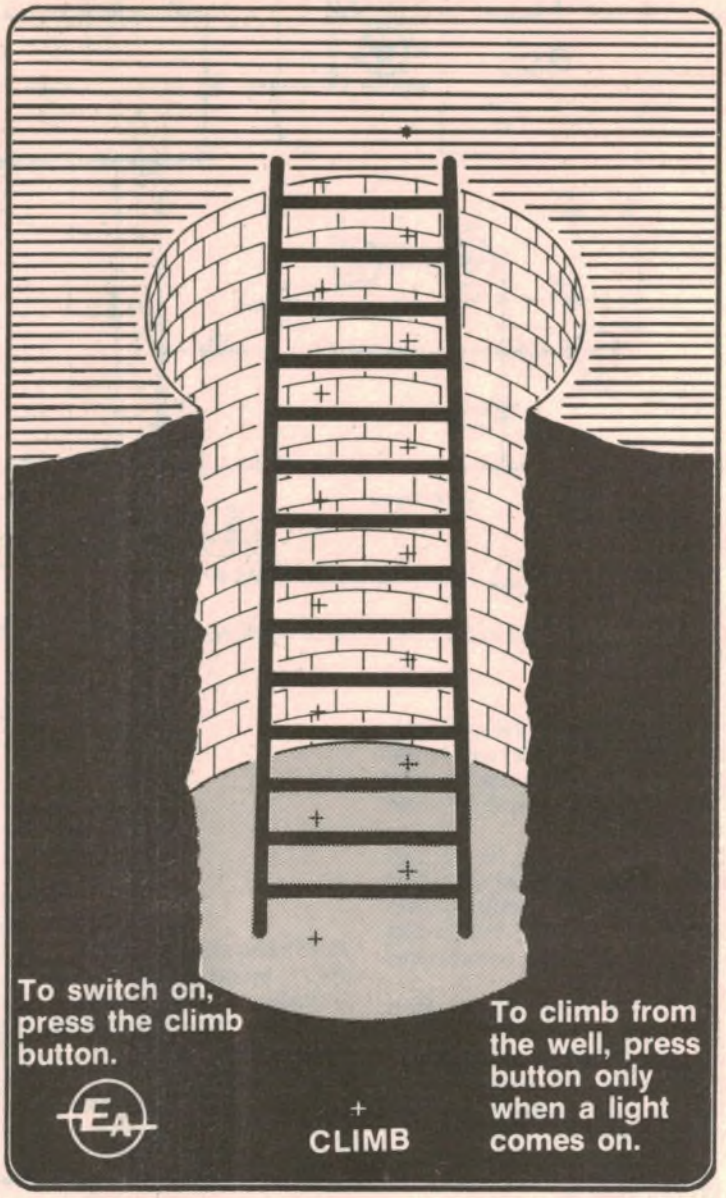
SEMICONDUCTORS
1 4011 quad NAND gate IC
1 UAA170 LED driver IC
3 BC549 NPN transistors
1 BC559 PNP transistor
5 1N914 silicon diodes
16 red LEDs

CAPACITORS
1 470uF 16VW PC mounting electrolytic
1 4.7uF tantalum electrolytic

RESISTORS (all ¼ watt, 5%)
2 x 1M, 1 x 470k, 1 x 220k, 1 x 150k, 1 x 100k, 1 x 68k, 1 x 47k, 4 x 10k, 1 x 1k, 1 x 470 ohms.

MISCELLANEOUS
Rainbow cable, solder, machine screws, nuts, washers, scrap aluminium etc.

NOTE: Ratings are those used on the prototype. Components with higher ratings may generally be used providing they are physically compatible.



Here is an actual size reproduction of the front panel artwork.

Pins 12 and 13 are the reference inputs to the comparators. The voltage applied to pin 12 becomes the lower threshold, while the voltage applied to pin 13 becomes the upper threshold. We have referenced pin 12 to 1.2V by means of diodes D4 and D5 to compensate for the turn-on voltage of Darlington transistor pair Q1 and Q2. This means that the first LED will turn off only when the voltage on the control input (pin 11) exceeds 1.2V.

The 16th LED will be illuminated when the voltage on the control input exceeds the voltage on pin 13, while for voltages in between these two extremes, corresponding LEDs will be illuminated. Note that when the threshold between two LEDs is being crossed, both LEDs will be partially illuminated.

The control voltage is applied to pin 11 from the voltage divider formed by the two 1M resistors. These values have been chosen in conjunction with the values for the divider connected to pin 13 to ensure that it is possible to turn on the 16th LED.

Although we stated earlier that the loading on the 470uF electrolytic capacitor was negligible, this is not strictly so. The two 1M resistors, in conjunction with the impedance presented by pin 11, plus the input resistance of the Darlington pair as well as the leakage resistance of the electrolytic itself, combine to slowly discharge the capacitor. This discharge is most noticeable when the capacitor is highly charged, and accounts for the "slipping back" observed by our hypothetical player. This adds to the difficulty of the game.

The stabilised LED driving voltage is made available at pin 14, and is normally connected to pin 16 via a suitable resistor. In this case, transistor Q3 is included in series with a 10k resistor, and

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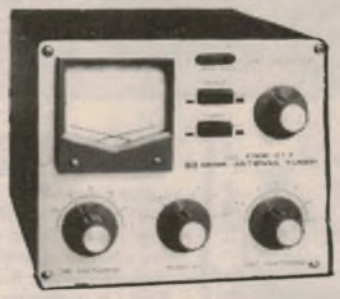

ANTENNA COUPLERS

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Professionally engineered cavity construction, high isolation.

Power rating: 2.5 KW pep, 1 KW CW
Impedance: 50 ohm
Insertion loss: less than 2dB
Maximum frequency: 500 MHz
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Cross-needle type offer DIRECT readings.

SPEECH PROCESSORS

RF660	Phasing type dc	109.00
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Talk power: Better than 6dB
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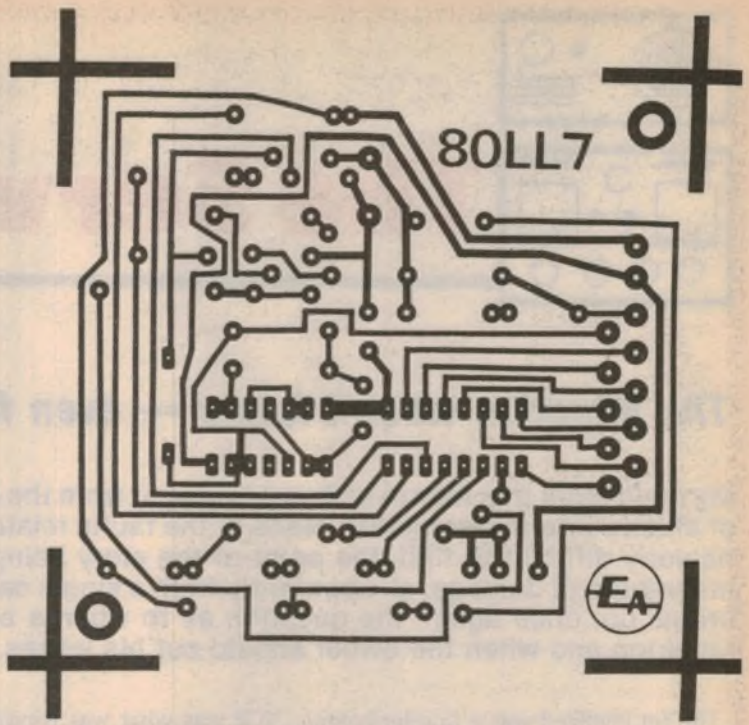
the output of the CMOS oscillator used to switch the transistor on and off. This, in turn, pulses the LEDs, eliminating the need for a separate flasher circuit.

Transistors Q1, Q2 and Q4 form a solid state on/off switch, and save money by eliminating the need for a conventional mechanical switch. The way in which this part of the circuit operates is quite simple: When the CLIMB button is initially pressed (ie circuit off), the voltage on the 470uF capacitor rises and turns on Q1 and Q2. These two transistors then provide forward bias to Q4, which turns on and supplies power to the UAA170 IC.

The game is turned off by deliberately pressing the CLIMB button while the LED display is off. This discharges the 470uF capacitor into the output of the CMOS oscillator cutting off forward bias to Q1 and Q2 and turning off Q4 to remove power from the UAA170. It will usually be necessary to press the CLIMB button two or three times in order to discharge the capacitor sufficiently for the game to turn off.

Note that power is removed only from the UAA170 and the LED display. The 4011 IC is left permanently powered,

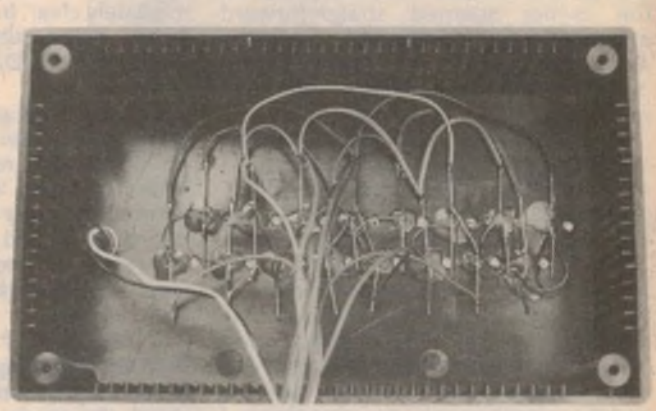


ABOVE: actual size reproduction of the PC pattern.

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

$18.00

This includes sales tax.



RIGHT: the LEDs can be held in position using epoxy adhesive. Arrange them so that their anodes and cathodes are all oriented in similar fashion, to make wiring easier.

while the voltage divider networks on pins 12 and 13 of the UAA170 also draw current on a continuous basis. Even so, total current consumption in the off-state can be considered negligible and will have little effect on battery life.

We used eight 1.5V penlight cells to power the circuit, giving a nominal 12V supply. The batteries are mounted in an eight-way battery holder, as shown in one of the photographs. Average current drain of the circuit in the "on" state is about 28mA, giving an estimated battery life of 40 hours.

CONSTRUCTION

Construction of the game is quite simple, as all the major components, except the LEDs and the CLIMB switch, are mounted on a small PC board measuring 81 x 76mm and coded 80LL7.

Commence construction by wiring the PC board according to the circuit and component overlay diagrams. Fit the passive components (resistors and capacitors) first, followed by the transistors and the UAA170 IC. Make sure that all polarised components are correctly oriented, and don't forget the six wire links.

The 4011 IC is a CMOS device and should be left till last. Take the usual precautions when soldering CMOS devices. Connect the soldering iron barrel to the earth track on the PC board, using a clip lead, and solder the supply pins (pins 7 & 14) first. These measures will prevent damage to the IC by static charges.

We mounted the game in a plastic utility box measuring 150 x 90 x 50mm and fitted with an aluminium lid. The box is used upside down, with a Scotchcal adhesive label glued to the plastic base to provide an attractive front panel. Scotchcal front panels should be available from Radio Despatch Service, 869 George St, Sydney by the time this article appears in print.

Use either the Scotchcal panel or the actual size artwork reproduced with this article as a drilling template for the 16 LEDS. The LEDS are then pushed into the mounting holes and glued at the rear with epoxy adhesive. Arrange them so that the anodes and cathodes are all oriented in similar fashion, to make wiring easier.

The wiring from the PCB to the LEDs and the switch is best done with rainbow cable, as this makes for easy identification of the different leads. Complete the interconnections between the LEDs first, using the circuit diagram as a guide, and then connect them to the PCB. The completed circuit board is fastened to the lid of the box using machine screws and nuts, together with the battery holder which is held in place by an aluminium clamp.

Construction is then complete, and you can attempt to climb the ladder. If the LEDs do not come on in order, it is likely that the connections to them are in error. Any LEDs failing to emit will probably have anode and cathode transposed.

The Serviceman

The situation wasn't funny — even for a serviceman!

My main story this month differs somewhat from the usual saga of elusive intermittent faults. None of the faults related was particularly difficult to find, the point of the story being the sheer magnitude of damage, all apparently from a single cause. It also brings up, once again, the question as to when a set is worth repairing and when the owner should cut his losses.

The set involved was a Kriesler colour TV set, some four or five years old, fitted with a 59-1 Chassis. The complaint by the owner seemed straightforward enough: the set had stopped completely – no picture, no sound. I didn't imagine that it would be anything more than routine.

When answering calls like this, for sets of this general type, I invariably pack a spare switched mode power supply board. Total failure usually means that the power supply will have shut down, either because it is sensing a fault in the set or because it has developed a fault of its own. The easiest way to determine which is to plug in a known good board.

This was a classic example. The set was quite dead, as the customer claimed, and the power supply was shut down. I plugged in the spare board and this promptly shut down also. Whether there was a fault in the original board was not immediately obvious, but it was clear that there was a problem in the set proper.

One likely fault in such cases is a damaged tripler, which will effectively shut down the power supply, so I disconnected this first. When that had no effect I reached for the ohmmeter and began looking for more obvious shorts. Nor did it take long to find one. The main (155V) HT rail showed only a few ohms resistance to chassis, and I blissfully imagined that finding and fixing this fault would be all that would be necessary to get the set going.

A major component associated with this HT rail and the line output stage is a BT100/300R SCR (D750). This is part of a crowbar circuit designed to function in the event of transients on the line scan, and prevent the generation of excessive EHT voltages with possible destruction of the tripler and even the picture tube.

It did not take long to establish that this SCR was what was tying the HT rail to chassis, though whether it was being operated, or had failed, was not immediately clear. In fact, it turned out that it had failed, along with three zener diodes (D751, D747, and D748) in its gate circuit.

Just why these components had failed was not clear, and there was little I could do other than replace them and see what happened. When I did, everything seemed to go as it should; the set produced sound and was generating a normal 8kV at the line output transformer to feed the tripler which, however, was still disconnected.

At this point I confidently expected that re-connecting the tripler would bring up a picture and all would be well. Instead, the power supply promptly shut down again, suggesting that the tripler may have failed also.

Normally, these triplers do not show any visible signs of failure, but the body of this one was a mass of hairline cracks. On the other hand, I couldn't be sure that they were the result of the failure, since many of them had been around long enough to fill up with dust.

"This time, Charley, you'd better get me a plastic one!"

More to the point was the need to replace the tripler, and fortunately I had one with me. But that didn't solve the problem either; fitting the new tripler served only to reveal yet another source of trouble. This was a combination BY176 diode (D760) and two 10k series-connected resistors (R759-760) in parallel with it.

This is a protective network fitted between the 8kV terminal on the line output transformer and the input to the tripler. It is intended to prevent any spurious spikes or pulses from finding their way back into the line transformer and thence to the line output transistor with possible fatal results for the latter.

The problem was a miniature smoke column and a smell of burning paint emanating from the two 10k resistors. Closer examination revealed that the BY176 diode was open circuit and, at this point, I speculated that this alone may have been the reason for the overheating resistors. Without a path through the diode, the resistors would have had to carry all the EHT current.

I replaced the diode and the resistors, and tried again. The result was the same as before; smoke and smell and, when I checked it, the replacement diode was open circuit. The only conclusion I could come to now was that, for some reason yet to be determined, excessive EHT current was flowing. And, horrible though it was, I couldn't escape the fear that the fault could be in the picture tube.

Disconnecting the tripler to avoid any more damage, I switched the set on again and prepared to make further checks. It was then that my attention was drawn to the picture tube and, in particular, to the fact that the heaters were not working. The meter quickly confirmed that heater voltage was being applied, so that meant that I did have a picture tube fault – but not the one I had visualised!

So I now had two faults; excessive EHT current drain – the reason for which was still to be determined – and a picture tube with no heaters.

This discovery put a completely new light on the whole exercise. The owner was already committed for a fair amount of labour and component costs, with the

possibility that there could be faults in the power supply board as well. Now that it was obvious that I would have to supply and fit a 26in picture tube it was reasonable to ask whether he wanted to go on with the job, or cut his losses.

Many people would have chosen the latter course, reasoning that the cost of repairs would be better directed towards a new set. But this customer decided otherwise. One factor which influenced him was the cabinet, which was one of the top Kriesler models and a beautiful piece of furniture.

Another factor was my suggestion that I fit a rebuilt tube rather than a new one.

The decision having been made, the next step was to get the set out of the customer's home and into the workshop. That done, I proceeded to strip out the deflection coils and associated hardware, preparatory to removing the tube. And it was only then that the full nature of the picture tube failure became apparent. Until this point all I had known was that the heaters would not light, without realising the full significance of this fact.

Now the reason was clear. The tube had flashed over from the final anode, through the glass, to the scan coil assembly, puncturing the glass and admitting the air. Nor was this discovery simply one of academic interest; because the tube was not under vacuum it was no longer acceptable for rebuilding and therefore of no value. While the rebuilt tube would still be cheaper, the saving would be less.

Damage of this kind to picture tubes is not as rare as might be imagined. Several makes of set of this general type are prone to it, and some have been modified to minimise the problem. In broad terms the problem is caused by the generation of excessive EHT – unofficial figures of between 40kV and 50kV having been quoted.

The most common cause of the excessive EHT involves a capacitor (or capacitors) connected across the line output transistor, from collector to emitter. Any loss of capacitance here can send the EHT soaring. In this particular set there are two capacitors in parallel, a 6800pF and a 3900pF (C746, C747), and there is a prominent warning notice on the circuit against operating the set without these capacitors in place.

Being well aware of this situation, mainly from the experience of colleagues, I went straight to these capacitors immediately I realised what had happened to the tube. But I might have known it wasn't going to be as straightforward as that; by any tests that I could make these capacitors were intact. So I could only leave the possible explanation in abeyance, and hope that it would become obvious later.

Next, and before actually ordering a tube, I decided to check the original power supply board. First I gave it a visual check using a high powered glass,

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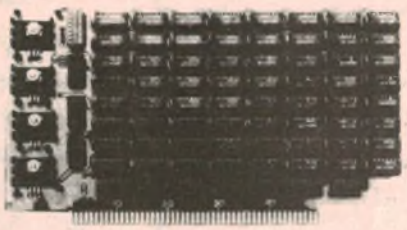

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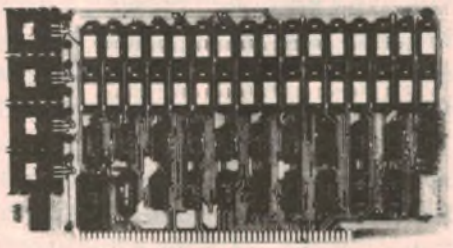

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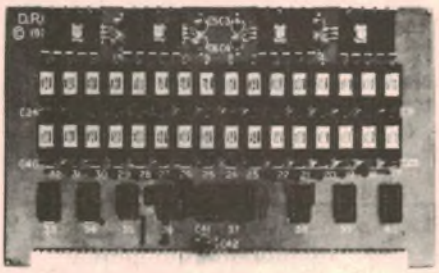

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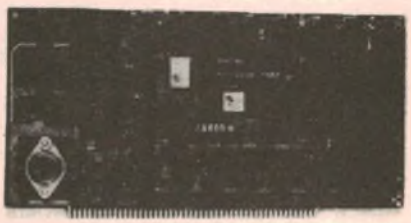

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and I wasn't really surprised to find several dry joints.

The suspect joints were resoldered, the chopper transistor tightened on the heat sink — another potential problem — and the board examined generally for any other obvious faults. When none was found I fitted it back in the set for a dynamic test.

I don't suppose I really expected it to work first off, and I wasn't disappointed. Fortunately, the fault wasn't hard to find; a 27k resistor (R185), one of two in series feeding pin 4 of the control unit, was open circuit. Replacing it brought the power supply into operation and, at long last, it appeared that we had a workable set, albeit without a picture tube at this stage.

A replacement tube was then ordered and, when this duly arrived, I lost no time in fitting it into the set. Finally there came the moment of truth when I switched on — not without some trepidation — and heaved a sigh of relief when everything functioned as it should.

But I still had to go through the purity and convergence routine, and even here there was trouble. All went well until I tried to adjust the blue lateral convergence and found that the appropriate controls had no effect. One of these is a 22 ohm variable resistor (R821) and two others are variable inductors (T820, T822).

The first thing I did was to check whether the appropriate waveform was being fed to this network (point 103 on the circuit) and, in fact, the CRO confirmed that it was. This left relatively few components to be checked, and it didn't take me long to find that a fixed 22 ohm resistor (R820) in series with the aforementioned 22 ohm variable resistor was open circuit.

With this replaced the convergence controls came good and I was able to finish the job. In fact, that really was the last fault and the set was duly returned to the customer.

Which, in one sense, is the end of the story. But the question remains; why did it happen? In one stroke something had destroyed one SCR, three zener diodes, one ordinary diode (and two resistors as a result), one tripler, two resistors (one in the power board and one in the convergence network), and one picture tube.

But what? I doubt if we shall ever know for sure, but my bet is that it was the dry joints in the power supply board, particularly those associated with the main filter capacitor. Arcing could have occurred at these points, causing spikes which were, apparently, of such magnitude that not even the various protective circuits could control them. In fact, they took the protective circuits out as well, but not before they had done a lot more damage.

If this theory is true — and I emphasise that it is only a theory — then the ubiquitous dry joint has chalked up another victory; the destruction of a picture tube. As I have said before in these notes, the dry joint is now emerging as the most consistent single cause of failure in modern electronic equipment, regardless of country of origin.

But I never thought the effect could be this drastic!

By Coincidence

Dear Sir,

This letter was originally prompted by the Forum article: "The Great TV Bomb Scare." However, on second thoughts, it might be more appropriate for the "Serviceman."

I have, in fact, been confronted with a set which exploded at switch-on, but there was no fire. The basic fault was an open-circuit capacitor between emitter and collector of the line output transistor. It allowed the EHT to the tripler, and hence to the tube, to rise dramatically. It went from around 28kV to around 60kV, which was sufficient to puncture the glass and cause an implosion.

Fortunately, loss of a picture tube is a fairly rare outcome of such a fault. More commonly, the line output transistor shorts and the EHT disappears.

In another set, I was faced with burning at switch-on — in the form of a long arc from the ultor of the tube, along the surface of the tube to the plastic mask and thence to the cabinet; some eight inches altogether. There was no sparking — just a long, burning arc.

The cause was found to be excessive smoking by the occupant(s) and no ventilation in the room. This had created a thick, sticky layer of nicotine over all of the high voltage sections of the set.

I discovered that the customer smoked in excess of 60 cigarettes a day in the room and, from its appearance and smell, the statement was entirely believable.

I stress that there was no explosion in this instance although, on reflection, I feel that such an arc could cause a hot spot on the tube surface which might produce a crack and an implosion.

A.K. (Tullamarine, Vic.)

CIRCUIT & DESIGN IDEAS

Interesting circuit ideas and design notes selected from technical literature, reader contributions and staff jottings. As they have not necessarily been tested in our laboratory, responsibility cannot be accepted. Contributions to this section are always welcome, and will be paid for if used.

Conducted by Ian Pogson

Automatic multiple flash unit for photographers

Here is a circuit that many photographers will find novel and interesting. It is an automatic flashing unit which may be used with the more recently released "power ratio" flash units, for example, the Sunpak 3000.

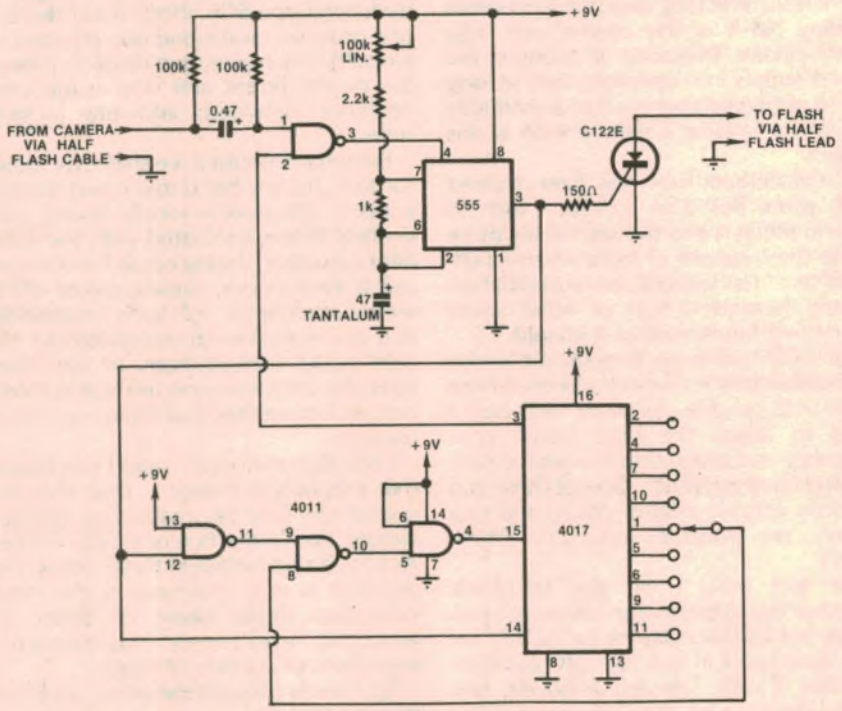
The unit is inserted in the line from the camera to the flash trigger. The camera shutter is set to the "B" setting. That is, the shutter is open while the camera button is pressed and closed when it is released. The flash power ratio control is set to its lowest setting, 1/16, 1/32, 1/64 or lower if possible. This low power ratio means that little power is taken from the flash unit capacitor, so that flash intervals as little as ⅓ second can be used. If your flash unit does not have a power ratio control, then this circuit cannot be used below flash intervals of about 5 to 10 seconds, corresponding to the recycle time.

This is how the circuit works. When the camera shutter is opened, a flash will result but by setting the rotary switch to any position 1 to 9, that number of flashes in total will result. By keeping the shutter of the camera open during these flashes, a multiple exposure effect will be obtained. The duration between flashes (0.3 to 10 seconds) is determined by the 100k potentiometer setting.

Opening the camera shutter results in a signal from its flash socket. This is sensed at NAND gate 1 (pins 1 and 2 are normally high with pin 3 low). The signal causes pin 1 momentarily to go low and pin 3, which is linked to pin 4 of the 555, goes high. This resets the 555 and allows it to oscillate. Each time pin 3 of the 555 goes high, the SCR is triggered which results in a flash. The 555 contiues to oscillate until stopped by the 4017 counting circuit.

As the 555 oscillations continue, the outputs 1, 2, 3, etc, on the 4017 successively go high. When the output as selected by the rotary switch goes high, pin 8 of the NAND gate goes high, resulting in a high at pin 15 of the 4017. This results in the output of the 4017, pin 3, going high. Thus pin 3 of the NAND gate goes low and the 555 oscillations stop.

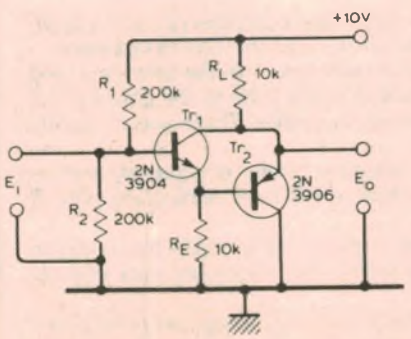
(By Mr D. Williams, P.O. Box 224, Doncaster, Victoria 3108.)



Unity gain buffer with wide frequency range

By DC coupling an NPN common-emitter stage with a PNP emitter follower stage sharing a common load resistor, a unity gain buffer is formed which offers a high impedance, wide frequency response, low output impedance and low current consumption.

The 3dB bandwidth is above 80MHz and by selecting better transistors this can be extended. Care in minimising the lead inductance and stray capacitance will also improve this figure. Current consumption is about one milliamp with a 10V to 30V supply. The circuit will operate from 3V to 30V without degrading its performance. It is important to select the correct input biasing resistors because they reduce the input impedance. (By A. L. Equizabal, in "Wireless World," February, 1980.)



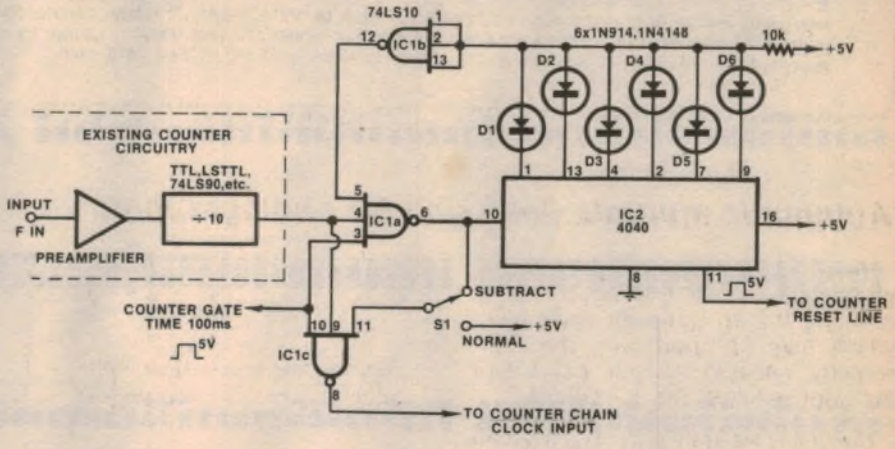
Digital readout for HF receiver using standard counter

This circuit was designed to modify a standard frequency counter for the display of received frequency on an HF receiver. The circuit design is intended for use with 455kHz IF receivers with high side injection but it may be modified for other requirements.

For a six digit counter — resolution to 30MHz — the display will always overread by 4550 counts, or 455kHz. The circuit shown inhibits the first 4550 pulses during the gate time and allows the counter to display the true received frequency.

The incoming frequency from the receiver local oscillator is amplified, shaped and fed to a divide-by-10 device to give a waveform in the region of 100kHz to 3.05MHz to the input of Ic1b. During the gate time (100mS) the incoming signal is fed through to the 4040 whose cumulative output is currently logic "0" at the input to IC1b. Inverted by IC1 to "1", the output is fed to pin 5 of IC1a to enable pulses to clock the 4040. The 12-stage ripple counter is configured to yield a "1" output after counting to 4550, at which point pin 5 on IC1a is pulled low, inhibiting further pulses to the counter.

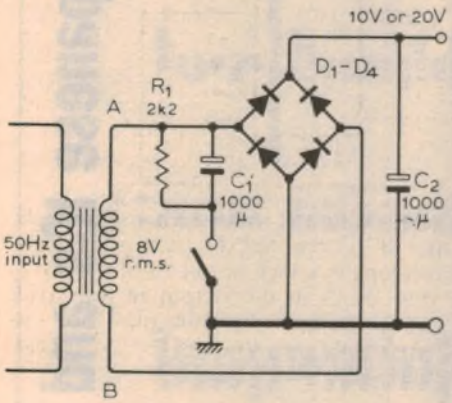
At the same time, the "1" output of the 4040 is fed to pin 11 of IC1c and allows the incoming pulses through to the main counter section for the remainder of the clock period. For a one-second timebase, resolution to 10Hz, an additional 4040 is required to be used as a "45,500" counter. For 10mS timebase with resolution to 1kHz, the 4040 can be converted to a "455" counter by altering D1-D6 to give the required count.



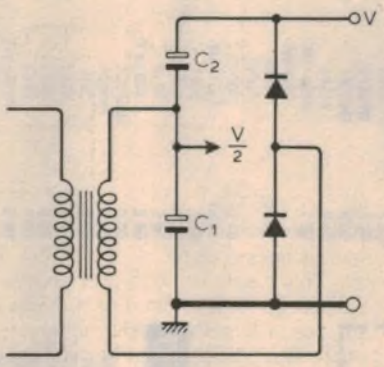
The switch S1 is used to allow offset subtraction to be used in one position and normal counter operation in the other. The reset pulse of the counter is used to reset the 4040 after the gating period is complete, or the strobe pulse of the counter may be used also for counters with latches, provided the strobe is after the gate period.

(By Cpl R. Richardson, C/o Sqn, RNZAF Base, Whenuapai, Auckland, New Zealand.)

Single switch doubles bridge voltage



(a)



(b)

In figure (a), with the switch open, D1 to D4 act as a full wave rectifier feeding C2. When the switch is closed, C1 becomes charged via D4 when A is positive with respect to B, and then feeds C2 via D3 when B is positive with respect to A. Capacitor C1 therefore becomes charged to the peak voltage of the AC input, and C2 becomes charged to twice the peak voltage. Diodes D1 and D2 are both reverse-biased and do not conduct. Resistor R1 discharges C1 when the switch is opened.

If the switch facility is not required, the circuit of figure (b) is preferable because the ripple frequency of V is 100Hz, rather than the 50Hz of usual doubler circuits, and is hence easier to smooth.

(By D. D. Williams, in "Wireless World" June, 1979.)

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734Y	.80
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799	6.25
815	.90
828A	.90
829	.75
838	.75
839	.60

	$ ¢
2SC900E,F	.70
926	1.25
930	.55
933	1.40
940L	6.40
941	1.20
945	.70
1000GR	.85
1014	1.55
1017	1.70
1018	3.50
1047	.75
1061	1.45
1070	3.75
1096	1.25
1124	1.95
1162	1.15
1166	1.00
1173	1.55
1175	.85
1210	.70
1213	.80
1215	.70
1222	.70
1226A	1.25
1239	9.70
1306	3.15
1307	7.35
1312	.80
1313	.90
1317	.75
1318	.90
1327	.70
1328	1.15
1359	.65
1360	1.05
1364	.70
1383	.85
1384	1.00
1394	1.30
1398	1.75
1446	2.00
1449	1.40
1450	7.90
1506	1.30
1507	1.45
1520	2.35
1521	2.35
1550	1.90
1571	.65
1589	5.30
1647	.70
1674	.70
1675	.70
1678	2.20
1683	3.10
1685	.75
1687	.85
1688	1.10
1740	.70
1760	1.55
1775	1.50
1815	.55
1846	1.30

	$ ¢
2SC1848	1.80
1856	1.15
1906	1.75
1923	.65
1957	1.35
1964	3.55
1967	26.60
1968	39.65
1969BH	6.25
1973	1.60
1974	1.95
2028	2.60
2029	5.20
2053	1.50
2055	2.60
2073	2.60
2074	1.90
2075	2.90
2076	.70
2086	1.00
2099	26.90
2116	4.25
2131	7.30
2132	68.25
2146	4.40
2166	3.35
2320	.60
2327	9.80
2SD 30	1.10
180	4.60
187	1.10
200	6.30
213	20.50
234	1.80
235	1.60
261	.80
288	1.85
313E	1.50
325	1.10
330	1.60
350A	5.90
355	1.05
359	1.80
380	9.15
382	2.50
389	3.60
400	.75
424	18.90
467	1.75
525	2.65
587	3.40
863	1.15
2SK19GR,Y	1.45
23	1.40
30GR,Y	1.60
33	1.20
34	1.10
40	1.35
41D	1.00
41F	1.50
49H	1.05
54B	1.00
55D	1.00
55E	1.00
68L	1.00

	$ ¢
3SK39	4.10
41L	2.85
45B	1.70
48	3.95
54B	3.05
59	2.45
INTEGRATED CIRCUITS	
AN214Q	5.25
AN217	3.45
271	5.30
272	7.20
315	7.95
612	4.30
7151	6.60
BA511	4.50
521	6.95
CA3012	8.20
CX075B	4.45
DS8654N	7.90
FX107	
HA1306W	5.40
1322	6.20
1338	3.65
1339	5.45
1342	5.45
1366W	6.20
1366WR	6.20
LA1201	2.90
4102	3.90
4420	9.30
4430	2.40
M5115PR	12.90
51202L	3.10
51313L	
58476	29.95
MB3705	
MC14049	1.35
14511	3.10
14526B	6.95
14568B	12.55
1458	2.90
1496	2.95
3340	5.65
4044	5.95
MHW710-3	56.20
MM5369AA/N	5.95
5387AA/N	7.50
5799NBR	39.95
74C93	6.15
MSM5107	11.75
NDC40013	15.95
40044	24.80
NIS7261A	7.00
NJM4558D	2.85
PLL02A	11.95
SL1626C	10.70
1640	8.15
SN76115	3.65
76600P	5.55
TA78	6.05
7045M	4.95
7060P	1.70
7061AP	2.10
7062P	2.25
7063P	1.80

	$ ¢
TA7069P	3.90
7089P	10.20
7102P	11.55
7120P	1.65
7130P	3.50
7141AP	11.05
7146P	11.05
7153	25.60
7201P	5.10
7204P	4.60
7205P	3.00
7215P	12.00
TA7222P	6.25
7301P	2.70
7313P	3.35
TBA810SH	6.25
TC4508	11.75
5032	16.25
5080	11.80
5081	5.85
5082	5.85
9100	13.25
TMS1943NL	13.20
uPC78LO5	1.75
78LO5	1.75
78LO62AWC	2.70

	$ ¢
78LO62WV	2.70
78MO8C	5.65
78LO8AC	1.75
20C	5.20
41C	5.40
555H	1.50
566H	1.25
575C2	4.60
577H	1.60
592H2	1.55
1001H2	5.20
1020H	5.45
1025H	6.60
1156H	4.85
uPD858C	10.75
UP477C12	69.00
CURTIS 8044	24.95
CRYSTALS	
3.579MHz	4.80
7.4015MHz	6.80
7.8015MHz	9.90
9.555MHz	4.80
9.565MHz	4.80
10.000MHz	6.35
10.020MHz	4.50
10.0525MHz	6.35

	$ ¢
10.240MHz	6.35
10.692MHz	6.35
10.695MHz	6.35
12.800MHz	11.50
16.965MHz	6.20
17.065MHz	6.20
17.115MHz	6.20
17.165MHz	6.20
17.215MHz	6.20
21.145MHz	11.50
32.520MHz	11.50
33.020MHz	11.50
33.520MHz	11.50
35.500MHz	11.50
36.380MHz	11.50
37.36875MHz	11.50
39.16875MHz	11.50
40.9875MHz	11.50
41.000MHz	11.50
41.4875MHz	11.50
41.500MHz	11.50
41.9875MHz	11.50
42.000MHz	11.50
42.500MHz	11.50
43.500MHz	11.50
44.000MHz	11.50

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Letters to the editor

Vintage receiver: help needed

In an effort to retain some vestige of our electronic heritage, I have been rebuilding several early receivers for the possible future interest of my two sons, both of whom appear to be destined for computer and space technologies.

Recently at a trash and treasure market I acquired a very early crystal receiver although some components are obviously missing. The vendor knew nothing about the unit so I am seeking some more information on the circuit details before commencing restoration. After a short discussion with a lady in the John Fairfax office in Melbourne, it was agreed that you may be able to help me.

I have enclosed a plan sketch of the unit as I acquired it. However, there are too many pieces missing to determine the original circuit and layout, which, of course, I wish to duplicate.

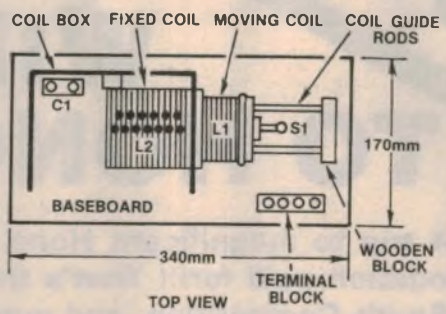
The bseboard is a highly polished wood, as is the wooden box section housing the coil assembly. The coils and wood-work are obviously homemade but considerable care was exercised by the builder.

I do recall, some 10 to 12 years ago, reading an article in your excellent monthly publication of a similar receiver that had been restored by one of your readers. I also seem to recall that the receiver described in your journal may have been used for communications work on the LF marine bands.

It is possible that my unit was constructed shortly after World War I. I could rebuilt it as an operating unit but I feel that circuit authenticity is as important as an authentic appearance. It would be a help if I could contact the owner of the receiver described in your journal; even a photograph would be useful.

Peter J. Martin,
93 Kirkwood Ave,
Seaford South, 3201.

COMMENT: The set you have would appear to pre-date our magazine in its monthly form, and probably belongs to the early twenties. While we cannot help you directly, we have published your name and address, together with a copy of the plan sketch that you provided. It's just possible that one of our readers will recognise the set and offer assistance.



L1: 200 turns No. 36 on 2.5-inch diameter former with 8 taps.
L2: 80 turns No. 26 on 3-inch former with 12 taps.
C1: Brass plates, paper dielectric, locked by two bakelite strips and whole assembly screwed together. "W & M" engraved on upper strip; "100" engraved on lower strip.
S1: 9 point rotary switch; controls L1 taps.

All wiring was cemented into grooves cut along underside of baseboard.

The amazing micro-mouse contest

After reading your fascinating article "The amazing micro-mouse contest" (EA April, 1980), and knowing the Australian scene, I can only conclude that an Australian micro maze is inevitable. I don't know who is likely to organise it, or when, but some preliminary discussion in the popular (electronics) press may help make the competition available to everyone and more equitable to the average hobbyist.

May I offer the following alternatives to the American rules:

1. Have a club organise foster competitors to look after mice mailed in.
2. No stepping motors allowed. These are too expensive for the average hobbyist.
3. Rather than using a maze constructed of board sections, have it on a flat matt black surface with the maze comprising, say, 12mm masking tape between 18cm centres.

A. This simplifies maze construction and it is a simple standard open to few "local variations" such as colour and wood sizes. Think of the number of test mazes that will have to be built!

B. It allows a simple optical arrangement to be used for guidance rather than all sorts of terrifying appendages that would be the downfall of most hobbyists. Such appendages are open to damage and misalignment and would be too great a concern for mailed in entries.

5. Non-intelligent mice should be allowed equal entry opportunity. This will encourage good mechanics, more competition, and a greater chance of computerist and mechanist joining forces.

I would be pleased if the above ideas could guide you in any recommendations your columns make towards the running of such a contest. I am putting forward these ideas now, because once the competition is announced, it will be too late to make such drastic changes.

No, I haven't built my Dalek-mouse yet, but I am burning to start, and I bet many other people are too!

J. Pittar,
Cook, ACT.

Foreign equipment & capacitor ratings

I was very interested to read your "Forum" for this month about power mains and earthing problems, and perhaps I might be permitted to add to this.

Several months ago my somewhat elderly CRO, which I use for servicing, stopped working and emitted a large cloud of smoke. Subsequent fault-finding located the trouble: a small ceramic disc capacitor from one side of the mains input to chassis had "blown" – literally: one side was completely missing and carbon deposited over a wide area.

The CRO was by a US manufacturer, and the American power reticulation system is somewhat different from ours, in that consumer products can be connected between one active and neutral/ground (115V) or between two actives on a multi-phase system (230V). For the 115V system the two primaries of the power transformer are connected in parallel, whilst in the 230V system they are connected in series.

The American 230V 2-phase system is symmetrical about the neutral and hence the voltage across each capacitor is still the single phase voltage (115V RMS or 163V peak).

The Australian system however, results in 240V RMS or 340V peak across one capacitor and virtually nil across the other; small wonder that the capacitor, rated at 200V DC in my case, blew.

The moral of the story (if any) is to check American and Japanese equipment to see if the capacitors have a large enough voltage rating.

Wishing you continued success with your excellent magazine.

R. Tregea,
Pennant Hills, NSW.

YAESU

ANNOUNCING A GREAT NEW CONTEST

WIN A TRIP TO HONG KONG!

Yes! A trip to magnificent Hong Kong, with your flight and accommodation paid for!!! That's the prize in our exciting new Yaesu/Dick Smith Competition: and you could be the winner!

OPEN TO ALL PURCHASERS OF YAESU AMATEUR GEAR FROM DICK SMITH

Here's how it works:

We at Dick Smith Electronics want to know what you, the amateurs of Australia want from your hobby: the amateur radio service. And we want to know how we, as a company, can serve you and Australia best for the benefit of Australia. So we're asking you to tell us, in fifty words or less, 'The best way that Dick Smith Electronics can promote the fantastic hobby of Amateur Radio to the benefit of Australia'

Entry to this competition is only open to purchasers of any Yaesu equipment from Dick Smith stores or authorised Dick Smith Yaesu re-sellers, between August 1, 1980, and November 1, 1980.

If you think about it, your chances of winning this trip are very, very good: the number of entries cannot be all that high – all it takes is a little originality and constructiveness of comment from you, and you could be going to Hong Kong: free!

Entries will be judged initially by a panel from Dick Smith Electronics to produce five finalists: these will be judged by Neville Williams, MIREE, Editor-in-chief of Electronics Australia magazine.

The winner will be notified by Dick Smith, and will be announced in Electronics Australia and Electronics Today International.

So if you're thinking about buying Yaesu, why not buy it in the next three months: of course, only from Dick Smith Electronics or authorised Dick Smith Yaesu re-seller!

Remember: we're the number one supplier of Yaesu amateur gear in the Southern Hemisphere!

HERE'S HOW TO ENTER: RULES AND CONDITIONS

Entries will only be accepted on the official entry form, which is available only with the purchase of any item from the Yaesu range from a Dick Smith store or a Dick Smith authorised re-seller.

All entries must show the model number and serial number of the item purchased, (if applicable), and be signed by the store manager or authorised person.

In the space provided on the entry form, write in one paragraph of not more than 50 words,

'The best way that Dick Smith Electronics can promote the fantastic hobby of Amateur Radio to the benefit of Australia'

Post your entry to:

Amateur Radio Contest,
Dick Smith Electronics
PO Box 321,
North Ryde, NSW, 2113.

Entries close at 5PM on Monday, 3rd November, 1980. Entries received after this date will not be considered.

Final judging will take place on 10th November, 1980. The judge's decision will be final and no correspondence will be entered into.

As this flight departs from, and returns to Sydney, the winner must travel to Sydney at his/her own expense.

All entries become the absolute property of Dick Smith Electronics Pty Ltd, who may use such entries as they see fit.

NOW, MORE THAN EVER, IT PAYS TO BUY YAESU FROM DICK SMITH!

AMATEUR RADIO

by Pierce Healy, VK2APQ

New fields for the amateur to explore

There is a clause in the amateur code that reads: "The amateur is progressive. He keeps his station abreast of science. It is built well and efficiently. His operating practice is clean and regular." Such is the aim of those who have a real feeling for their hobby.

The technical and commercial development of radio communication over the past decade or so has changed "home brew" activity and outlook in relation to much essential amateur station equipment. Moreover, the adaptation of other technical developments to amateur radio has not been overlooked, particularly among those who consider amateur radio an intriguing and fascinating activity.

Nor has the service offered and given freely to the community, in the fields of education and emergency service, been overlooked, but rather intensified by these developments.

A fact not to be forgotten is that the lessening of "home brew" activity through the advent of commercial amateur equipment, has, to a major degree, been the result of amateurs demanding that the latest techniques and advancement in technology be available for their use. Often amateurs were responsible for such developments, while working in professional trades or careers associated with such techniques.

The redundancy of mechanical teletype machines, in the commercial field, through the introduction of more compact telex equipment – silent solid state video displays with memory banks – put another potentially useful device on the disposal market. As the volume increased so did amateur interest in radioteletype. Greatly assisted by the skills of amateurs professionally involved in the field of computer design and application, who devised ways to interface such units with normal amateur station operation, there has been a steady increase in amateur radioteletype communication.

Still more recently techniques used in commercial applications have been turned towards amateur needs and current "home brew" activity is being affected. Compact units with many facilities, including sending and receiving capability in BAUDOT and ASCII at various frequency shifts, and speeds, with visual display, recording and printout outlets, are now available to amateurs. In addition, some units can send and receive Morse code at speeds from three to 50 words per minute, displayed visually, or printed in plain language.

Having been associated with developments and changing outlooks in amateur radio since the mid-1930s and observing the expanding interest in RTTY locally, this amateur (VK2APQ) decided to sample the mode. Initially a mechanical teletype machine and basic solid state interface was obtained and tried.

However, it was not long before "keeping abreast with science" took over and a home was given to a Tono Theta 7000E communications computer. A very ancient portable TV receiver was revived and lo – "silent glass RTTY" was now a part of my life.

Participation in the VK/ZL/Oceania RTTY DX contest in June last was an experience with a difference – an experience shared and enjoyed with newfound friends in several countries.

Besides being an exercise in patience, watching and waiting to identify stations writing on your screen or waiting for your call sign to magically appear, it is slower than voice communication. But it gave time to cogitate on what changes had taken place in amateur communications since first becoming involved in its many and intriguing aspects.

Yes, the "L plate" syndrome still applies. Memorising and endeavouring to master all the possibilities provided by this newly acquired device is adding another facet to appreciation of amateur radio.

Could it be that commercial achievments, through the use of solid state techniques, have caused an awareness of things that have been around for a long time?

A thought – how long will it be before an amateur will interface a language translator with his transceiver to allow him to converse freely in other than his native tongue without requiring ability to speak the other tongue? Maybe it has already been done and I have not been told. After all it is possible to converse with a computer on RTTY before realising the fact.

LICENCE FEES

As from July 1, 1980, licence fees for the Australian Amateur Service were increased. Fees for full and limited licenses will rise from $12 to $15 and for the novice licence from $6 to $10. There is no provision for reduced fees for persons holding a limited and novice licence.

The Wireless Institute of Australia has in recent years made a request to the Federal Government for a reduction of amateur licence fees for pensioners. Although the request has been acknowledged it is understood that the matter is still being considered by the departments concerned.

EUROPEAN RTTY AWARD

The Deutscher Amateur Radio Club (DARC) issues the "Europaeisches RTTY Diplim" (EURD) to promote amateur RTTY activities. The award is available to all radio amateurs and club stations holding an official RTTY licence. It is based on two-way RTTY contacts with different European countries and prefixes.

1. The EURD will be issued in three classes: EURD III, EURD II, EURD I.

2. EURD III: written confirmation (QSLs) from at least 20 different countries regardless of the band used and a minimum of 100 prefix points are required.

a) The European countries are determined by the European country list.

b) Each official European prefix counts one prefix point per band.

EURD II: 150 prefix points in 30 countries.

EURD I: 200 prefix points in 40 countries.

AMATEUR RADIO

3. All amateur bands including VHF may be used.

4. All QSLs must confirm "Two-way RTTY" and be dated after January 1, 1965. Any altered or forged confirmations will result in disqualification of the applicant.

5. Contacts during the RTTY WAE DX Contest (RTTY WAEDC) can be used for EURD endorsements provided the log of the claimed station is also received. Therefore, claims should not be made before the publication of the contest results. Requests must be made within two years after the contest.

6. The fee for each certificate is DM 10, or 15 IRCs.

7. Send applications, log extracts confirmed by your local radio club, and fee to: DARC RTTY manager, Klaus Zielski, DF7FB, PO Box 1147, D-6455 Erlense, West Germany.

European country list: C31, CT1, Ct2, DL, DM, EA, EA6, EI, F, FC, G, GC, Guer, GC Jer, GD, GI, GM, GM Shetland, GW, HA, HB9, HB0, HV, I, IS, IT, JW, JW Baer, JX, LA, LX, LZ, M1, OE, OH, OH0, OJ0, OK, ON, OY, OZ, PA, SM, SP, SV, SV Crete, SV Rhodes, SY Athos, TA1, TF, UA13456, UA2, UA Franz Josef Land, UB5, UC2, UO5, UN1, UP2, UQ2, UR2, YO, YU, ZA, ZB2, 3A, 4U, 9H1.

Copy of the 1979 WAEDC RTTY contest certificate.

EUROPEAN DX CONTEST: The Deutscher Amateur Radio Club (DARC) has the honour to invite amateurs all over the world to participate in the annual European DX Contest.

Contest periods: CW – second weekend August 1980. Phone - second weekend September 1980. RTTY – November 8 & 9, 1980, 0000-2400UTC.

RADIO CLUB NEWS

MUSEUM OF APPLIED ARTS AND SCIENCES AMATEUR RADIO CLUB: The first annual meeting of MAASARC was held at the Museum, Harris Street, Broadway, Sydney on Wednesday evening May 28, 1980.

The annual report was presented by the chairman Pierce Healy, VK2APQ. The report gave a review of the activities during the year and noted that the Museum amateur radio station, VK2BQK has been manned on all but two weekends in the past year. Also, on nine occasions, weekday demonstrations were provided for schools and college groups visiting the Museum.

Mentioned also were the interesting talks and displays arranged by members of the Museum staff at bi-monthly club meetings.

Mr Jeff Sergel, curator of electronics at the Museum, and secretary-general of MAASARC, conveyed to the meeting a message of appreciation from Dr Lindsay Sharp, Director of the Museum, of the

AMATEUR RADIO

assistance given by members manning the station and answering enquiries by visitors.

The meeting re-elected the committee consisting of Geoff Campbell, VK2DKY, and Pierce Healy, VK2APQ for a second term of office.

The meeting affirmed that MAASARC not be associated or affiliated as a club with any local or overseas amateur group or organisation and does not participate in dialog among such bodies. The object of the club is assist the Museum in demonstrating radio communication and amateur radio as a worthwhile educational activity within the community.

The Museum station, VK2BQK, is operated by club members each Saturday and Sunday afternoons for public demonstration.

Schools, colleges, and other interested organisations may arrange special weekday group demonstrations by contacting the Museum's education officer and making appropriate arrangements. Telephone (02) 2113911 for information.

ROYAL SIGNALS AMATEUR RADIO SOCIETY: Steps are being taken to form a branch of the society in Australia. Conditions for acceptance are that the applicant must be or have been in one of the following:

a. A member of the Royal Corps of Signals.

b. A member of the Royal Australian Signals.

c. A member of any branch of the army in a signals section.

Engaged in forming the branch are Les Simons, VK2NLE and Rob Lake, VK2NAW.

Those wishing to join or enquire eligibility for membership should write, enclosing a stamped self addressed envelope, to Les Simonds, VK2NLE, Acting Secretary, PO Box 402, Double Bay, NSW 2028, or telephone (02) 337 6325.

CENTRAL COAST AMATEUR RADIO CLUB: A WICEN exercise was held in conjunction with the St Albans 96km horse endurance ride on May 4, 1980. A total of 14 check points were provided around the course and communications maintained on 146.5MHz FM and 28.35MHz USB. A public address system and computer processing at the base camp were provided to keep interested parties informed of the last known position of the entrants.

There were 59 entrants in the endurance ride and only seven failed to complete the course within the specified time limit. There were 750 messages consisting of date/time groups handled, while 50 formal messages were passed. The efforts of those participating in the WICEN exercise were highly praised by the organisers of the event.

THE BUNDABERG AMATEUR RADIO CLUB: This club meets at the TAFE College, 118 Walker Street, Bundaberg at 7.30pm on the fourth Wednesday each month. Details may be obtained from VK4LP on telephone (071) 72 3290 (bus or (071) 79 3188 (AH). Postal address is PO Box 129, Bundaberg, Qld 4670.

EASTERN & MOUNTAIN DISTRICT RADIO CLUB: Included in the May 1980 issue of the EMDRC Bulletin is a copy of their 1980 call book containing details of their 354 licensed members. All told the club has 451 members.

A breakdown of the figures show that there are 178 with full license, 67 limited, 91 novice and 18 with both limited and novice calls.

Profile of occupations of members is interesting. Occupational groupings with more than 30 members include: Retired - 55; Students - 50; Comunications and electronics - 49; Engineering - 34; Business administration - 32; Teaching and training - 31.

WEST AUSTRALIAN VHF GROUP (INC): The group has a six metre experimental repeater in operation. The input frequency is 53.2MHz and the output 53.8MHz. The mode is FM with plus or minus 5kHz deviation.

Thought is being given to the establishment of a repeater between Perth and Geraldton to allow access to mobiles travelling that route.

Radio clubs and other organisations, as well as individual amateur operators, are invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown.

The Australian CB SCENE

CB ON THE HOME FRONT — AND IN IRELAND

Another month has passed, and quite a few interesting things have happened, not the least important of which is the announcement that CB licence fees are to be reduced from $25.00 to $20.00 a year. The reaction which has reached me at the time of writing is quite predictable. . . . "Fine, but not enough."

Persnally I welcome this reduction, especially as it comes at a time when just about everything else is going up. The reduction will take effect from July 1st, so a number of you will already be enjoying the benefit of an unexpected extra $5.00 in your pockets. One wonders about the reason behind the reduction; after all, this is an election year. However, I am not one to look a gift horse in the mouth; so.... "Thank you, Mr Staley."

FROM THE MAILBAG:

"R.R." has written again, and apologised for thinking that I am a male. Apology accepted, R.R.! I hope that I have not given R.R. or any other reader the impression that I condone the use of linear amplifiers or other illegal equipment or practices, because I don't. I run stock standard – not even a power mike! But I am certainly involved in the fight to retain the dual service, and the betterment of the conditions under which we operate.

I have received a letter from Ken Upton of Lethbridge Park, NSW. It was accompanied by a newspaper cutting on a Talk-a-Thon which the Emerson Citizens Band CB conducted to raise money for the Thorndale Special School. The drive was very successful, with a total of $800.00 being raised; truly a terrific effort by the CB operators involved. Good on you, Emerson! Too rarely do we see the good side of CB publicised. And thanks to you Ken, for bringing this to the attention of E.A. readers. (Ken, by the way, gives his call sign as Omega One.)

Some more information supplied by Ken: The Lima Mike CB Club raised $1600.00 for the Foundation 41 Appeal last January. It also seems that the Lima Mike's are intending to do the same again in the near future. Please keep me posted on the outcome.

Along with the above snippets, Ken sent me some advertising material from a 1976 Canadian publication, relating to some pocket-sized communicators. They were advertised for $C40.00 each but, after a brief period, were withdrawn from sale. They sound familiar! Maybe we should be more ready to learn from experiences overseas and thus save ourselves a deal of time and trouble.

As you are all probably aware, the closing date for submissions to the Minister regarding the CBRS is the 15th August. I would hope that the Department has been inundated with submissions, indicating the interest which CBRS have in the retention and betterment of the service.

On the subject of the submissions: the National Director of the NCRA, Terry Watkin, and I were invited by Mr Col King, the Queensland Stae Superintendant of the Radio Branch to meet Mr Ross Ramsay, the Acting First Assistant Secretary of the Radio Frequency Management Division of P&T. Mr Ramsay is taking the place of Mr Jim Wilkonson who is tied up with the WARC reports and will be for the next 6 months or so. We spoke to Mr Ramsay on many aspects of the CBRS and also took the opportunity to present him with the NCRA submission.

We have since received a letter from Mr Ramsay saying that he had read the submission on his way back to Canberra. Mr Ramsay said that he "was impressed by the constructive nature of the submission". To his knowledge, it was the first submission received by his Department indicating "the enthusiasm of the NCRA regarding CB Radio matters."

Mr Ramsay will be part of, if not heading, the four-man inquiry into the CBRS, and I am sure that we will get a fair hearing. So please get those submissions in.

CB IN IRELAND

Through the efforts of the NCRA's NSW State Director, Mr Reni Barnes, we have opened up lines of communication between the CB operators of Australia and our counterparts in the Irish Republic. At the time of writing the service is not legalised there but indications are that it may well be by the time that you read this.

The co-ordinator of the National CB Council of Ireland (their counter-part to our NCRA) Mr Kevin O'Neill, has been kind enough to send me copies of the first three editions of their magazine. The NCRA and the NCBC have affiliated, so both can now claim to be "international".

AN ABUSIVE LETTER

Dear Ms Christensen,

Unfortunately for you it is, and always will be, a man's world. They designed, built and maintain the technological world we are living in.

Women in naturally male jobs are a fake. Please stick to more female things like the killing of innocent children by abortion. Stay out of a technical magazine.

You will be tolerated but never wanted. Unfortunately, we cannot abort you.

(Signed) . . . . . .

OUR RESPONSE

We have omitted your name and address, if only to deny you the notoriety that you may well be seeking.

In fact, we have three women in our "man's world", all selected on their merit and all doing a good job: Jan Christensen, whom you attack; Pam Hilliar who looks after our office routines, and Janis Wallace, our Melbourne representative.

As far as we are concerned, Jan Christensen is making a sincere effort to encourage a more constructive approach to CB radio. We resent and repudiate the kind of remarks you have directed at her, and women in general.

Neville Williams

Kevin has also extended the invitation for clubs in Australia to become "sister" clubs of those in Ireland. Reni's club, the BPA Club of Sydney, has formed a liaison with Kevin's 10-30 Club in Ireland.

It may do well to point out that Ireland is now experiencing the same teething problems which we have had around the time of legalisation. Any helpful suggestions you may have, will be most welcomed by our Irish counterparts.

Ireland seems to be going one better than us, however, indications being that they will be granted a CBRS along the same lines as in the USA, ie 40 channels. There would appear to be approximately 80,000 operators in Ireland at the moment, many of them waiting to hear from you, so get to it.

The NCBC of Ireland is a member of the European CB Council, which is a member of the World CB Union. Ireland has extended the invitation to NCRA to join the WCBU, and this offer has been accepted. At last we may see a world-wide CB association

Kevin is also the National co-ordinator of HARP (Help, Aid and Rescue for the People) the Irish equivalent of our CREST. He says that he is receiving advice from CREST and from REACT in America in making his emergency team into a cohesive and responsible body. I must congratulate Kevin and his co-workers for the time and effort they are putting into their battle for legalisation and the setting up of HARP.

Those of us who were involved with the early fight for legalisation in Australia, and the on-going struggle for the betterment of our service can well sympathise with Kevin and the NCBC of Ireland. They have a long, hard road ahead of them, and will need all the assistance they can get. If you feel that you can help, write to Kevin via my post box; I'll make sure that the letters are passed on.

1980 CONVENTION

Back on the home front again, the NCRA is holding its 1980 Convention . . . wait for it . . . in Brisbane! The Convention is being held at the Astor Motel, in Wickham Terrace, on the 22nd and 23rd of November. The weather should be terrific, and I am looking forward to seeing lots of E.A. readers from interstate in attendance.

Thank you again for the information supplied and for your encouragement. There was just one very sour note, in the form of a letter from a correspondent whom I choose not to identify. He abuses me in quite offensive terms for daring to intrude into "a man's world". But despite that, if anyone would like to write to me and add information to my column, please do so. Your name will be printed as the source if you wish. My address is P.O. Box 406, FORTITUDE VALLEY, Queensland, 4006.

. . . Jan Christensen

SHORTWAVE SCENE

by Arthur Cushen, MBE

New program from Radio New Zealand

Interest in a special program for shortwave listeners has been answered by Radio New Zealand with the introduction of a program entitled "Radio New Zealand" now broadcast every two weeks to North America, Asia, and the South Pacific. Judging from the letters received, the program has been widely appreciated.

Radio New Zealand commenced shortwave broadcasting on September 26, 1948 and gradually expanded it service to include special programs in the languages of the South Pacific, with transmissions beamed to that area and to Australia. In May, 1976 the Government, in a dramatic move cut the funding of the Shortwave Service, and took the transmitters off the air. World-wide reaction followed and in five weeks the Shortwave Service was back in operation, though with no programs of its own and only a relay of the internal National Program. Since then, there has been a move to break away from the domestic program and include special transmissions to the South Pacific in the languages of that area.

Two of the regular features of the Shortwave Service were introduced to the National Program in 1976, so that they would still be heard by shortwave listeners. These two programs, Arthur Cushen's DX World (which had been broadcast since 1960) and Mail Box with Tony King, were heard on the first and third Sunday of each month. Recently the External Service of Radio New Zealand decided to incorporate both these programs in a special transmission for shortwave listeners. This is now broadcast every two weeks using the title "New Zealand Calling".

The first broadcast is to the West Coast of North America 0530-0600UTC on 15345 and 17860kHz, with a repeat at 0845-0915UTC on 6105 and 11945kHz for New Zealand, Australia, Japan and the South Pacific. These broadcasts are heard every second Monday and are scheduled for 11th and 25th August and 8th and 22nd September.

The first broadcast showed that listeners appreciated this new program and in the first few days over 100 letters were received from throughout the Pacific Basin. 90% of these remarked on the DX World contribution to the program. It is obvious that since Club Forum ended on Radio Australia and the DX Time feature discontinued, the need for a replacement program from the South Pacific was widely felt.

Radio New Zealand has verified reports on the "New Zealand Calling" program with a special verification card. Reports should be sent to the External Service, Radio New Zealand, PO Box 2092, Wellington. Two IRCs should be enclosed for return postage.

MOVE TO UTC

At the World Administrative Radio Conference held in Geneva last year it was decided that International broadcasters should give time announcements in Co-ordinated Universal Time in place of Greenwich Mean Time. The abbreviation is UTC and there is no change in the actual time but only a change in the name of the time standard. The usual 24 hour clock system is still in force and readers of this feature will find only a change in the designation of the times we are quoting

RADIO POLONIA

The Polish Radio in Warsaw has recently changed its slogan to "Radio Polonia", which indicates the area around Poland. Warsaw broadcasts to North America 0200-0230UTC and 0300-0330UTC on 6095, 6135, 9525, 11815 and 15120kHz. This transmission is of 30 minutes in English and then 30 minutes in Polish. The higher frequencies should provide fair reception for the next few weeks.

Another transmission in English, beamed to Europe, is heard 0630-0700UTC on 6135, 7270 and 9675kHz, with the latter frequency giving the best reception.

TIFC VERIFIES

Radio TIFC, the Lighthouse of the Caribbean, has confirmed reception of their broadcasts on three shortwave frequencies and gives some details of their transmitters. According to the scheduele the station operates 1055-0435UTC, but the station has been heard opening as late as 1130UTC.

The three shortwave tranmitters operate on 5055kHz with a power of 5000W, 6175kHz at 2500W and 9645kHz at 500W. TIFC is located approximately 3km from the centre of San Jose, the capital of Costa Rica. This high central area is surrounded by a ring of volcanic mountains, three of which have erupted within the past 15 years. The present population of Costa Rica is nearly two million.

TIFC broadcasts Gospel programs in Spanish, while English is broadcast 1935-2155UTC.

RADIO KIEV

The English broadcasts from Radio Kiev in the Ukraine have been heard on new frequencies. We have noted an English program 2000-2030UTC on 11880kHz. As well, the station announces that it is also using 7175 and 9560kHz.

The broadcast to North America 0300-0330UTC is heard on several channels including 11735, 11790, 15180, 15405 and 17870kHz. The station has an earlier transmission at 0030UTC on the same frequencies. Radio Kiev has a DX program which has been heard on Wednesday afternoons and is best received at 0300UTC.

TURKEY CHANGES FREQUENCIES

The Voice of Turkey at Ankara has been heard on new frequencies with the English transmission 2030-2130UTC on 11885 and 11895kHz, according to Douglas Doull of Auckland NZ. At 2200UTC Ankara Radio was heard to announce that they were using 7215, 9515, 15250 and 15360kHz. The transmissions for Australia and South East Asia

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

SHORTWAVE SCENE

1200-1300UTC are now on 17860kHz with an additional frequency of 11880kHz beamed to North America. English is broadcast 1330-1430UTC to South West Asia on 17860kHz according to the World Radio Handbook Newsletter.

EXPANSION OF VOICE OF MALAYSIA

The Voice of Malaysia, Kuala Lumpur, the External Service of Radio and Television Malaysia (RTM), is to be beamed to more countries in Asia and later to Europe. At present the service is beamed to Australia and New Zealand, Indonesia, the Philippines, Thailand, Burma and West Asia. Under the Voice of Malaysia expansion project, priority would be given to broadcasting to Asia, according to a BBC Monitoring Service report.

The Voice of Malaysia broadcasts to Australia in English 0625-0855UTC on 6175, 9750 and 15295kHz, with the latter frequency giving the best reception.

BERLIN RETIMES SERVICE

Radio Berlin International in East Germany has brought forward its broadcast times and has been noted on new frequencies. The afternoon transmission to this area 0230-0315UTC is on 11840, 11890 and 11975kHz; The broadcast to Australia 0545-0630UTC is on 17700, 21465 and 21540kHz; and a later transmission 1215-1300UTC is on 21485kHz. Other transmissions received in this area are at 1900-1945UTC on 9665 and 15390kHz. Afternoon signals include an English broadcast 0345-0430UTC on 11795 and 11720kHz.

The Spanish transmission received during our afternoons has been noted at 0300UTC on 6070kHz, while 6040kHz carries the same transmission.

NEW FRENCH RELAYS

Tests from Africa No.1 in Gabon earlier in the year were a preliminary trial of the 500kW transmitters, in preparation for use by Radio France International. According to a BBC Monitoring Service Report, a French official has signed an agreement with the Gabonaise Government to operate the stations at Moyabi and studio facilities in Libreville.

According to the BBC Monitoring Service, France has decided to set up a radio station in Morocco similar to that of Africa No.1. The project is to be carried out by a French state-owned company. The report added that the radio station would broadcast in African languages and would function in collaboration with the African service of Radio France Internationale

LISTENING BRIEFS

EUROPE

CZECHOSLOVAKIA: Radio Prague's present schedule includes the use of a new frequency, 21705kHz, for the service to Australia. The broadcast in English is heard daily 0730-0800UTC and is repeated 0830-0900UTC on 11855, 17840 and 21705kHz. On Saturdays and Sundays there is an extra broadcast from 0900-0930UTC. The transmission in English 1430-1457UTC is on 7345, 11990, 15110, 17705, 17840, and 21505kHz, the latter frequency replacing 21615kHz.

DENMARK: Copenhagen broadcasts transmissions of 50 minutes duration on 15165kHz. The transmissions are 0900-0950, 1000-1050, 1100-1150 (to Australia), 1200-1250, and 1300-1350UTC. The next transmission is 1630-1730UTC and then from 1800 onwards transmissions are heard each hour up to 2350UTC. All broadcasts are in Danish with an English announcement at the opening of each transmission.

AFRICA

CAMEROON: Details on the new signal noted on 4000kHz have been given by WRH Newsletter. This station is located at Bertoua and opens at 0430UTC with announcements in English and French. Signals have also been observed around 2000UTC. The address of this new station is Radio Bertoua, PO Box 230, Bertoua, Eastern Province, Cameroon.

UGANDA: According to the BBC Monitoring Service, Radio Uganda is now operating on 5027kHz with a test transmission. The station announced that they would appreciate reception reports to Radio Uganda, PO Box 2038, Kampala. Reports from Australia indicate that this frequency has also been observed around 1900UTC, with the close-down at 2100UTC.

ASIA

MALDIVE ISLANDS: Adrian Peterson of Poona India, has supplied the latest schedule for the "Voice of Maldives": Saturday-Thursday 0030-0330UTC on 4754kHz at 7.5kW; Friday 0030-0500UTC on 4754kHz; Saturday-Friday 1200-1730UTC on 4754kHz; Saturday-Thursday 0800-0930UTC on 9550kHz at 1kW; and Friday 0700-0930UTC on 9550kHz. These programs are also carried on medium-wave on 1485kHz with a power of 1kW

LEBANON: Radio Lebanon in Beirut has been heard on 15375kHz opening at 0130UTC with a program in French. The Transmission continues in English at 0230-0300 but the frequency is subject to severe jamming.

IRAN: The Voice of the Islamic Republic of Iran at Tehran has returned to 9022kHz from 9033kHz and is heard with English at 1830-1930UTC. The transmission also includes French at 1800-1830UTC, while after 1930UTC the program continues in Persian.

NEW PRODUCTS

FM "wireless" microphone from Dick Smith

Recently released by Dick Smith Electronics is a new, highly compact FM wireless microphone which, when used in conjunction with an FM receiver, provides portable, unobtrusive public address or recording facilities. The transmitter measures just 60 x 41 x 13mm and is easily concealed on the person.

Called the Hi-Mike WEM-31, the device consists of a cardioid electret microphone which plugs into a separate FM transmitter unit via a phono socket. Signals generated by the transmitter can be picked up on a standard 88-108MHz turner (as used in hifi systems), with the actual frequency of transmission tunable over the whole FM band by means of an adjustment slug on one side of the transmitter. This adjustment is provided so that the user can avoid interference from local FM stations,

Power for the unit is supplied by two mercury cells which the manufacturer claims have an operational life of around 50 hours. Current drain is quoted as 4.5mA. The circuit itself uses four transistors, including a FET preamplifier for the electret microphone. Actually, there are two different microphones available from Dick Smith for use with this unit – a miniature tie clasp model complete with clip (as pictured), and a conventional hand-held model.

The sensitivity of the microphone can be adjusted by a miniature potentiometer control which also doubles as an on/off switch. With the gain at maximum both the sensitivity and the signal-to-noise ratio are excellent. Even with the microphone positioned a metre from the speaker, signal levels are still good and the sound is clear and undistorted.

The FM output level is quoted as less than 15uV/m at 100m which means that 15uV signal will be developed across a dipole antenna at this distance. This is an acceptable level since a typical tuner will give a 55dB S/N ratio at 10uV. At closer distances, of course, the signal will be much stronger and a better S/N ratio would be obtained. This was verified by tests we made which showed that a good quality signal could in fact be received at least 20 metres away.

Our only real criticism of the unit is the tendency of the transmitter frequency to drift when the trailing 60cm wire antenna is moved. Even with the antenna securely tied down, the frequency will drift if the wearer moves about.

The Hi-Mike WEM-31 wireless microphone can transmit signals up to 100m for reception on a standard FM tuner.

The batteries, a frequency adjusting rod, and a simple instruction sheet are included as accessories with the unit.

Retail price of the Hi-Mike WEM-31 with the tie clasp microphone is $29.95, and with the handheld microphone is $27.50. The Hi-Mike is available at Dick stores, or enquiries can be made by mail to PO Box 321, North Ryde, NSW 2113.

Versatile analog multimeter

An electronic analog multimeter which provides 62 measuring ranges, including current up to 10A and resistance to 30M, has been launched by Philips Test & Measuring Instruments. The new meter, the PM 2505, features a built-in audible continuity tester and automatic polarity indication, and has an input impedance of 10M.

Resistance ranges from 100 ohms to 30M on a linear scale, DC voltage ranges from 100mV to 1000V, AC voltage ranges from 100mV to 600V, and AC and DC current from 1uA to 10A are all provided. In addition, there is a diode test range and a battery check function.

Full overload protection is provided, and the standard test leads are designed for use up to 1000V.

For further information contact Philips Test & Measuring Instruments, 25 Paul St North Ryde, NSW, 2113.

HP Model 5316A Universal Counter

The new Model 5316A Universal Counter from Hewlett-Packard measures frequency, frequency burst, frequency ratio, time interval, time interval average, and period. Two input channels operate over the counter's 100MHz range, and an optional third input channel is available to cover frquencies to 1GHz for communications applications.

The counter uses reciprocal-taking measurement for frequencies below 10MHz, providing full 8 digit resolution over its complete range, so accurate measurements of low frequencies can be made very quickly.

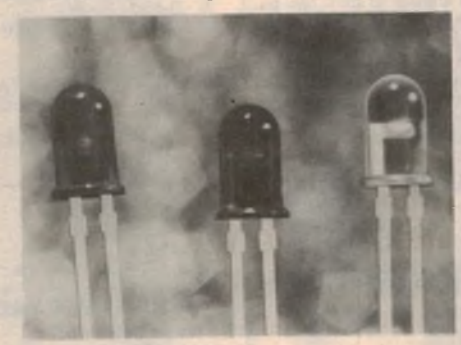
The Model 5316A is fully compatible with the IEEE488 instrumentation bus, and is Hewlett-Packard's lowest price fully programmable systems counter. It can function as both "talker" and "listener" on the IEEE488 bus, and all major measurement functions are programmable, including trigger level.

For further information contact Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St. Blackburn, Vic 3130.

New LEDs have built-in current limiting

Two new series of light-emitting-diode (LED) "lamps" from Hewlett-Packard combine a LED, current-limiting resistor, and reverse-protection diode in one subminiature package. LEDs which may be driven directly from a 5V supply are available in high-efficiency red, yellow and green. Standard red indicators are available in both 5V and 12V models.

For further details, contact Cema Electronics Pty Ltd, 21 Chandos St, St Leonards, NSW 2065 or 208 Whitehorse Rd, Blackburn, Vic 3130.



Smoke detectors for early fire warnings

"There's no smoke without fire", as the old saying has it, and equally there's no fire without smoke. In the case of fire, smoke can usually be detected long before the fire itself gets out of hand, and so a wide variety of smoke detectors has been developed.

Chloride Batteries Australia Ltd has now announced that it has been appointed sole Australian agents for Chloride Pyrotector, one of the leading manufacturers of smoke, flame and heat detectors in the United States. A full range of detectors, covering residential, marine, industrial and aircraft applications is available. In addition, the Pyrotector range of smoke detectors, based on photoelectric principles, has been expanded to include ionisation units, providing a wide choice of devices for every application.

Full details of the new range are available on application to The Product Marketing Engineer, Chloride Batteries Australia Ltd, PO Box 168, Smithfield, NSW 2164.

A.C.E. RADIO

136 VICTORIA RD. MARRICKVILLE, NSW 2204 PHONE 51 3845

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● NEW BSR STEREO RECORD PLAYER ● ● MANUAL OPERATION ●

Model P-207 ● 240V AC, 50Hz ● Auto-Stop ● S-Shape tone arm ● Ceramic cartridge, diamond stylus ● 33-45rpm ● Plays 17, 25, 30cm (7, 10, 12in) records ● Cue lever ● Template for cut-out ● operating instructions ●

~~$49.95~~ *P&P NSW $3.00; V, SA, Q $4.00; TAS, WA, NT $5.00*

● HITACHI STEREO CASSETTE TAPE DECK

Model D-230. Front Load. Dolby system. 12 mth warranty.

DISCOUNT PRICE **$155.00**
SEND SAE FOR SPECS

P&P NSW $3.50
INTERSTATE 5.50

FACTORY SCOOP ● ½ PRICE BARGAIN ● BRAND NEW A1 QUALITY ● 8"(20cm) 2-WAY SPEAKER SYSTEM ● 8 OHMS ● 10 WATTS ●

$42 PAIR

ATTRACTIVE WALNUT CABINET: 62H x 30W x 14½D cm

P&P NSW $3.00, SA, V, Q $4.00 TAS, NT, WA $5.50

HEAVY DUTY POWER TRANSFORMERS

Ferguson type PF3040. 240V, 50Hz. Primary sec. 25-0-25V, 11 amp, cont. 152H x 127W x 115D mm. Wt 10kg. $39.95
P&P NSW $3.50.
INTERSTATE $6.50 ●
270-0-270V. 190MA, 5V, 1.9A, 6.3V, 2A, 6.3V, 1.7A. $13.50. P&P NSW $2.50. INTERSTATE $3.50. ●
PF2050. Prim 240V. 50Hz. 0-285V. 325V-0-325V, 300MA, 6.3V, 12A, 5V, 3A. $17.50. P&P NSW $3.50. INTERSTATE $5.50.
Type 216. 240V, 50HZ. Prim 325V-0-325V, 300MA, 6.3, 12A, 5V, 3A. $17.50 P&P NSW $3.50. INTERSTATE $5.50.
PF385, 240V, 50Hz. Prim 225V-0-225V. 125MA. 2 x 6.3V, 2A, 5V, 2A. $8.50. P&P NSW $2.50. INTERSTATE $3.50.

FIBREGLASS P-C BOARD

A1 quality • Fraction of normal price • 1.5mm single sided.
405 x 310mm.
$2.50 ea. P-P 75c.
or **3** for **$6.25.** P-P NSW $1.50, interstate $2.50.

CERAMIC INSULATORS HIGH GLAZE

High power stand-off (illustrated) 110mm high, flange dia 95mm **$4.50.** (with hardware) P-P NSW $1, Interstate $1.50. Stand-off ● Above chassis MT 75mm high, mounting hole centres 55mm **$2.50.** P-P NSW 75c. Interstate $1.25.

EGG INSULATORS

10 for **$8.50.** P-P NSW $1.25. Interstate $1.75 ● Ceramic coil formers ● Fluted with tuning slug dia 23mm x 62mm, stripped from ex-AWA transmitters. **$2.50.** P-P NSW 75c. Interstate $1.00.

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Omni-directional ● Heavy duty base ● On/off switch ● 310mm Goose neck ● 3 mtrs Cable, 6.5mm plug ● Freq 70-12kHz. Sen — 50dB ● 50K ohms Imp ●
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220vac 50/60Hz 120x120x38mm **$17.50**
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P&P 50c

5 RPM. Plenty of torque. With Cam and N/O N/C microswitch. 15 switch contacts per min. OA size 65 x 60 x 35mm.

Refer Dec 79 EA New Products Review

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Paper capacitor. Type APA250. Ex PMG equipment. 5mfd 250vac 50Hz.
$2.50 P-P 75c

● BSR BELT-DRIVE RECORD PLAYER ●

ABSOLUTE LATEST MODEL P-200

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STYLISH S SHAPE PICK-UP ARM ● ADC MAGNETIC CARTRIDGE, DIAMOND STYLUS INCLUDED ●

ALSO AVAILABLE WITH WALNUT BASE AND PERSPEX COVER WITH HINGES **$129.95** P&P NSW $5.00 INTERSTATE $7.50

Specs. 240VAC 50Hz, auto or manual operation ● Plays 17, 25, 30cm (7, 10, 12in) records ● 33 and 45 rpm, adjustable counter weight and stylus pressure ● cueing lever ● Bias compensator and anti skate control ● Die-cast platter with mat ● RCA audio plugs and cable. 3-core power cable and plug ●

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LOW NOISE ● HIGH EFFICIENCY ● PRIMARY 240V. 50Hz. CONT. RATING.

MODEL	SEC.V.	AMPS	PRICE	PACK AND POST V. Q. NSW	SA. T.	WA. NT
JT 266	0-18V	8A	$25.95	$2.95	$3.75	$5.50
JT 235	26-0-26V	2A	$24.95	$2.95	$3.75	$5.50
JT 248	0-10V	10A	$25.95	$2.95	$3.75	$5.50
JT 249	8.5-0-8.5V & 15VCT	4A 1A	$26.50	$2.95	$3.75	$5.50
JT 274	0-9.5V & 2x0-12V	10A 1A	$26.50	$2.95	$3.75	$5.50
JT 253A	0-18V	12.5A 30A PEAK	$45.95	$3.50	$5.50	$7.00

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MODERN SMALL TYPES
Primary 240V 50HZ

Type No

1. 12-0-12V ½A $2.95
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4. 0-240V 60MA Isolation $3.50
5. 0-40V 250MA $1.95
6. 12-0-12V 1A, 6-0-6V 1A $3.00
7. 0-17V 200MA $1.95
8. 0-13V 1A, 0-9 1V 1A $3.00
9. A&R 6232 70V CT 75A $6.50
10. 115-0-115V, 300MA 15-0-15V 400MA 6.3V 4A C-CORE $8.50
11. 0150V, 300MA 6.3V 8A C-CORE $8.50
12. 55-0-55V,2A, ideal for 110V, 1A $7.50
13. 6.3-0-6.3V, 250MA $2.50

● HI POWER VALVES

KT-66 **$10.95 ea.**
6 L6GC **$5.75 ea.**
P-P NSW 75c. Interstate $1.50.

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* Rugged diecast frame.
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12" Woofer, 30 Watts RMS.
Resonance 65Hz.
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12" Twin Cone, 30 Watts RMS.
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	Speaker	NSW	Interstate
Pack	1	$2.00	$2.75
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Guaranteed brand new, A1 quality. Min order $10. Modern panel mt lever switch, DPDT, 10 for $2.75.
Polyester caps. PCB. 0.47UF/100V, 2UF/50V. 25 for $4.00.
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Black plastic boxes — strong. 63 x 53 x 20mm. 5 for $3.00.
Mini toggle switch, sim to C and K, SPDT 250V 3A, 3 for $2.95.
Add P&P NSW $1.50. INTERSTATE $2.50.

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$24.95

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SIZE	AH	PRICE	PP
D.	4	**$6.25**	75c
C.	1.8	**$3.75**	75c

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PP NSW $1.50; INTERSTATE $3.

High-performance 400MHz oscilloscope

Tektronix Australia has introduced a new oscilloscope, the Model 7854, which combines analog performance with microprocessor-based waveform processing. In addition to the capabilities of a conventional oscilloscope, the 7854 features digital storage of waveforms, which may be recalled later for comparison. With optional memory the 7854 can digitise and store up to 40 waveforms.

The 7854 offers a bandwidth of DC to 400MHz and calibrated sweep rates to 500 picoseconds/division as well as storage of waveforms, signal averaging, and storage of single shot events, with a fast sweep of 50us/div.

The oscilloscope is pre-programmed so that the most common waveform measurements – such as rise and fall times, pulse width, and complex waveform comparisons – can be made by touching a button on the calculator keyboard. Users can also create their own measurement programs using the calculator.

The instrument has a GPIB interface for customers requiring additional processing, data storage or co-ordination of the oscilloscope with other instruments. Waveform data or measurement results can be sent over the interface, and keystroke instructions or CRT text can be sent to the 7854 via the interface.

Further information from Tektronix Australia Pty Ltd, 80 Waterloo Rd, North Ryde, NSW, 2113.

Magnalite-for PC board inspections

What at first glance may appear to be a fairly useless little torch is actually a very handy gadget for inspecting PC boards. The lens hinges out 90°, as shown in the photo, with the result that the surface under inspection is not only illuminated, but also magnified.

Price is $3.50 from Altronic Distributors Pty Ltd, 151 York St, Subiaco, Western Australia 6008.

Function generator

Leader's LFG-1300 function sweep/AM generator has a frequency range from .002Hz to 2MHz in eight ranges. It features an internal and external 1000:1 sweep range; sine, square, pulse, triangle, sawtooth and TTL outputs; a built-in 70dB attentuator which can be switched in 10dB steps; and external AM/FM inputs. Accuracy is stated as ±3% of reading ±3% of full scale up to 200kHz and ±5% of reading ±3% of full scale from 200kHz to 2MHz.

Leader is available in Australia from Vicom International Pty Ltd, 68 Eastern Rd, South Melbourne, Vic 3205.

New Products

20MHz logic trigger probe

Philips Test & Measuring Instruments division has released a 20MHz logic trigger probe designed to increase the trigger capabilities of any logic analyser or oscilloscope. The PM 8810 Logic Trigger Probe has 16 inputs with two qualifiers and provides a choice of TTL, ECL or variable thresholds, and can operate synchronously or asynchronously with the user's system clock.

The probe essentially functions as a trigger word recogniser, extending the analyser trigger word by up to 16 bits. Time filters are provided with a choice of 15, 50, 65, 150, 500 or 650ns minimum triggering pulse duration to avoid the possibility of the probe being triggered by glitches or other unwanted short duration events. The logic triger probe is a compact unit, measuring 230 x 110 x 210mm, and is supplied complete with active probe pods.

Further ... mation can be obtained from Philips Test & Measuring ' .ruments, 25 Paul St, North Ryde, NSW 2113.

Automatic universal counter

A new electronic counter from Hewlett-Packard, the HP 5335A Universal Counter, features built-in calculating capability and automatic measurement routines. The counter combines a microprocessor with a "Multiple Register Counter" (MRC), which is a high density, analog/digital, LSI chip specially designed and produced by Hewlett-Packard for this type of application. The Hewlett-Packard IEEE-488 interface bus is standard, to facilitate communication and processing of measurements.

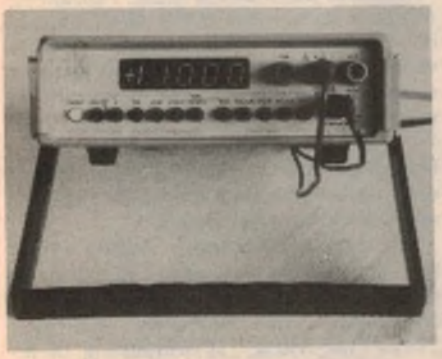
The HP 5335A combines reciprocal-taking measurement techniques with automatic interpolators to provide 9 digits per second display for all frequency measurements up to 200MHz or, with an optional extender, up to 1.3Ghz. Other measurements available include frequency ratio, period,

period average, and totalising. Measurements that normally require extensive data processing, such as phase, duty cycle, rise and fall times, and slew rate can be made by simply pressing keys on the HP 5335A front panel. In addition, statistical data such as standard deviation and mean value can be automatically computed and displayed for any of the measurements.

All measurements can be processed by the counter's maths functions. This feature can be used to obtain direct readout – of up to 12 digits – in units such as rpm, pressure, flow rate, velocity, or temperature, or the counter can display frequency deviations, or add and subtract intermediate frequencies. Four trigger level setting functions are provided, so the counter can be used with a wide variety of waveforms. Trigger level, in volts, is displayed at the touch of a single button, and an auto-adjustable mode allows the counter to sense the input signal amplitude and adjust the trigger level accordingly.

Further details can be obtained from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn Vic 3130.

Two new digital multimeters



Applied Measurement Australia Pty Ltd now has available two digital multimeters in the Kontron 3½/4½ digit range that feature built-in calibrators which allow a complete recalibration with only three adjustments. Options available include battery operation, BCD output, and a "hold probe" feature. The hold option allows the user to concentrate on positioning the probe, and when the probe is removed from the measuring point the reading is frozen – a particularly useful feature when testing high density circuits and points with poor access.

The meters have measurement ranges from 200mV to 1000V DC, 200uA to 10A, and 200 ohms to 20 megohms, and the inputs are protected to 750V RMS for AC, to 1200V for DC, and to 250V RMS on the ohms ranges.

For further information contact Applied Measurement Australia Pty Ltd, PO Box 207, Glen Iris, Vic 3146.

REVIEWS OF RECENT

Records & Tapes

CLASSICAL ● POPULAR ● SPECIAL INTEREST

THREE ENGLISH COMPOSERS: Brian, Finzi, Delius

BRIAN (Havergal) — Symphony No. 8 and Symphony No. 9. Royal Liverpool Philharmonic Orchestra conducted by Sir Charles Groves. An HMV Stereo Recording released for its members in Australia by the World Record Club. (Compatible Quadraphonic) WRC-OR 06089.

How many well informed readers of this column could identify an English composer as under: born in the Staffordshire potteries in 1876; died in Sussex in 1972 at the age of 96; worked for coal mines, timber firms and carpenters; had an undeniable urge to compose music; for most of his last 50 years lived in obscurity; is only just creeping into the concert and record repertoire?

I am referring to Havergal Brian. Despite the admiration of Elgar, Tovey and Richard Strauss, who encouraged him to write five operas, eight massive choral works, 32 symphonies and a host of smaller works, his compositions were largely ignored.

His life was a bizarre series of ups and downs — mostly downs — and it is only since the '60s that his works have been even sparsely performed. This disc is the first fully professional one ever to be made of any of his major works.

Both symphonies are brief, the eighth written in 1949, the ninth two years later. My advice is not to play them in chronological order, the latter being the easier to listen too. It is full of fine themes, the orchestration is superb and the playing excellent. Don't rely on a hurried first hearing to form your opinion of its many alluring features. These will emerge as you get to know the symphony better. Although its structure is more or less formal for a one movement symphony — which really has its divisions into three movements played without pause — it changes tonalties with bewildering frequency. Although there is no break you will recognise the adagio by the introduction of a sad cor anglais solo.

It starts lyrically, even elegiacally but Brian's character was too restless to leave it in this placid mood and, later, he sends it rocketing into a heady climax, before returning to its opening atmosphere. From this he goes on to a triumphal march-like Finale. This, too has its tranquil interruptions but soon moves back to heroism.

You will be wise to get well used to

"Again, the scoring is quite wonderful . . ."

nine before starting on No. 8, which makes much heavier demands on the listener's concentration. It is a work of colliding moods and, although much of the music has obvious depth, one is left with the feeling, after a few readings, that all is not revealed by either orchestra or conductor. This, despite splendid playing, a little ragged for only a few bars, a hint perhaps of too hurried preparation. Again the scoring is quite wonderful and many might be tempted to repeat the work several times to enjoy this feature alone. The engineering of the whole disc is superb. (J.R.)

★ ★ ★

FINZI — Orchestral Works. A Severn Rhapsody; Introit; Nocturne; Three Soliloquies for Love's Labour Lost; Romance; and The Fall of a Leaf. World Record Club Stereo R 06092.

Here is another obscure English talent rarely recognised or played — if one excepts his songs and other forms of vocal music. He was a contemporary of Holst and Vaughan Williams and although he had the stature of neither, his work has the same inexplicable quality that labels it "English"; this, after having listened to only a few bars.

The English Gramophone record catalogue lists only the smaller of his works as having been recorded although there is talk of doing some of his larger works. For instance, this disc under review has seven works, some of them very brief and none that could be called major; yet all are very pleasant indeed to

Havergal Brian

listen to. It is to be regretted that he is so seldom heard in Australia, at any rate, in Sydney.

Asked to describe his music I would be tempted to say it is rather like Delius in its atmosphere but without Delius' sliding from key to key through luscious sounding chords of the dominant in many of its extensions and inversions. Yet it is not without passion of a typically English gentlemanly kind. If you want to enjoy some plangent whiffs of nostalgia, you'll find them in this disc.

The Severn Rhapsody, written when the composer was only 22, already shows a firm grasp on picturesque orchestration. The Nocturne, sub-titled "New Year Music", is something of an anomaly since, instead of greeting the New Year with joy, it is more in the mood of regret at the passing of the old.

"Rather like Delius in its atmosphere"

The selection here gives a good idea of Finzi's fairly large output during his relatively short life, much of it produced during his stay of three years as Professor of Composition at the Royal Academy of Music, London. You will find in this disc nothing really gay, although much quiet joy. Indeed there is not a single really fast movement. The one piece that might appear to contradict this last statement is the last of the three soliloquies composed as incidental music for Shakespeare's Love's Labour Lost. Even so, because of the moderate tempos of all the works on this disc, you may risk monotony if you play them all at one sitting. (J.R.)

Reviews in this section are by Julian Russell (J.R.), Paul Frolich (P.F.), Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

DELIUS — North Country Sketches; Life's Dance; and a Song of Summer. Royal Philharmonic Orchestra conducted by Sir Charles Groves. World Record Club Quadraphonic/Stereo compatible disc W.R.C. R 4987.

Another example of short works by an English composer, who is most certainly of greater stature than either of the other two mentioned in this column this month, although by no means up to the standard allotted to him by Beecham — "The greatest composer of the first half of the 20th Century": Frederick Delius.

But Beecham had a way with Delius that has never been heard before or since. It was a magical touch that always sounded right. No matter how long he had rehearsed it one way on the morning of the concert he might play it quite differently at the concert itself and both times it sounded exactly right. Don't expect this Beecham magic from Sir Charles Groves, although he and his orchestra do very well indeed.

This issue consists of six pieces of varying length, one of them, Life's Dance, recorded here for the first time. It was composed as long ago as 1898 but hardly ever played. Coming before the well-received "Paris" it acts almost as a study for the larger work, especially in Delius' use of the orchestra, which is quite devoid of the usual Delius mannerisms. Indeed it seems to show such diverse in-

fluences as that of Richard Strauss and Elgar. Yet it is still typically Delian and no collection of his works would be complete without it.

Nothing could have less in common with the forward looking composer of the period than his suite of North Sketches. The four pieces take on the characters of the four seasons. Here are some of the highlights: The extraordinary scoring for high strings in the second, Winter Landscape. A dreamlike - yes, dreamlike - atmosphere in a mazurka - like dance, which grows handsomely in its climax in Summer (No. 3). No. 4, Spring, is rhapsodic, sumptuously scored, and full of surging energy.

The concluding item, Song of Summer, opens in an atmosphere of lulling serenity, interrupted by surges of Delian rapture. Much of it is reminiscent of the Cuckoo-Village Romeo period and, although dictated to an amanuensis, remains truly Delian in form, harmony and orchestral colour. (J.R.)

DEVOTIONAL ALBUMS

GOT TO TELL SOMEBODY, Don Francisco Newpax NP33071. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135.)

Don Francisco is somebody new to me in the gospel music scene and he creates songs that make you sit up and listen again and again with titles like these: If You're Thirsty — Steeple Song — The Duke And The Duchess — Whenever You're Speaking To Me — Got To Tell Somebody — Who Do You Think You're Fooling? - I'll Never Let Go Of Your Hand — Balaam — He Still Loves You — Too Small A Price.

Three of the tracks warrant special mention: "Got To Tell Somebody", the story of Christ's miraculous bringing back to life of the little girl, daughter of Jairus, as described in the Gospel of Mark chapter 5; "Who Do You Think You're Fooling?", a powerful condemnation of hypocrisy; and the last track, "Too Small A Price", a haunting description of the Crucifixtion, as seen through the eyes of the thief who was forgiven.

It would be worth buying the record for this track alone. The backing group and overall quality is superb. (N.J.M.)

★ ★ ★

ANDRAE CROUCH, I'll Be Thinking Of You. Light LS5763. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135.)

Eight tracks, including a three-part medley, demonstrate the musical skills of Andrae Crouch in the field of popular Gospel music. The styles range from tent revival meeting, to old-time Negro spirituals to disco.

The tracks are: I'll Be Thinking Of You — I've Got The Best — Touch Me — Lookin' For You — Bringin' Back The Sunshine — The Love Medley — Dreamin'.

The backing, both vocal and instrumental, is first class and the sleeve carries the full lyrics of the songs and the names of the other artists involved. One interesting point: the vocal and most instrumental sections were recorded in Hollywood but the strings were recorded in London. (N.J.M.)

★ ★ ★

SONGS FOR INSPIRATION AND MEDITATION. The 101 Strings Orchestra. Alshire (Astor) stereo S-5031. (Also on cassette.)

I'm pretty certain that I've reviewed this record at some other time — or perhaps it's just the collection of old devotional evergreens that seems familiar:

Bless This House — Praise God From Whom All Blessings Flow — Rock Of Ages — Hallelujah Chorus — Beautiful Isle Of Somewhere — The Lord's Prayer — Holy, Holy — Onward Christian Soldiers — In The Garden — Abide With Me — The Lord Is My Shepherd — Now The Day Is Over.

As per the title, the music is orchestral throughout, with the strings well to the fore. However, it's not an album that I would recommend to anyone who is at all hifi conscious; the sound isn't clean enough. But if you don't mind turning the treble down a bit, and playing it at "reverie" level, the "inspiration" and the "meditation" might work for you. (W.N.W.)

BRAHMS — Piano Concerto No. 2 in B Flat Major played by Maurizio Pollini and the Vienna Philharmonic Orchestra conducted by Claudio Abbado. DGG Stereo Cassette 3300 790.

Among the multitudinous recorded performances of Brahms' two piano concertos, almost all share one feature in common: an approach as if the performer is scaling some mighty edifice, but dwelling for rest in the pleasant nooks and crannies on the way up. This applies equaly to all the greats: Arrau Brendel, Curzon, Backhaus. All have their individual ideas about interpretation but all finish up with a giant among piano concertos.

Pollini offers something different in his approach. He treats even its massive moments with lyricism, without trivialising them in any way. Of course, there are monumental passages in the work where gentleness is impossible; passages that will not be denied their expression as a fortress-like structure. These are given their due weight.

But there are parts of the work where Pollini and conductor Abbado seem to drift off into some dreamland, ignoring what has gone before and what follows. I am not referring to obvious places for such treatment as the lovely Andante movement but rather the general structure of the work.

By what I have just written I don't want to give the impression that this is anything but a very fine performance. Only that pianist and orchestra seem to find a more intimate communion with the composer than any I can recall having heard before. I admit that the treatment tends to fragment the work somewhat and to separate it into interludes. Yet such is the vitality of the performance that they never fail to hold the

listener's attention, whether or not he/she agrees with what is going on. It certainly becomes more decorative than usual, as against a version more pondered upon.

Some might find all this a refreshing change, others will be outraged. I confess to having been delighted, although I would not keep this disc as the only recording of the work. But I will certainly play it now and again, just for the change.

Without the space to go into other details, I will content myself by saying that the cellist in his beautiful solo in the Andante is good enough to be one of the world's most famous playing anonymously; that the most beautiful of all entrances of the solo instrument in the same movement will be found completely bewitching. (J.R.)

★ ★ ★

HAYDN: Orlando Paladdno (excerpts). Arleen Auger & Elly Ameling, sopranos; Gwendolyn Killebrew, mezzo-soprano; George Shirley & Claes H. Ahnsjo, tenors; Benjamin Luxon & Domenico Trimarchi, baritones; Lausanne Chamber Orchestra; harpsichord continuo and conducted by Antal Dorati. Philips (Serie Grandioso) stereo disc 6570 095 (pressing imported from the Netherlands).

This recording should help finally to disprove the long-held belief that Haydn was incapable of writing good operas. Despite its very silly libretto (and many other operas suffer from such) this comes mighty close to being a true masterpiece and it is easy to understand that the work enjoyed a huge success in Haydn's lifetime. If it can be given direction of the high quality provided by Dorati, this is an opera that may yet find favour again and restore Haydn to the opera stage.

There is no point in wasting time on the story — after all, Orlando is not even the central character in the opera named after him! The heroine is Angelica who is given a delightful cavatina, several magnificent arias and a highly dramatic accompanied recitative: all these are superbly sung by Miss Auger, sweetly lyrical where this applies, brilliant in her coloratura elsewhere. The part of the shepherdess Eurilla is sung cleanly and with some pertness by Miss Ameling. Ahnsjo, in the part of Medoro (Angelica's lover) sings with authority and beauty of tone though his voice seems rather too powerful for this occasion. George Shirley, reliable as ever, gives us an excellent Orlando.

One of the opera's central characters is the sorceress Alcina who is invariably appealed to when things don't run smoothly; she is sung by Miss Killebrew, whom I'd not heard before — hers is an exciting voice and Haydn provided her with some quite sensational opportunities, when coming to the rescue. As far as one can tell from mere excerpts, all the singers are absolutely first-rate and the same may be said for the orchestra throughout the varied score of comic and heroic episodes. Top honours, apart from the recording crew, must go to Dorati; he is now well

For information on World Record Club albums, contact the club at 605 Camberwell Road, Hartwell, Victoria, 3124. Tel. 29 3636.

ALLEN ORGAN: "Difference is minimal"

PHILIP HAHN PLAYS Buxtehude, Bach, Liszt, Franck, Vierne, on the Allen Computer Organ. Stereo, unbranded 32426. [From Allen Organs Aust, 32 Woodhouse Rd, Doncaster East, Vic 3109. Phone (03) 842 3465.]

If one had walked in on this performance in the First United Presbyterian Church of San Francisco, one would probably have accepted it without further ado as competent recital by a competent organist on a large classical instrument. And that's the way the casual buyer would react in picking up this album, with its conventional title and jacket notes.

But in the fine print and on the label are the words "Allen Computer Organ" and the inevitable question is likely to take precedence: "How does it sound?"

Let me answer that forthwith. In terms of its final sound, the Allen 603-3 is very much a real organ; in the acoustic environment of a big church, the difference between pipe and electronic, as revealed in this album, is minimal. It would appear that the program has been chosen with an eye and an ear to demonstrating the voices available — understandable in that Philip Hahn is apparently connected with the company that is responsible for the installation.

The items, attributed to the composers in the order above are: Prelude, Fugue and Chaconne in C Major — Two Chorale Preludes — Ave Maris Stella — Fantaisie In A Major — Carillon De Westminster.

The sound quality is good and, if the music appeals, you'll enjoy it in its own right and as an indication of the qualities of a big classical electronic instrument. (W.N.W.)

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enough known as a Haydn specialist to have undertaken the revival of stage-works as well and I shall be looking forward to any other Haydn operas he may proceed to direct; this one is certainly a great work and worthy of anyone's attention. (P.F.)

★ ★ ★

BEETHOVEN: 12 Minuets (WoO 7); 12 German Dances (WoO 8); 12 Contredanses (WoO 14). Academy of St Martin-in-the Fields; directed by Neville Marriner. Philips stereo disc 9500 567.

However gigantic Beethoven may appear in our artistic firmament, to his contemporaries he appears as yet another musical tradesman; a talented one, to be sure, an honoured one, but a tradesman all the same. For a composer 25 years old and still a relative newcomer to Vienna, it was quite an achievement to receive the 1795 commission for the composition of pieces for the annual Artists' Ball – an occasion attended by the Emperor and his court, as well as the leading aristocrats and citizens of the ancient city.

Beethoven acquitted himself honourably and although he never dignified these works with opus numbers, they were largely responsible for giving him access to Viennese society. The Contredaneses were written in 1802 – another set of dances, this time in French time, such as every composer regularly turned out! All 36 pieces are of interest, tuneful, variably scored and quite brilliantly played on this disc. Although one or the other of these dances may be familiar, most of them are rarely heard and I know of no other disc currently containing them all; I know of no other performance which could rival this one for standard of either playing or recording! (P.F.)

★ ★ ★

BARTOK: Piano concertos Nos. 1 & 2. Maurizio Pollini, piano; Chicago Symphony Orchestra; conducted by Claudio Abbado. DG Stereo disc 2530 901.

A mere 20 years ago, a recording of Bartok's first two concerti would have been quite a rarity and warranted exhaustive comment; now they are heard fairly regularly, both in concert and on disc. These works have become part of most pianists' standard repertoire and we are in the fortunate position of being able to make comparisons and considered choices. If a recording of this music was rare, even less expected would have been performances in the hands of Italian artists who, as a rule, are thought of as exponents of far more mellifluous works than those associated with the dreaded "Bartok" label.

BRASS IS BRILLIANT

AMERICAN BRASS QUINTET. Renaissance, Elizabethan and Baroque Music. DMS DELOS Digital D/DMS 3003. [From P. C. Stereo, PO Box 272, Mt Gravatt, Qld 4122. Phone (07) 343 1612].

Anyone who attends live performances regularly will know that the brilliance and intensity of brass instruments such as the trumpet and trombone is unmatched by any other musical instrument. In fact, anyone with reasonably acute hearing will be made positively uncomfortable by the crescendos from a trumpet, if he or she happens to be listening "on axis" and within about 30 metres or less and indoors. So, while they can be thrilling to listen to, trumpets are rather more comfortable "off axis".

Often, disc recordings of brass instruments and trumpets in particular, are but pale shadows of the real instruments. This certainly does not apply here. With the advantage of greatly increased potential dynamic range from the digital recording technique and the use of special "high pressure" microphones, the full impact of trumpets has been captured. With the volume control set for lifelike reproduction, the trumpets and other brass instruments really do sound the part.

This brilliant sound quality goes with a brilliant brass ensemble. The American Brass Quintet is recognised as one of the world's finest. Some of the compositions they play on this record are as follows: Samuel Scheidt: Battle Suite; J. S. Bach: Art of the Fugue, Contrapunctus No. 9, Contrapunctus No. 3. German Festive Sonatas, two by Daniel Speer, one by Johann Storl. Venetian Baroque: three pieces by Giovanni Gabrieli, one by Andrea Gabrieli. And several others. Highly recommended. (L.D.S.)

In the event, one's prejudices are proved groundless; Messrs Abbado and Pollini supply readings that are full of affection, warmth and colour – more or less what one would expect – plus a marked lack of inhibition and good humour. Recent excellent performances by Stephen Bishop-Kovacevich, conducted by Colin Davis, were remarkable for their seriousness and profundity; by contrast, the Italian team are less awed and bring a degree of expansive exuberance to the works. As regards virtuosity, the two pianists are probably about level and there can be no great preference for either on pianistic grounds.

Among the many felicities of this disc must be listed the beautifully pure string tone of the orchestra, the avoidance of aggressiveness in the 1st and the emphasis on dancing sparkle in the 2nd concerto. On close comparison, the Chicago orchestra might be a little less stylish than either of the English ones heard on the Philips set – the superiority would be marginal. On the other hand, the vivid sound captured on this DG issue would be hard to beat. In all, a valuable and very enjoyable record. (P.F.)

★ ★ ★

WITH A BIT OF BRASS. John Inman. Stereo. Interfusion (Festival) L-37264.

A curious record this. Backing is provided by the West Midlands Police Male Voice Choir – a group in the tradition of many other British male choirs. With them is the Webb Ivory Newhall Band – amateurs all, but you would never know it. John Inman is up front at the mic, hamming his way through 13 numbers.

Tandem Song – The King's Horses – The Laughing Policeman – Pensylvania Polka – Northern Lament – Lily Of Laguna – 76 Trombones – The Music Goes Round – A Policeman's Lot – With Catlike Tread – Christopher Robin – Omm Pah Pah – My Gran's Trombone.

Personally, I would have been happier if it had been left to the choir and the band but that would obviously not have suited John Inman's fans for whom this record has been produced. Best you sample a few tracks. (W.N.W.)

★ ★ ★

THE VERY VEST OF FRANKIE VALLI. MCA 3198. Astor release.

Ten tracks, with a mixture of ballad and disco style, would be the best description of this disc, sung in a very light tenor, with an unnamed backing group. Most of the titles are standards: My Eyes Adored You – Grease – Our Day Will Come – Can't Take My Eyes Off You – You're Gonna Hurt Yourself – You're Ready Now.

The record quality is not really first class, having a distinctly edgy distortion at the beginning of some tracks. (N.J.M.)

From "Readers Digest" . . .

STEREO SPECTACULAR. Reader's digest eight-record set, or on six Dolbyised cassettes. (From Reader's Digest, Box 65 GPO, Sydney 2001.)

The description "spectacular" and "stereo all the way" is backed by the "Decca" label on the actual recordings and by the fact that they are sufficiently recent to be described as Decca "phase 4".

Record one opens the five-hour program with 10 light classical selections including "The Anvil Chorus from Il Trovotore" and "Hungarian Dance No. 5". All are played by well known orchestras. Record two changes the sound to that of big-band swing, provided in this instance by Ted Heath and his music.

Well known orchestras – Stanley Black, Frank Chatsfield, Ronnie Aldrich – provide music from the silver screen on record three, but Werner Muller and orchestra have record four to themselves: "Holiday Spectacular" Blue Hawaii, Paris and Rome provide just three of the theme venues.

Record five is a "Broadway Spectacular", record six a "Viennese Spectacular", and seven a "Country Spectacular". The last a "Finale Spectacular" – a kind of musical reprise.

I certainly didn't attempt to listen through the whole five hours for the purpose of this review but, in picking and choosing the tracks that caught my fancy, the performance and the sound quality gave no cause for disappointment.

So, if you want an "instant library" of popular orchestral selections, from light classics to country, this new R.D. set is an easy way to get it. The cost is $39.99 plus $1.75 postage ($1.16 for cassettes) payable in cash or by instalments. Write to Reader's Digest at the address above and they'll tell you more about it. (W.N.W.)

101 STRINGS AND THE ALSHIRE SINGERS do the Dolly Parton Song-Book. Alshire S5372. Astor release.

The 101 Strings and their vocal group, the Alshire Singers, do a competent job of performing 10 of Dolly Parton's best known songs, all with a hint of country and western style about them: Baby I'm Burning – Jolene – Because I Love You – We Used To – Miss Dolly – Two Doors Down – Love Is Like A Butterfly – Just The Way I Am – I Will Always Love You – Goodbye.

So you have a choice: either the songs sung by the writer herself, or a record such as this with a good vocal group doing the honours. (N.J.M.)

★ ★ ★

BLUE COLLAR, Movie Sound Track. MCA 3034. Astor release.

"Blue Collar" is a movie about the workers in the car industry in the USA and the problems they have with corruption in their union. The music is a mixture of Blues and rock, with a driving theme to remind one of the monotony of most of the jobs. Some of the tracks, are: Hard Workin'man – Satin Sheets – Wang Dang Doodle – Quittin' Time – Saturday Night Special – BLue Collar.

The musicians include Ry Cooder, Jesse Ed Davis, Tim Drummond, Stan Sileste, Jim Keltner, Milt Holland and Mike Boddicker. The sound quality is good. (N.J.M.)

"GOON-STYLE" HIFI DEMONSTRATION

PROFESSOR JOHNSON'S ASTOUNDING SOUND SHOW. Stereo, 45rpm, Reference Recording RR7. (From M.R. Acoustics, PO Box 165, Annerley Qld 4103. Ph (07) 48 7598).

"A touch of Goonish humour" in the presentation, says the M.R. Acoustic blurb sheet; that is putting it mildly. The whole jacket is styled like century old "Show" and "Wanted" posters. The presentation (or the crime): committing outrageously realistic sound "direct to tape".

Inside, the double-fold jacket are six columns of small print which boil down to the "purist" message: if you want sonically superb recordings, you go to a lot more trouble than is accepted top commercial practice: specially detailed microphones, near-fanatical care in mic placement, re-worked electronics, a custom-built analog master tape deck, half-speed transfer to disc and pressings by Teldec in Germany.

And it's not new; we (the writers) have been taping stereo that way since the late '50s.

To help make their point, they present five tracks: Fanfare and Band Organ – Red Norvo Group – African Ensemble – Pipe Organ – Harp – String Quartet – Tubulong.

Sonically, it's pretty impressive stuff, effectively demonstrating that sound-on-disc quality does not begin and end with the mere mastering process: analog vs direct vs digital.

The track contents would interest those with catholic, ie. wide-ranging tastes but, primarily, it is an album for audiophiles and, in that context, a sure-fire $13 conversation piece. (W.N.W.)

Books & Literature

For Beginners

ELECTRONICS SELF TAUGHT . . . with experiments and projects, by Jim Ashe. Published in 1971 by TAB books Blue Ridge Summit, Pa. Soft covers, 285 pages, 135 x 216mm.

This book covers almost every topic that is of interest to the beginning in electronics. Apart from the usual introduction to electronic principles, a fair amount of space is devoted to such topics as necessary, test equipment getting a lab together and various methods of assembling or prototyping projects.

While much of this advice on equipment and components obviously springs from some experience in the field, it is almost soley concerned with the American hobby scene, even to the point of nominating specific brands and models of equipment.

As far as the discussion of circuit principles is concerned the book is quite good, with extensive use of analogies being made. The book then goes on to the operation and use of transistors, diodes, SCRs and op amps.

Despite the recent origins of the book, though some of the terms used are not only wrong they can be quite misleading: transistors are referred to as transistor triodes; the logic symbol for an inverter is incorrect and logic ICs such as TTL and CMOS are almost completely ignored. Instead, the author discusses discrete diode and transistor logic.

Apart from these points, the book still provides a good description of the basic principles in electronics and could be a useful aid to the beginner. Our review copy was supplied by the Technical Book & Magazine Co, 288-299 Swanston St, Melbourne 3000. (RdeJ)

Computer Games

BASIC COMPUTER GAMES edited by David H. Ahl. Soft covers, 183 pages, 279mm x 210mm, illustrated with sketches. Published by Creative Computing Press. Price $11.75.

Reversing the usual order of things, we reviewed "More Basic Computer Games", the companion volume to this present book, in our November 1979 issue. There our reviewer stated: "With the current popularity of computer games and the number of small systems now around which speak Microsoft Basic, the book should sell like hot cakes."

David Ahl is the founder of the US magazine "Creative Computing" and many of these games have previously been published in that magazine. The book contains 101 programs, all of which have been converted to Microsoft Basic, so that they will run on all of the popular small computers, including the TRS-80, the Apple, the Exidy Sorcerer, and the Commodore PET. The one exception is the program called "Super Star Trek", which was created for a Data General Nova 800 system with 32K of memory. It is probably most useful as a guide for those who wish to write their own version of this classic game.

Each program is presented in the form of a full listing, accompanied by one or more sample runs and a brief description of the operation of the game. The book is fully indexed by program name and by category of game ("Educational", "Plotting", "Combat" etc), and opens with a brief guide to the Basic language and information on converting the Microsoft Basic programs to run on other systems. It is illustrated throughout with drawings of various bizarre robots which are entertaining in themselves.

Many of the games are variations on the same theme, and David Ahl has since written that "missles and cartesian coordinates are a very common theme in computer games . . . a bit overdone". Nevertheless, at approximately 12c per program, the book is good value.

Our review copy came from McGill's Authorised Newsagency Pty Ltd, 187 Elizabeth St, Melbourne, 3000, but copies should also be available from other technical bookshops. (PV)

Fault-finding chart

TRANSISTOR RADIO FAULT-FINDING CHART. By Chas E. Miller. Published 1980 by Bernard Babani. Chart 64cm x 45cm folded within stiff paper covers. Price in Australia $1.50.

This chart is intended to assist readers to repair transistor radios themselves, which would not warrant servicing by a professional. Starting with four common fault symptoms, it leads the reader systematically (and hopefully) towards the source of the problem.

Unfortunately, some of the steps require the user to identify stages, transistors and their connections, and to read and interpret electrode voltages. If they can respond at that level inside a typical transistor portable, I wonder whether they are likely to need a fault-finding chart in the first place.

Still, it may help, particularly with the more obvious faults and, at the price quoted, one is not risking a great deal. Our copy came from Technical Book & Magazine Co Pty Ltd, 289 Swanston St, Melbourne 3000. (W.N.W.)

TRS-80 Level II Basic

LEARNING LEVEL II, by David A. Lien. Soft covers, 352 pages, 230mm x 178mm. Published 1979 by Compusoft Publishing, San Diego, California. Price in Australia $17.95.

"Learning Level II" is written with two types of readers in mind – those who are upgrading from a Level I system and so are already competent in Level I Basic, and those who are starting off with a Level II machine and have not had any previous experience with Basic.

Part I of the book goes through the Level I Manual chapter by chapter, describing the changes which must be made so that the Level I Manual can be used as a guide to the Level II machine. This part provides an alternative text which can be cut out and pasted over the appropriate pages of the Level I Manual. Thoughtfully the publishers have also provided the alternative text in Appendix Z of the book, printed on the side of the page only it can be cut out while leaving the body of the book intact.

Those already familiar with Level I can skim through Part I and update their Level I Manual, then move on to Parts II and III of the book. Part II, "New Power at the Command Level" gives an overview of Level II Basic, and then discusses the powerful editing facilities of Level II, the extended error messages (23 in standard format, rather than the WHAT? HOW? and SORRY of Level I), and the automatic line numbering feature.

Part III of the book is the lengthiest Part, as is to be expected since it covers the program statements of Level II. There are five chapters on the extended string functions of Level II and two chapters on the intrinsic mathematical and trigonometrical functions, as well as chapters on the PRINT USING statement and linking machine language routines to Basic programs, to mention but a few.

Conversion of programs from Level to Level II is also fully covered, including instructions for using the taped conversion program supplied by Radio Shask. There is also a guide to the TRS-80 expansion interface and dual cassette operation.

In addition to Appendix Z, four other Appendices cover error messages, the ASCII code, and Level II reserved words, and provide a summary of Level I Basic and Level I shorthand.

"Learning Level II" is a very complete guide for the TRS-80 Level II user who is already familiar with some form of Basic. When used in conjunction with the Level I User's Manual, it is also well suited to those users of Level II who have no previous programming experience. Once again, David A. Lien has demonstrated that learning to use a computer can be fun as well as a great source of personel satisfaction.

Our copy came from Dick Smith Electronics. (P.V.)

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A look at the short-term future of

Microprocessors

Microprocessor technology has already made significant advances, affecting almost every aspect of our lives, and the pace of development seems set to continue. In this article we look at some of the short-term prospects for the microprocessor. Further development depends on the recognition of new areas of application and the standardisation of design features among processors.

By V. X. GLEDHILL*

Forecasting technological development is always a risk. Forecasting in the area of computer technology is particularly difficult, because of the rapid rate of innovation in the industry. This can be further complicated by other factors including public reaction to certain directions in development, government decisions which lend considerable weight in this area of highly capital-intensive development, and, finally, the marketing decisions of the industry leaders.

However, there is a considerable time lag between the conception and initial development of the technology and its application. Historically, major influences such as higher level languages, the matrix printer and time-sharing have taken considerable time to diffuse through the system and become generally accepted. It should, therefore, be possible to predict the short and medium term developments without recourse to any great risk in the forecasts.

In the past, a number of forecasts failed to predict significant computing developments. Although the importance of the integrated circuit in reducing the cost of computing was identified, the possibility that this would create a new market for minicomputers and microprocessors and change the pattern of usage was not explored. The primary mistake was to over-emphasise the place of multiprogramming and time-sharing in the future development of computing. This led to an over-estimate of the growth of large-scale computing and its associated techniques such as the demand for telecommunication facilities; the concepts of distributed processing, intelligent terminals and stand-alone microcomputers did not weigh heavily in these predictions.

This suggests that much greater emphasis needs to be placed on the fundamental changes that the technology will introduce and on the ways in which these will be modified by social and economic pressures. Even given substantial information on the operation and planning of a large company like IBM, it is difficult to predict their response to changes which threaten the basis of their current operations.

What are the expected medium term developments for the technology of microelectronics?

Looking to the future, it is necessary to ask whether the expected increase in capability of the integrated circuit can continue and whether adequate demand exists for increased circuit complexity. The increase in circuit complexity is a function of three factors:

- improved definition leading to greater circuit density,
- increased chip sizes,
- new circuit and process techniques.

Each of these requires separate consideration.

Further improvements in definition are possible. Physical limits on semiconductor behaviour would allow a further reduction of around two orders of magnitude in physical dimensions but fabrication difficulties will impose earlier limits. It is possible to go beyond the photolithographic limit by using X-rays to replace visible light and creating the necessary masks by electron-beam machining. There is, however, the further difficulty of aligning successive exposures of the wafer with sufficient accuracy. Until this problem can be overcome, resolution is likely to be limited.

The overall size of the chip is limited by two factors:

- As the chip size is increased the yield falls because the expectation of imperfections is increased.
- As the chip size is increased, the power requirement increases, leading to more complex packaging in order to maintain the chip temperature at an acceptable level.

Forecasts predict a doubling of present chip area, to 80mm², by 1981.

Finally, the improvements in circuit and process technology may be seen as complementing improvements in definition, rather than providing an alternate route to increased density.

Since the development of the Intel 4004, a large number of manufacturers have entered the microprocessor market, so that there are now over 50 distinct microprocessor architectures available, while the number of separate offerings total well over 100.

The earliest microprocessors required a large amount of external circuity to turn them into usable devices. The number of additional circuits required has been reduced, firstly, by bringing all the processor functions on chip, like interface controls and clock generation and, secondly, by bringing other functions on the chip, like storage and interfacing.

The first microprocessor used a 4-bit word. As the technology has advanced 8 and 16-bit devices have been introduced. Two alternative views have been put forward for the pattern of further development. The first is that each type of microprocessor has a natural market and will continue into the future:

- 4-bits for control systems,
- 8-bits for information products,
- 16-bits as a minicomputer.

The alternative view sees word length as a limitation and looks forward to the successive replacement of 4-bit devices by 8-bit, 8 by 16 and, in the future, 16 by 32 or 64.

In the short term, most semiconductor companies propose to introduce 16-bit products which must necessarily be incompatible to some extent with their existing 8-bit products. The rationale behind this move seems to be based largely on competitive pressure; the technology allows this capability and manufacturers feel that if they do not introduce leading-edge products, they will lose the future market. Several such new products were announced in 1978, with deliveries starting in 1979 and volume in 1980.

In 1978-79, microprocessors were available in three basic varieties:

(i) The microprocessor requiring external store and interfacing. Examples are

* *Dean, Faculty of Mathematical and Computing Sciences, NSW Institute of Technology.*

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the Intel 8080, Motorola 6800 and Texas 9900.
(ii) The combination circuit, in which the microprocessor is combined with storage or interfacing, thereby reducing the overall package count in a system. Examples are the Intel 8085 and Motorola 6802.
(iii) The microcomputer, in which all the functions of the computer processor, program store, data store and interfacing are combined on a single circuit. Examples are the Intel 8084 and the Texas 9940.

With the microcomputer, the semiconductor industry has truly achieved the goal of a computer on a chip, although with the present scale of integration, the processors offered are extremely limited in capability.

The semiconductor developments that are envisaged will make possible the complete 16-bit microcomputer with a 4Kbyte store, sometime in 1980. Such a device would have a performance in excess of many present-day minicomputers.

There are strong market forces that will probably lead to a reduction in the number of different microcomputer architectures, leaving just one or two *de facto* standards, just as is happening with the computer (IBM 360) and minicomputer (Digital PDP11). The existence of a standard architecture does not preclude it from being offered in a variety of forms with different capabilities and cost and it is expected that one or more microcomputer families will emerge as the dominant product offered by several "second sources".

MINICOMPUTERS TO BE COPIED IN UP FORM

Because of the high cost of developing new architectures and the associated software, semiconductor manufacturers will be increasingly attracted to the idea of copying existing computer architectures. To date, this approach has not been practicable because the complexity of even a simple minicomputer has been rather greater than could be achieved by the technology. This situation is now changing. In order of complexity, the three obvious architectures to copy are:
(i) the Data General Nova,
(ii) the Digital PDP11,
(iii) IBM products, such as System 360.

Neither the software nor the organisation of these computers may be suited to microprocessor technology or their application but the advantages of a wide range of software and expertise is likely to overwhelm these drawbacks.

Fairchild has already announced a copy of the Nova, and the Data General Company has initiated litigation to prevent the use of its architecture. Unfortunately, this is an ill-defined area of the law and it is not clear whether, or to what extent, a company can protect an architecture, or the associated software. Pressure to copy existing systems is likely to increase since the PDP11 architecture has been adopted as a standard, by the American Department of Defence, and copying the IBM 360 architecture at the discrete-logic level is already an accepted practice.

As a guide, the technology has the capability to integrate existing computer architectures fully, at the following dates:
(i) 1979 Data General Nova
(ii) 1980 Digital PDP11
(iii) 1981 IBM 360

The microprocessor versions of these architectures are likely to offer higher throughput than the basic discrete versions, although they will not match the throughput of the higher members of these computer ranges.

A NEW LEVEL OF ABSTRACTION

The importance of the microcomputer is that it provides a new level of abstraction in the physical design of information systems. So, there have been two levels of abstraction:

- The electronic component: here, information is represented by an electrical signal and the design is carried out in terms of electrical properties,
- The logical gate: here, information is represented by logical levels and design is on terms of a logical calculus; the electrical details have been abstracted from the design process.

The microcomputer offers the potential for the design of information systems in terms of a third level of abstraction, based on language, where the basic unit is the word, which can be given specific semantic connotations by the provision of an appropriate set of information operations.

The significance of the microcomputer is not widely appreciated. This is partly because the design technique for using this component has not been developed; it is also because the emergence of the microcomputer has been obscured by the intermediate version of the microprocessor, which has been available, with increasing capability, since the early 1970's.

What then, can we draw out of this by way of summary and conclusion?

Firstly, the decreasing cost of microelectronics now means the development of applications will not be retarded by the technology or design of systems, rather by the ability of people to innovate and the degree of social acceptance of proposed applications. This innovation will be most effective in the information industry.

Secondly, there will be a tendency to standardise on design architectures in microcomputers in the same way that we have seen in current mainframes and minicomputers; the investment in software will ensure long term commitment to the high-volume-sale architectures.

Finally, the microcomputer will be developed in the early 1980's, possibly based on current computer architectures. The microcomputer is seen to be a more significant development than custom designed circuits because of its generality, and thus its suitability for; high volume markets. The development of the microcomputer will allow systems to be designed at a logical level, with less concern for the electronics than has been possible with either discrete circuit systems of microprocessors. These forecasts are all based on current knowledge of technology and with the knowledge of prior developments in the mainframe and minicomputer area.

Reprinted from Proceedings of the IREE Australia, Vol 41 No 1 March, 1980.

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On screen character editor for special characters and shapes. Lots of fun and includes 12 page manual with examples.
Cat. X-3623 ..... **$17.95**

DEBUG
Debug machine language programs by stepping through one instruction at a time. Relocatable. Several display options. Multiple break points. Modify memory and registers.
Cat. X-3624 ..... **$17.95**

FASTGAMMON
Backgammon players will find this program a skillful opponent. Has ultra sharp screen graphics and comes complete with an 8 page booklet with rules of the game.
Cat. X-3625 ..... **$22.95**

MARTIAN INVADERS (NEW)
Similar to the very popular 'Space Invaders' you find in amusement parlors.
Cat. X-3626 ..... **$17.95**

NIKE II (NEW)
Fight off bombing attacks with your missiles and protect the city from heavy casualties.
Cat. X-3627 ..... **$14.95**

TANK TRAP (NEW)
Render the marauding tank harmless but watch out for slow drying cement and unarmed citizens!!!
Cat. X-3628 ..... **$14.95**

GRAPHIC GAMES
Land on the moon in a LEM, lob a pie, nuclear reaction, bounce, checkers and dodgem – games of skill, games for fun.
Cat. X-3631 ..... **$14.95**

SMART ALEC
Answer over 200 questions that the computer gives you and let it decide whether your a genius or not.
Cat. X-3632 ..... **$14.95**

ADVENTURELAND
Recover the 13 treasures from the enchanted world, but watch out for the unexpected.
Cat. X-3633 ..... **$12.50**

MISSION IMPOSSIBLE
Enter the world of suspense as you try and save the world's first automated nuclear reactor.
Cat. X-3635 ..... **$12.50**

VOODOO CASTLE
Rescue the Count from his castle after he has had a fiendish curse placed on him – you're his only hope!
Cat. X-3636 ..... **$12.50**

THE COUNT (NEW)
Another exciting game for you and your Sorcerer to play.
Cat. X-3638 ..... **$12.50**

WILDERNESS (NEW)
Trudge through uncharted lands fighting off with swords and sorcery the foul monsters that live there.
Cat. X-3639 ..... **$12.50**

BLACKJACK
Play the table in this ever popular game of 21's, pontoon, blackjack. Whether you win or lose, it's a fantastic game.
Cat. X-3602 ..... **$9.95**

WUMPUS
This is a great game of hunt the Wumpus through 20 rooms with a bent bow and arrow!!!
Cat. X-3604 ..... **$9.95**

SKETCH 80
For the TRS-80 and System 80
A program tape that allows you to sketch on your VDU – the light pen becomes a real writing tool with this tape program.
SEE THE LIGHT PEN ON PREVIOUS PAGE
Cat. X-3646 ..... **$17.95**

FOR YOUR TRS-80 COMPUTER

TIME TREK
For TRS-80 4K level I and II. Hunt the Klingons through space and fight an intergalactic war. Has nine levels of play.
Cat. X-3650 ..... **$17.95**

STIMULATING SIMULATIONS
For TRS-80 4K level I and II. 10 games on one cassette from monster chase to nautical navigation and lost treasure – it's great fun.
Cat. X-3652 ..... **$17.95**

ELECTRIC PAINTBRUSH
TRS-80 4K level I and II. Create dazzling real time graphics. Commands let you draw lines, turn corners, change white to black, repeat previous steps or call other programs.
Cat. X-3654 ..... **$17.95**

BLOCKADE
TRS-80 4K level I and II. Many variations whereby you and your opponent try and make each other collide with a wall.
Cat. X-3659 ..... **$17.95**

BRIDGE CHALLENGER
TRS-80 16K level II. Practice and improve your game of Bridge.
Cat. X-3656 ..... **$17.95**

MICRO CHESS
The computer is programmed to beat you at chess and you are trying to beat it – absorbing and educational.
Cat. X-3658 ..... **$22.50**

SIMUTEK 1
Contains 5 games that would normally cost $19.50 each! Great fun for all the family and friends. For TRS-80 4K level I and II.
Cat. X-3685 ..... **$17.95**

SYSTEMS SOFTWARE DISCS

CP/M Floppy Diskette Operating Systems from EXIDY
CP/M PLUS MICROSOFT BASIC for Micropolis quad drives ..... Cat. X-3710 ..... **$445.00**
CP/M PLUS MICROSOFT BASIC for Micropolis dual drives ..... Cat. X-3711 ..... **$445.00**
CP/M for Micropolis quad drives
Cat. X-3715 ..... **$149.00**
CP/M for Micropolis dual drives
Cat. X-3716 ..... **$149.00**

Also available is a Word Processor Linker for Micropolis quad drives. Cat. X-3720 at only **$99.00** and also for the Micropolis dual drives. Cat. X-3721 at **$99.00.** (Both of these need CP/M as well).

THE COMPLETE MICROCOMPUTER SYSTEMS HANDBOOK
Written by E.L. Safford Jr. for the beginner through to expert. Goes from basics to advanced subjects such as magnetic bubble memories.
Cat. B-1872 **$12.00**

SOME COMMON BASIC PROGRAMS
Fantastic book containing 76 programs in BASIC.
Everything from tax depreciations to Gaussian Quadrature.
Cat. B-2345 **$9.95**

AND NOW!
A program tape for the TRS-80 – 16K level II – a cassette version of the book. Why not buy the book and the cassette and have a lot of fun.
Cat. X-3665 **$19.50**

DOS PATCH
Extends the TRS-80 to take advantage of the 40 tracks on the Dick Smith Disc Drive for TRS-80 computers (Cat. X-3230 only **$379**). Also enhances TRSDOS in other ways as well.
Cat. X-3550 ..... **$19.50**

"TINY" PASCAL
Cassette tape for developing and debugging or running programs on your TRS-80. Provides powerful subset of standard Pascal statements. Comes complete with comprehensive manual.
Cat. X-3670 ..... **$49.50**

FOR YOUR TRS-80

C10 COMPUTER CASSETTE
Dick Smith special grade cassette tape with 5 minutes per side and 38K capacity per side.
Cat. X-3500 ..... **$1.95**

Store data the easy, convenient way.

'DUMB TERMINAL'
Program which enables you to use your Sorcerer as a 'dumb terminal' with another computer or another dumb terminal. Operates in full or ½ duplex mode, software selectable – output through the RS-232 port.
Cat. X-3637 ..... **$9.95**

NEW SORCERER BOOKS

A new series of books containing programmes that will make your Sorcerer even more versatile!

Small business ..... Cat. B-6110 ..... **$49.95**
Educational & Scientific Cat. B-6112 **$37.95**
Fun & Games No 1 Cat. B-6114 **$17.95**
Fun & Games No 2 Cat. B-6116 **$17.95**
Home & Economics Cat. B-6118 **$27.95**
Fantastic value for everyone with a Sorcerer.

Sorcerer Technical Manual
Cat. B-6100 **$14.95**
Sorcerer Word Processing Manual
Cat. B-6105 **$17.50**
Sorcerer Development Tour Manual
Cat. B-6106 **$17.50**
Sorcerer Software Manual
Cat. B-6108 **$14.95**

NEW QUAD DENSITY HARD SECTOR DISKETTE – suitable for use with the Micropolis
Cat. X-3205 and Cat. X-3208 drive systems.
Cat. X-3514 1-9 **$6.95 ea** 10 up **$6.50 ea**

COMPUMAX ACCOUNTING DISCS

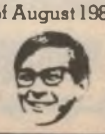
For the small business, a book and disc that will assist in the running of the accounts department. Discs suitable for use with the Micropolis Quad Density Disc Drive and the Sorcerer computer.

MICROLEDGER – General ledger, chart of accounts, journal, trial balance, posting, audit trail of transactions, profit and loss statement and balance sheet.
Cat. X-3700 ..... **$169.00**

MICROPAY – Accounts payable, statements by vendor and by date, cash requirements, prints cheque and mailing stub, journalizes A/P transaction into MICROLEDGER.
Cat. X-3702 ..... **$169.00**

MICROREC – Accounts receivable, aged trial balances, prints invoices, statements by customer and by date, cash projections, journalizes A/R transactions into MICROLEDGER.
Cat. X-3704 ..... **$169.00**

See us at the **DATA 80** show in Sydney from the 5th to 7th of August 1980



DSE784

Microcomputer News & Products

Tandy Electronics introduce the TRS-80 Model II

Tandy Electronics has recently released a 24 page Microcomputer catalogue entitled "The Expanding World of TRS-80", to higlight the introduction of the new TRS-80 Model II system. Designed for users who require more power, speed, and storage than the Model I can provide, the TRS-80 Model II is contained in one cabinet, with a built-in 200mm disk drive and a detachable keyboard.

The Model II displays 24 lines of 80 characters, with both upper and lowercase available. Double-width characters (40 per line) can be program selected. Internal memory is either 32K or 64K, but the required operating system software, which is automatically loaded from disk on power on, occupies 27K. The built-in 200mm disk, which contains the system software, has an additional 416k available to the user. Up to three additional disk drives can be added, for a total of almost 2M bytes of storage.

The new system uses a Z-80A processor, running at 4MHz, and provides separate processors for the keyboard and video display. Three expansion connectors are provided, one parallel and two serial, so that printers, plotters, modems, and many other external devices can be added. Internal plug-in card slots allow for further expansion, without the need for a separate expansion unit.

The Model II comes with an expanded Level III Basic on disk, and a new command-compatible "TRSDOS" operating system. Applications software for General Ledger, Inventory Control, Payroll, and Mailing List are available now, and more software will be available shortly.

The new catalogue gives the price of the TRS-80 Model II system as $5300 with 32K of RAM and $5999 with 64K.

Software for the Compucolor from the Logic Shop

Four new software packages for the Compucolor have been released by The Logic Shop. The new packages are Word Processor, a Fortran compiler, an Inventory control program, and Basic Tutorial lessons one to ten.

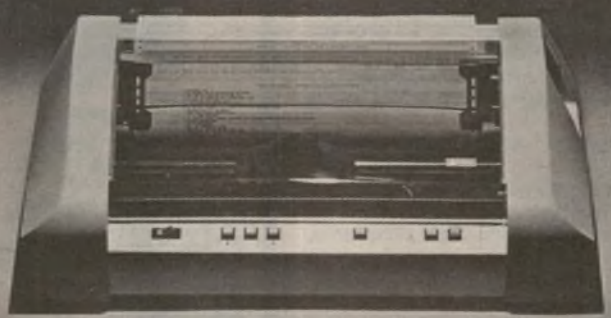
The word processor provides all the normal editing functions, using control keys available on the Compucolor. It costs $75. The locally designed inventory control program, which sells for $100, enables the user to store up to 900 goods classifications on one 5¼ inch disk. The Fortran compiler was designed for the Compucolor by Microsoft, and is available for $92.

The Basic Tutorial program provides tutoring for those wanting to learn to program in Basic. Tutorial lessons one to 10 are now available, at $36, and more are to follow. All the packages are available from The Logic Shop, 91 Regent St, Chippendale 2008, and 212 High St, Windsor, Vic. 3181.

MICRONEWS CONTINUED ➜

Meet two new Printers from Anadex:

Resolutionary!



Introducing two totally new alphanumeric line printers from Anadex - Models DP-9500 and DP-9501 - featuring 132/175 or 132/220 columns, respectively.

Both models employ a new, Anadex-manufactured 9-wire print head with 150 million character life (optionally, 650 million) that makes them ideal for high-resolution printing requirements including high-density graphics where print quality and reliability must go hand in hand.

The full standard 96 character ASCII character set, including descenders and underlining of all upper and lower case letters, can be printed bi-directionally on up to 5 crisp copies at speeds up to 200 CPS. Adjustable-width tractors, accommodating paper from 1.75 to 15.6 inches wide, allow the printers to adapt to your application.

The three ASCII compatible interfaces (Parallel, RS-232-C, and Current Loop) are standard in every printer; so interfacing is usually a matter of "plug it in and print." With simplified interfacing, the printers also feature sophisticated communications capability including control of Vertical Spacing (6 or 8 lines/inch), Form Length and Width, Skip-Over Perforation, Auto Line Feed, and full point-to-point communications capability.

Other standard features are a 500 character FIFO buffer (optional, an additional 2048 character buffer), shortest distance sensing logic, self test, and replaceable ribbon cartridge with 6 million character life.

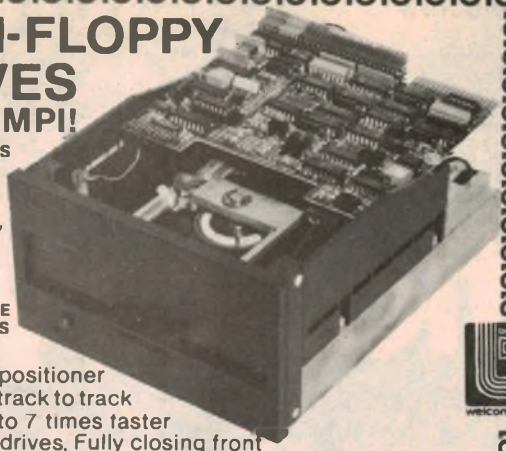
For complete details, attractive OEM pricing, and a demonstration, contact Bell & Howell today.

Anadex®

BELL & HOWELL AUSTRALIA PTY. LTD.

55 MURRAY ST, PYRMONT, NSW 2009 ELECTRONICS & INSTRUMENTATION DIVISION

MINI-FLOPPY DRIVES FROM MPI!



THE WORLD'S SECOND LARGEST MANUFACTURER OF MINI-FLOPPY DRIVES — THE DRIVES WITH FEATURES COMPARABLE TO 8" DRIVES

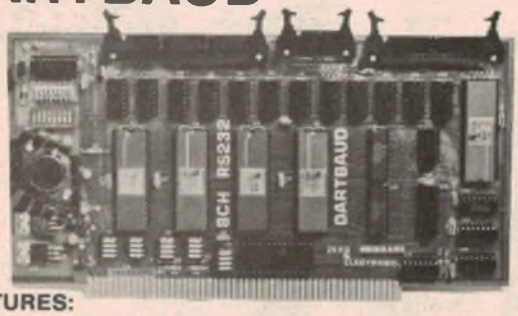
Head band positioner gives 5 ms track to track access - 5 to 7 times faster than other drives, Fully closing front door and ½" Clutch Cone for media protection, Double Density Heads, Shugart Compatable, only 10 moving parts due to non-mechanical switching.

TWO MODELS AVAILABLE
- Model 51 Single Head 250k Bytes DD
- Model 52 Double Head 500k Bytes DD

PRICING: 51 $350.00 (402.50) Inc. tax. 52 $450.00 (517.50) Inc. tax

Write or call for technical description.
Power supply/case available May
Since we are the Australian Distributors OEM discounts are available.

DARTBAUD



FEATURES:
- 8 independently selectable 1/0 channels
- 2 Eight bit parallel ports
- RS-232 interface levels
- Async or optional synchronous channels
- Baud rates 50-19, 200 independently selected for each channel

SPECIFICATION:

Serial Ports: 8 Independent ports using Zilog D/ARTs (sync) or optionally S10/0 (may be retrofitted for synchronous parts for any pair (S10 and DART are dual devices).

Baud Rates: 6 independent, crystal-controlled, software selectable rates for each port selected from the 16 standard rates between 50 and 19,200 baud.

Parallel Ports: 2 Independent ports using Zilog P10, selectable as either input or output.

Interrupts: Full on-board interrupt control provided. On-board devices daisy chained. Rotating priority control provided for running multiple boards (through top connector). Jumper selection of interrupt control (local, rotating, vectored). **PRICE: POA & MANUAL AVAILABLE**

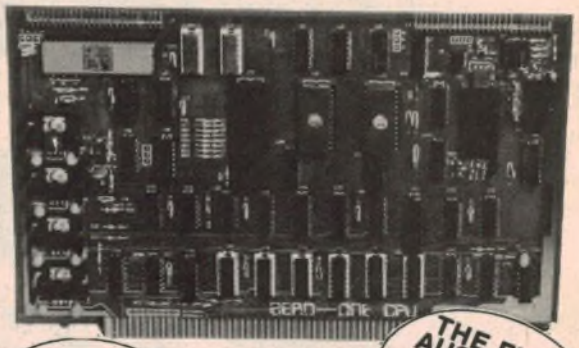
KEYBOARDS!

THE CLARE MODEL C70/MGP — by far the best value in keyboards we have seen to date.

- 70 key full upper and lower case with non mechanical Capacitive Keyswitch — fully encoded Microprocessor control with RS232 or 20ma serial options — parallel output standard single 5V Supply, Serial baud rate jumper from 110 to 9600 baud.

PRICE $160 ea Connector $3.00
MOULDED ABS plastic case to suit $26.00

GET INTO MICROPROCESSORS WITH THE S100 BUS FOR EASY EXPANDABILITY



CHEAPER THAN THE USA

THE FIRST AUSTRALIAN DEVELOPED Z80 S100 BUS SYSTEM

SOFTWARE (on cassette)
Z80 6k Basic to suit our CPU Card **$19.95**
12k Basic etc $35.00
Z80 Assembler/Editor/Debugger $19.95
GAMES PACKAGE 8 large games **$9.95**
And more to come!

SUPPORT DEVICES

Mother Board —
- 8/Slot
- 7.5a SCR preregulated supply for 5v lines + 16v. 75a − 16v. 75a
- Actively Terminated
- Comes complete including all edge connectors and power supply components
- All Components excepting power transformer and main filter Capacitor mounted on Mother Card

Price $159.50 kit

CARD FRAME/CASE
To accept S100 or EXORCISER mother board/power supply and has provision for Fan and 19' rack mounting
Price: $105.00
Freight: $10.00

S100 MEMORY CARDS
16k Static —
- Access time 450 ns (2MHZ only) 2114
- 16k Kytes organised in 2 x 8k Blocks individually selected to any 8k Boundary

Price kit $299.00. All sockets supplied. Assembled and tested add $40.00

64k DYNAMIC
THE ZERO ONE DYNARAM II
- Access time 250 ns (2MHZ or 4MHZ) 4116
- 64k Bytes organised in 4 x 16k Blocks
- Refresh completely transparent using bus signals to derive refresh allowing processor to run at full speed without wait states
- Supplied on minimum of 1 x16k Blocks expandable by merely plugging in extra rams.

Price 16k kit $255.00 All sockets supplied. **each 16k add $100.00**
Assembled and tested add $60.00

ETI 640 VDU kit fully socketed $139
Please note that 200ns memories are required for VDU 4MHZ operation at $6.00 extra or 10 x 21L02-2 for $26.00 separately

Z80 CPU CARD
FEATURES —
- Comes with full assembly instructions and card documents.
- Power on jump for automatic execution of monitor program on startup.
- Front panel-less operation allowed by on board 2k monitor which is too good to explain here; 19 commands all unique abbreviations allowed.
- Full S100 DMA Capabilities.
- Sockets supplied for all major devices.
- Clock speed, 2MHZ
- 1/0 Z80 P10 2 x 8 bit programmable parallel 1/0.
- RAM 256 Bytes scratch pad (Monitor).
- Onboard 2100 baud Tarbell Cassette Interface (Software Controlled) with cassette recorder remote motor control Test Cassette supplied with CPU Kit contains set up procedures for cassette interface as well as software to allow the cassette interface to read and dump 300 baud CUTS (Kansas City) format.
- Keyboard input direct onto card in parallel ASCII.
- Monitor performs all functions to drive ET1640 VDU as an ASCII terminal. Entry points for cursor control etc.
- The spare socket onboard is to allow the National MM57109 to be fitted which works in conjunction with the CPU to give a full floating point RPN arithmetic unit.
- Functions as a general purpose Z80 single board computer or as the heart of a fully expanded system to 64k Bytes of memory and a multitude of 1/0 devices.
- Plated thru solder masked printed circuit board with components screened overlay.
- Description Manual Construction manual $1.00 refundable with purchase.

PRICE KIT $199.50 2MHZ
$22.50 Number Cruncher Option
Assembled and tested add $50.00

BOOKS
Z80 CPU Technical Description **$10.00** posted
Z80 P10 Technical Description **$6.50** posted
Z80 CTC Technical Description **$6.50** posted
Z80 CPU Programming and Assembly Language Manual **$10.00** posted

CARDS IN DEVELOPMENT
1/0 Card; with serial parallel ports, extra ROM etc.
Eprom Card; Holds 8 ROMS with Eprom Programmer
Floppy Control; Minifloppy or Floppy, CP/M Compatible
Exorciser Mother Board/Power Supply
Stand alone 80 column 125 CPS Tractor Feed Plain Paper Printer
6809 Exorciser CPU 10k Eprom — 4k ram — Serial/Parallel 1/0 — Dual Baud rate — 9511 NCU
TRS80 to S100 Interface
Exorciser 32/16 channel A/D Convertor
2650 useral 24k static card bus compatable KT9500
Exorciser 8 channel Asychronous — 1 channel synchronous communications interface

Prices are inclusive of sales tax, tax exempt institutions deduct six percent.

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200 MOGGIL ROAD,
TARINGA, 4068.
BRISBANE.
AUSTRALIA.
PHONE 371 6707

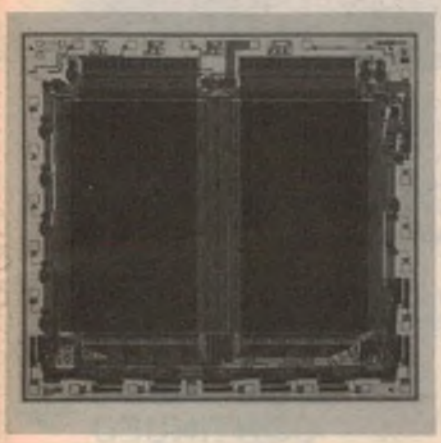
All prices include freight anywhere in Australia.
Allow 10 days for despatch.
Hours of business: Mon. to Fri.: 9am to 5pm. Sat.; 8.30am to 12 noon.

ZERO ELECTRONICS

Microcomputer News & Products

First 16k EEPROM

Hitachi Ltd has produced the first 16k bit EEPROM (Electrically Erasable Programmable Read Only Memory). The new device, designated the HN48016, is organised as 2048 x 8 bit words, and has a maximum access time of 350ns, faster than the maximum access time of 450ns of the 2716 family of UV erasable EPROMs which are presently the most widely used reprogrammable ROM.



The 16k bit EEPROM chip.

The device can be read at +5V and erased or programmed by a +25V pulse. The 24 pin dual in line package and the pin configuration are the same as the 2716 family. Because the HN48016 can be reprogrammed electrically it is useful in applications that require non-volatile storage of data which may be rewritten, as in point of sale terminals and banking applications where it is necessary to preserve data in the event of a power failure.

It is expected that volume production of the device will begin later this year.

Hard disks for micros

Details of the new Shugart SA1000 Series of Fixed Disks have been announced by Warburton Franki Pty Ltd. The SA1002 and SA1004 allows the microcomputer user to add five to 10 megabytes of storage to his system. The drive features an hermetically enclosed hard disk rotating at 3125rpm, and a choice of four general purpose interfaces are available, ranging from SA1401 which handles two drives to the SA1404 which handles four drives plus floppy disks.

Additional information can be obtained from Warburton Franki Pty Ltd, 199 Parramatta Rd, Auburn, NSW 2144, or Warburton Franki offices in other capital cities.

Microcomputer Interest Group TAFE courses

The IREE Microcomputer Interest Group of Brisbane has advised that it is planning a series of 10 week courses in conjunction with Brisbane TAFE. Five courses will be offered, starting in the first week of September.

The courses will cover:

1. Digital Electronics and Logic Circuits
2. Introduction to Microcomputers
3. Microcomputer Systems
4. Microcomputer Software (Machine code)
5. Introduction to Computer Programming

Courses 1 to 3 are essentially hardware oriented, while course 4 will deal with programming concepts in machine code.

Courses 5 will use computer facilities at various Brisbane Colleges of Advanced Education to teach computer programming in Basic.

Enrollments for the courses will be taken from 11th August. Further details may be obtained by phoning TAFE on 224 7847 or 224 7839.

The IREE Microcomputer Interest Group is also planning a one day seminar for users of systems based on the 2650 processor. A number of systems will be demonstrated at the seminar, and lectures will cover both hardware and software applicable to the 2650.

The seminar will be held on September 27 at the auditorium of the Technical College, Merrivale St, South Brisbane.

6800 Users Group

A DREAM 6800 Users Group has been formed in NSW. The Group will publish a monthly newsletter,which this month includes six games programs, two subroutines and an 8k memory expansion circuit.

The newsletter also explains how to order further issues, and how to submit programs forpublication. To obtain a copy, send a cheque or Postal Order for $4.00 to the NSW 6800 Users Group, 27 Georgia Ave, Keiraville, NSW 2500.

Donation from HP

Hewlett-Packard Australia Pty Ltd has donated $35,000 to Australia's largest college, the Royal Melbourne Institute of Technology, for upgrading the Institute's HP 3000 series II computer system. The donation will allow expansion of computer systems which RMIT authorities say are essential to the continued cost-effective running of the institution. Software systems developed at RMIT are in turn being introduced at other colleges in Victoria and other states which also use Hewlett-Packard computers.

MICRONEWS CONTINUED

Microcomputer News & Products

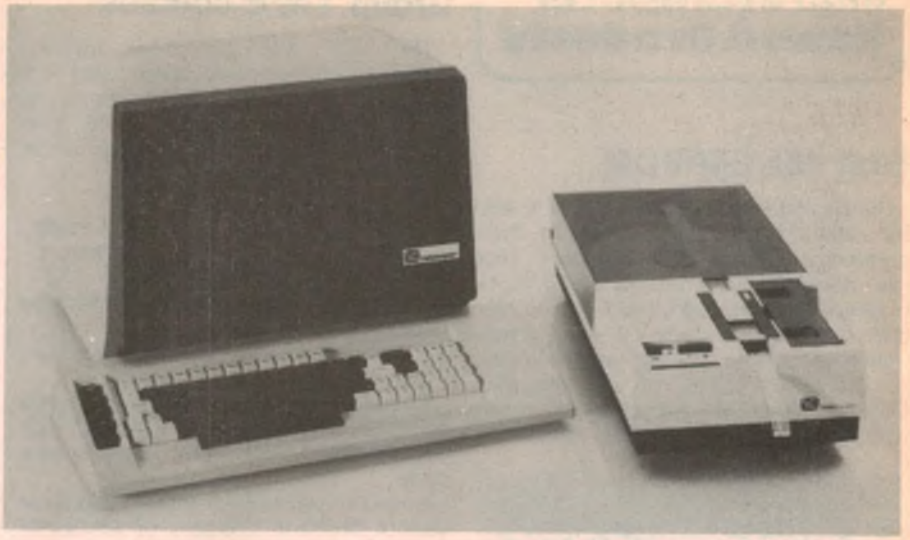
PROM programmer

A new universal PROM programmer has been introduced by Pro-Log Corporation. The M980 is said to be one of the fastest programmers available, capable of erasure checking or verifying a 2716 PROM in 5 seconds. A combination of audible prompts and lights leads the operator through the programming process, indicating errors and signalling program end. A built-in RAM buffer with battery back-up retains data for up to seven days without external power.

Using plug-in modules available from Pro-Log, the M980 can program more than 450 different programmable devices, and the M980's software and eight digit hex display will accommodate devices up to 64k x 16 bits. Operations include Checksum, Blank Check, Duplicate, Verify, Read, and Program, and a special manufacturing mode permits duplications of PROMs with a single pushbutton operation.

The standard M980 universal PROM programmer is available with a 4k x 8 bit CMOS buffer for $US2450, or with 8k or 16k buffers at additional cost. Details are available from Pro-Log, 2411 Garden Rd, Monterey, CA 93940.

New ADE equipment simplifies telex preparation



Anderson Digitdl Equipment Pty Ltd has anounced the release of equipment which provides a fast and convenient method of preparing telex tape. Two units, Teletaper and Telepunch, make up the system. The message is prepared on the Teletaper's keyboard and is displayed on a video screen which allows the copy to be checked and edited. Once prepared the message is transferred to a satellite unit, the Telepunch, which prepares the telex tape for transmission.

The Teletaper is a desk-top unit, 540 x 530 x 340mm, and weighs 15kg. The Telepunch is 477 x 246mm and weighs 5.3kg. Both require only standard power supply, and Telepunch uses standard Telex tape. The teletaper is expected to sell for around $5000.

Further information can be obtained from Anderson Digital Equipment, PO Box 322, Mt Waverley, Vic. 3149.

MICRONEWS CONTINUED

OPAL 1000

PRICE $4,174.00 + sales tax

The OPAL 1000 is an 8 slot S-100 system conforming to the new IEEE standards. A Delta Products Z80a 4MHz CPU card with 2 RS232c serial and 3 × 8 bit parallel ports is used in conjunction with the Delta Products Disk Controller. Memory is provided by a 4 MHz 64k dynamic RAM Board by Measurement Systems and Control. The memory board is fully bank selectable and is designed for upgrading to a multi-user system. Disk drives are 2 × 8" Shugart SA801R running at double density (480k/drive) and fitted with our exclusive Disk Saver which prolongs the life of the drives and floppy disks by turning off the AC power to the drives 14 seconds after the last drive select and thus reduces routine maintenance. The Disk Saver also reduces the risk of data loss due to power failures. The software is CP/M version 2.2 with Delta Product's utilities which include DTEST (for testing drives and floppy disks) and M2 (a comprehensive memory test program). The Delta PROM monitor enables fault finding to be carried out independently of the Disk Drives. The system is mounted in an attractive pressed Aluminium housing with a cast front panel fitted with reset button and key operated on/off switch.

SPECIALS

CROMEMCO Z2H with 64k RAM, 10 MEGABYTE IMI HARD DISK DRIVE, 2x FLOPPY DISK DRIVES.

$8,970.00 + 15% TAX

VECTOR GRAPHICS MZ WITH TELEVIDEO 920C TERMINAL (80 x 24) CP/M2 **$5,000.00** + 15% TAX

NORTHSTAR HORIZON II WITH 48K, 2 SERIAL PORTS CP/M, TELEVIDEO 920C TERMINAL

$4,700.00 + 15% TAX

MPI 88T

Serial/Parallel Printer

Printer $935.00 + 15% sales tax

The MPI model 88T is supplied with a dual tractor/pressure-roll paper feed system and a serial (RS232c) or parallel (Centronics) interface. (The printer is tested and supplied setup for a serial interface as detailed on the connection sheet). The tractor paper feed provides the precision required to handle multi-copy fanfold forms, ranging in width from 1" to 9.5". For those applications where paper costs are important, the pressure-roll feed can be used with 8.5" roll paper. A long-life ribbon cartridge gives crisp, clean print without messy ribbon changing. The microprocessor controlled interface has 40, 80, 96 or 132 column formatting capability while printing the 96 ASCII upper and lower case characters bi-directionally at 100 characters per second.

* Full 96 ASCII character code set.
* Automatic line feed and print functions.
* Built in self-test facility.
* Any one of 5 baud rates (110, 150, 300, 600, 1200) for the RS232 serial interface. The printer is also equipped with a switch selectable parallel interface (TTL level).
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* Warranty: 30 days.

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$$e_{RMS}^2 = 4KTR(f_2-f_1)$$

$$L_1 = 10\log\frac{1}{80} \times S_a \text{ (dB)}$$

$$A^2+B^2=C^2$$

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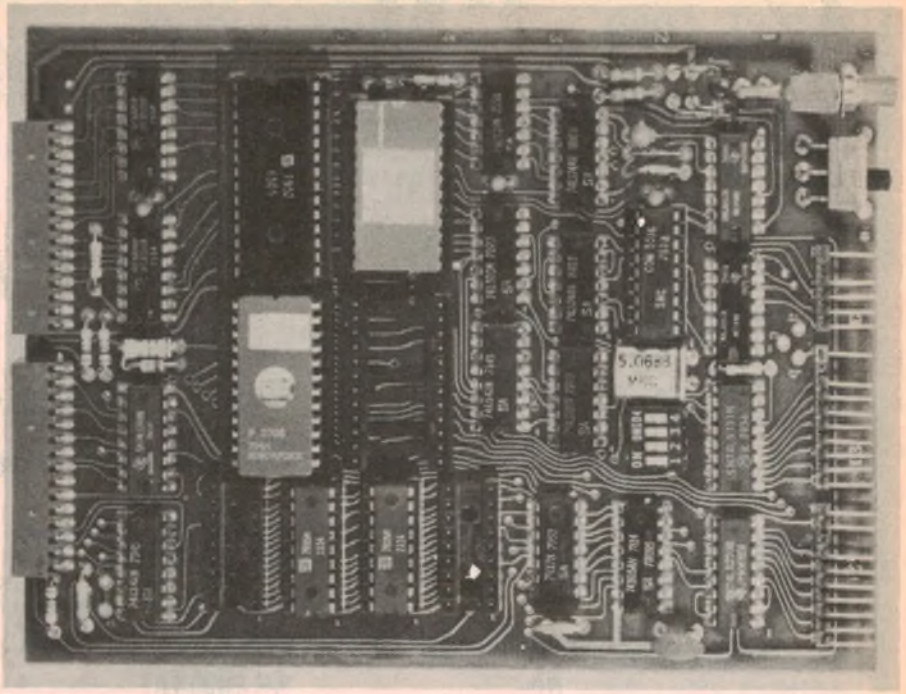
Microcomputer News & Products

Single board computer from Micropro Design

MicroPro Design Pty Ltd, manufacturer of the MicroCon Microprocessor/controller, has released a new single board computer designed for OEM applications. Called the MicroCon/OEM, the module is a 15 x 12cm circuit board containing 6505 processor, a IK monitor in EPROM. and IK of RAM. Eight-bit TTL level input and output ports and an RS232C serial interface are standard, and buffered data and control lines have been brought out for expansion purposes. The board also provides space for an extra IK of ROM or RAM.

The MicroCon/OEM can be used as a stand-alone microcomputer or as a replacement for the standard MicroCon Microcomputer in dedicated applications. The monitor allows the user to enter, modify and run programs, which are written in a unique Microncon interpretive language, via any RS232C terminal.

Micro Pro Design has also announced that it has become an authorised dealer for the Commodore CBM and Pet microcomputers, and the company's engineers and programmers are able to offer support in custom interfacing and applications software. Micro Pro Design has already developed a number of locally manufactured interfaces of the IEEE488 Bus.



Designated the Microcon/OEM, this single board computer contains a 6505 processor 1K of EPROM and 1K of RAM, with space provided for an extra 1K of either.

For further information contact MicroPro Design Pty Ltd, PO Box 153, North Sydney, NSW, 2060

MICRONEWS CONTINUED

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North Star has quadrupled the disk capacity of the Horizon computer but prices have increased a modest 15 percent. On a dollar per byte basis, that's a bargain that is hard to beat!

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Microcomputer News & Products

National Semiconductor opens new premises

Natsemi Advanced Systems Pty Ltd recently opened new premises in Sydney which bring together all of the Australian Divisions of National Semiconductor Corporation. The new facility at Artarmon unites under one roof the Semiconductor Components Division, the Consumer Products Division, Computer Products, and training and repair services.

In opening the new premises the NSW Minister for Technology, Mr Ron Mulock, spoke of the need for Government action to determine the social and economic effects of the introduction of new technology, and to ensure that any technology introduced does not prove to be counter-productive because of the social problems that it creates.

The NSW Minister for Technology, Mr Ron Mulock, at the opening of the premises of Natsemi Advanced Systems Pty Ltd.

Three Mile Island simulation for Apple

Computer Services, a United States software supplier, has released a program for the Apple II entitled "Three Mile Island". Advertising for the program asks "Is the technology of a nuclear reactor too complex to handle? Now you can have the opportunity to decide for yourself with Three Mile Island, a realistic simulation of a pressurized nuclear reactor." The program is intended to be run on Apples with 48k of RAM and disks. Availablity of the program in Australia is not yet known.

MICRONEWS CONTINUED

Microcomputer News & Products

Computer Country opens in Melbourne

Computer Country Pty Ltd has opened in Melbourne, at 338 Queen St. The store stocks a number of hardware lines, including Northstar, Apple, Texas Instruments, and NEC, and can also supply off the shelf software packages for business, word processing, medical, and publishing applications. Computer Country Staff can also customise software to individual requirements, and the store's service division completely supports all items sold through the store, and is inviting enquiries from owners who have purchased systems elsewhere.

Plotters from ADE

Anderson Digital Equipment Pty Ltd has introduced the CPS 14/15 family of plotting systems designed to provide "draftsman" quality plot in a wide range of applications including surveying, business, and design. The CPS 14/15 systems offer a standard four pen plotting capability under program control, and will produce four colour drawings in standard sizes.

Each plotting system in the CPS 14/15 family consists of a digital plotter and a microprocessor based controller. The plotters are available in widths from 56cm to 86cm, and an optional 30cm drum is also available. Each system accepts data either from a standard EIA RS-232C interface or a 20mA current loop, and they can be operated on-line or on a time share basis. Both systems feature up to 172 firmware generated symbols, including upper and lower case letters, a circular buffer memory and protocols for detecting data transmission errors.

Writing speeds of 10ips or 15ips may be selected by panel mounted pushbuttons, and thumbwheel selector switch enables the operator to scale the plot size up to nine times the original size.

A new double-sided, double-density DEC RX02 compatible flexible disk memory system has also been introduced by Anderson digital Equipment. The new system, the DSD 470 reads and writes on both sides of industry standard eight-inch disks, providing a formatted capacity of one megabyte per disk, or two megabytes of on-line storage. According to Managing Director Bill Anderson, the system is completely compatible with DEC LSI-11 computers and will provide new options for DEC LSI-11 users.

For further information contact Anderson Digital Equipment Pty Ltd, PO Box 322 Mt Waverley, Vic. 3149.

MICRONEWS CONTINUED

Microcomputer News & Products

New sewing machine uses a microprocessor

Janome Sewing Machine Corporation of Tokyo recently announced a microprocessor controlled sewing machine. The machine is claimed to be easier to operate than conventional machines because the processor makes the decisions, such as where place finishing stitches and how to sew buttonholes so that each buttonhole has exactly the same number of stitches.

Called the Memory 7, the new machine also provides unprecedented possibilities for decorative sewing because it enables the operator to sew fancy stitches in any sequence. The Memory 7 simplifies machine operation by replacing mechanical action with electronics.

The machine electronically selects the correct starting position for the needle, and sets the correct width, length, and tension of stitches according to programs selected by pushbuttons. Sewing speed can be pre-set, and the memory of the machine can store and recall a large number of stitch patterns automatically. The selected stitch pattern is displayed on a visual read-out.

The Janome Memory 7 will be available in Australia for around $900.

Demonstrator Pat Webb races against the clock to finish a seven minute bikini on the Memory 7 microprocessor sewing machine.

Programming with ADA

British software companies have formed a consortium to undertake work on the Ada programming language being developed by the US Department of Defence.

A spokesman for the consortium stated recently that Ada will be the key to the defence and industrial systems markets of the future.

The US Defence Department is expected to announce the final definition of its new standard language at the end of this month, and several hundred companies competing for the Department's business are clearly interested.

The new language is based on the same modular programming concepts as Pascal, and is designed to ease the writing of large programs by several programmers.

MICRONEWS CONTINUED

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EA

C1P Series 2 from Ohio Scientific

Ohio Scientific has released an enhanced version of its popular C1P computer, designed specifically to appeal to first time computer users. The C1P Series 2 offers versatility and new sound, music, and voice capabilities via an inbuilt digital-to-analog converter, and new screen formats which give it great flexibility in educational applications.

Mr Barraclough, a director of the TCG group, who are distributors of Ohio Scientific equipment in Australia has said, "We expect the Series 2 to have particular appeal to educational institutions because of a new 12 x 48 character screen in addition to the 24 x 24 display, and the fact that the Series 2 can plug straight into standard audio visual systems."

"It also has a wide range of applications as an advanced scientific calculator via a newly-developed floating point maths capability and 'immediate mode' operation," Mr Barraclough said.

The standard C1P Series 2 provides 8k of RAM, which can be expanded by the addition of plug-in boards, to a total of 32k. A mini-floppy version of the C1P, the MF Series 2, offers a dual disk operating system.

Both the C1P and the C1P MF Series 2 are readily expandable by the addition of the new Ohio Scientific 630 I/O Expander to provide a colour display, dual joystick interfaces, dual remote keypad operation, AC remote control interface, and programmable modem and high speed output ports. TCG is offering a wide range of educational, entertainment, and business programs for the two systems. Cost of the C1P Series 2 is around $550.

The C1P Series 2 from Ohio Scientific is said to be an ideal system for the first time user because of its simplicity and ease of operation.

INFORMATION CENTRE

CAPACITANCE METER: I have recently built the digital capacitance meter featured in the March 1980 issue. It would have to be the best project I have seen in test equipment, though I do have one problem - I cannot get it to work. I have checked and rechecked the board and layout of all components, but alas nothing. The 150uF tantalums were unavailable at the time and 100uF capacitors were used; also the Fairchild FND500 LED displays were substituted with FND507's.

The digits did for a while appear to come on but very weak. Could you please advise whether the above substitutes could be at fault, though they seemed compatible.

Being a regular reader of your magazine for a number of years I have often come across comments on CDI systems. I myself am not in favour of CDI on cars but has EA ever published a CDI unit that could be used on outboard motors. (T.H., Moree, Qld.)

● The FND507's are similar in appearance to the FND500's but are in no way compatible since they are common-anode rather than common-cathode displays.

This probably explains why the meter did not work.

With regard to the CDI for outboard motors, we were under the impression that most modern outboard motors already had a magneto-based CDI system and as such an alternative CDI would present no advantage.

WANTS PROJECTS: First let me say how much I enjoy your excellent magazine. For many years I have felt the urge to understand electronics and, after a year's reading of your magazine and the construction of several kits, I at least have some basic understanding.

Two projects that would greatly interest me would be an exposure meter for use with a photographic enlarger, and a radio control unit for use with model aircraft. The latter would need to be compatible with commercially available servos. Any hope that these projects will appear in the near future? (D.E., Tahmoor, NSW).

● Unless you are looking for a quicker way to "average quality" prints, we doubt whether there is much value in an enlarger exposure meter. For the best quality prints from given negatives, it is hard to beat the tried and true method of exposing test strips. So we are not really keen on that idea.

As far as radio control for model aircraft is concerned, we will certainly keep the idea in mind.

TACHOMETER IC: I am seeking data and/or application notes on the SAK140 IC. I have not been able to find it in any of the books that I have access to, nor have I been able to find out the name of its manufacturer. I do know that its function is an auto tachometer and that it is sold by Dick Smith Electronics. I would be grateful if you could help me – even the name of the manufacturer would be of assistance. (A.H., North Balwyn, Vic).

● A "Tune-up Tachometer" based on the SAK140 IC was described in October, 1975 EA and subsequently reprinted in our "Projects and Circuits No.2" handbook (Price $3.00 plus 60c p&p). The SAK140 is manufactured by Philips.

TV/CRO ADAPTER: After reading the May 1980 issue, my brother and I decided to build the TV CRO adapter but we have some problems we would like answered. (1) We live in Brisbane where unfortunately, there is a channel 0 which means we cannot use the UM1082AUSO without a great deal of interference from this station. Can you suggest a solution? (2) Would it be possible to connect two of these CRO's through a suitable VHF mixer to produce a dual-trace oscilloscope and, if so, could this be connected to the In-circuit Component Tester described in the same issue? (3) Could the time base range be extended by decreasing the capacitor in the time base oscillator?

Thanks for the great magazine and articles (especially the Serviceman) and keep up the good work.

By the way, is there any way the boys in the lab could whip up a microwave radio for use around the 2.3GHz band suitable to receive and listen to the Space Shuttle's transmitters? (D.T., Pullenvale, Qld.)

● Taking your points in order D.T., the best way of getting past any interference problems from your local station is to connect the adapter directly to the video input of the TV set as described in the original article. Another solution would be to retune the modulator to a higher channel.

As far as converting the TV CRO adapter to a dual-trace CRO is concerned, this could not be achieved by simply mixing two outputs. The solution is more complex than that and involves using one set of horizontal and vertical oscillators for both adapters and mixing their video outputs together prior to insertion of the sync – unfortunately we do not have the space to go into this further.

The timebase range of the TV CRO cannot be changed since it is locked to either the vertical or horizontal scanning frequencies of the TV.

Concerning the 2.3GHz receiver, we have no plans for such a project.

TV/CRO ADAPTER AGAIN: I wish to obtain some information about your TV CRO adapter. I have built the unit, but I can only get a 25mm clear wave on the TV set and it is saturated at 1300Hz. On the horizontal position all I get is a lot of spots and dots and this disappears as soon as the sync is switched on. (G.K., St Kilda, Vic.)

● The input sensitivity of the unit for a full screen display is only 100mV so you should be able to obtain a larger display than you have observed. The fact that the display also seems saturated at 1300Hz is because the timebase frequency in the vertical mode is only 50Hz which is a basic limitation of the TV CRO adapter.

The fact that you can only get a 25mm display is also the reason that the display dissappears when the sync is switched because the sync requires a signal amplitude corresponding to about one third of the screen width.

PC BOARDS & RF PRESELECTORS: I would appreciate it if the following two queries could be answered:

(1) After reading the article on the multi-purpose voltage regulator in the April issue of EA, I would like to know where I may purchase the PC board for this project. In the article, the only details given about it are its size and code number (80gps3). As is often the case, you have not indicated where readers may obtain the circuit board for the project.

(2) The article on the RF preselector for the broadcast band in the April, 1979 issue of EA left me wondering if junction FETs have a high input impedance after all. Why was the ferrite antenna connected to the gate in exactly the same manner as for a bipolar transistor? I can

Transistor-assisted ignition

TRANSISTOR–ASSISTED IGNITION: Recently, I made the EA Transistor-Assisted Ignition System. I have come across a couple of minor problems and hope you can help me. The unit is fitted to a 1979 Mazda 808.

The circuit used is the same as described in the Dec. 1979 issue, except that the 0.1uF capacitors are 50V disc ceramic types; also, Q2 is a BD135 instead of a BD139.

The problem is that there seems to be a "flat spot" at about 1200 rpm, although the rest of the range is fine. In addition, the system does run hot (I know that you mention this in the article). Any help would be gratefully accepted. (M.L., Wellington, NZ).

● The component changes you have made should have no affect on the performance of the TAI, while it is normal for the TAI heatsink and the ignition coil to become quite hot.

The "flat spot" effect is possibly due to the effects of severe point bounce which can cause the ignition system to deliver extra sparks – this causes misfiring and attendant loss of power. The cure is noted in the Errata for this month.

TRANSISTOR–ASSISTED IGNITION: As you are probably aware by now, there is an important error in the instructions for building the transistor-assisted ignition system (December, 1979). On page 61, the base diagram for the 2N6027 PUT is incorrect, with the anode and cathode connections shown transposed.

I built one of these units with the result of having no dwell extension. This was corrected by taking out the PUT and soldering it back into circuit with the flat side facing diode D1. Once this was done, the unit worked perfectly.

To change the subject, could you describe a receiver capable of receiving TV sound on all channels? Actually, a selection of up to six channels should do. The sound I receive on my FM stereo receiver from channel four is a considerable improvement over the TV sound. (I.L., Moranbah, Qld).

● You are right about the anode and cathode connections on the PUT being around the wrong way. We discovered the error shortly after the December issue was published, and published a note in the March issue. While we have no immediate plans for publishing a TV sound system, we will have a look at the situation in the near future. No promises though!

TRANSISTOR-ASSISTED IGNITION: I am gratified to note glowing reports on this profect because I am unable to endorse. Initially the PUT was wrongly connected in my unit. The car ran normally and presumably the only long term benefit would be longer points life due to the passing or reduced current.

With PUT correctly orientated the car runs roughly, starts badly, misses under load and needs a lead foot which in turn produces heavy fuel consumption. Disconnect the PUT or, revert to normal system and the car runs sweetly. I suspect that the dwell extension is too great and that the resultant HT discharge time is therefore inadequate. Vehicle is a newish BMW 320. No resistive wires or ballast feature and hence the +12V supply is taken direct from the coil positive which is switched by the ignition key.

I have replaced the PUT but with no improvement. There is no sign of carbon on the points, which are clean and bright. Plugs, points and ignition timing are spot on. New plugs, points and even, a new coil, have been substituted without improvement.

Problems seem to be in the PUT area and I figure that the 0.1uF in the Q1 divider network controls the effective dwell. Perhaps this 0.1uF is "off-value". I also figure that if I increase its value by 50% to 0.15uF, Q2 will switch off .9m/s after the points open. This would prove the point if I could measure the result – which I cannot. Before making such an adjustment I seek your comment upon whether my logic is correct. (I.S., North Balwyn, Vic.)

● The reason that your TAI is not working as it should is probably due to points bounce when the points close. This is not normally a problem but we know of one vehicle where points bounce caused the vehicle to run very roughly. Presumably, the points bounce causes the coil to fire when it should not.

We suggest you increase the 0.1uF capacitor associated with the points input circuit to whatever is required to solve the problem.

---

only think that either the particular FET has a very large Miller capacitance across the input or that this was the best way to overcome instability in the circuit.

In any case, I have often used junction FETs in my own projects, believing that they have very high input impedances. Apparently they do not, and this may be why my projects often fail. (T.C., Burnie, Tas).

●There are at least two sources for every PC board ever described in EA: Radio Despatch Service, 869 George St, Sydney; and RCS Radio, 651 Forest Rd, Bexley. In addition, a number of other parts stockists sell PC boards for selected EA projects.

You are quite correct in assuming that the Miller effect capacitance can be a problem in this type of circuit. We tried a number of circuit configurations using both bipolar transistors and FETs, and published the circuit which gave the best results.

AM BANDWIDTH: I have been told that AM broadcast stations transmit an audio bandwidth of ±15kHz. I find this hard to believe as all the AM radios which I have heard have a very restricted bandwidth. I was of the opinion that AM broadcast stations were limited to ±4.5kHz, as stations are separated by 9kHz. If AM stations do transmit ±15kHz, why do manufacturers of AM radios make them so poorly? Does any manufacturer build an AM tuner capable of taking advantage of the 15kHz bandwidth (if it exists)? Can AM be broadcast in stereo? I have checked my hearing and I find that it is limited to 5kHz. Thanks for your series of articles on RTTY some time ago. (T.R., Woodend, Vic).

● The bandwidth of AM broadcast stations is not restricted in this country to ±4.5kHz, although we understand that this could apply to AM broadcasts in Europe. There is no regulatory limit to the bandwidth of AM transmissions, indeed, the only regulation requires that the response at 10kHz must not be more than 4dB down for the whole system, from microphone to antenna. However, some transmitters do have a filter which cuts off at around 10kHz. Also, where a transmitter is located at a distance from studios, the Postal & Telecommunications program lines must be equalised to maintain a nearly flat frequency response up to 10kHz. This process then means that the frequency response above 10kHz falls off rather rapidly. On the other hand, where studios and transmitter are located together, this restriction does not apply and the bandwidth could go well beyond 10kHz.

Most AM receivers are made as a compromise between reasonable audio response and selectivity, the two being closely related. There are some manufacturers who do make high quality AM tuners and to give some idea of what can be achieved, we suggest that you read the review of such a tuner elsewhere in this issue. Indeed, this tuner does have a bandwidth of ±15kHz! Yes T.R., it is possible to transmit AM in stereo, as noted in a separate article elsewhere in this issue.

MODEL RADIO CONTROL: I read with great interest your reply to P.J.P. (Information Centre, June 1980), concerning your possible intention to develop a model radio control system. This would be the one article I have been waiting for. For 15 years, I have been hoping that

L.E. CHAPMAN

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330 ohm, 10W 25c
220 ohm, 5W 20c
5 ohm, 5W 20c
220 ohm, 10W 25c
950 ohm, 3W 20c
115 ohm, 5W 20c
10 ohm, 5W 20c
1k ohm, 5W 20c
5000 ohm, 5W 20c
6.8k ohm, 3W 20c
330 ohm, 10W 25c
6800 ohm, 10W 25c
1500 ohm DUAL, 21W 50c
50 ohm, 5W 20c
330 ohm, 5W 20c
1k ohm, 5W 20c
820 ohm, 5W 20c
12 ohm, 10W 25c
470 ohm, 7W 20c
4700 ohm, 4.5W 20c
5000 ohm, 10W 25c

ELECTROS

470uF, 25V ..... 5 for $1
400uF, 10V ..... 5 for $1
47uF, 63V ..... 5 for $1
350uF, 16V ..... 2 for $1
27uF, 160V ..... 5 for $1
25uF, 63V ..... 10 for $1
22uF, 160V ..... 10 for $1
47uF, 16V ..... 5 for $1
47uF, 200V ..... 5 for $1
220uF, 10V ..... 10 for $1
68uF, 16V ..... 10 for $1

CAPACITORS

0.0039uF, 1500V ..... 20c ea.
6N8, 1500V ..... 20c ea.
0.0068uF, 1500V ..... 20c ea.
1200PF, 400V ..... 10 for $1
0.068uF, 400V ..... 5 for $1
2200PF, 630V ..... 10 for $1
0.47uF, 250V ..... 10 for $1
0.10uF, 400V ..... 5 for $1
0.082uF, 160V ..... 10 for $1
26k, 250V ..... 10 for $1
0.041uF, 400V ..... 10 for $1
0.033uF, 250V ..... 5 for $1
0.027uF, 100V ..... 20 for $1
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Power leads 240 volt, suit most tape recorders, radios, etc. $1 each.

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240V pri; two x 25V, 117V & 6.3V sec windings. $7. P&P NSW $1.50, interstate $2.50.

- Telescopic aerials, $1.50
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- Line output transformers, 1200 to 3/ohm, 5 watt, $1
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- 240 to 15 volt transformers, $3.50.

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OA 626 ..... 4 for $1.00
OA 662 ..... 4 for $1.00
EM 410C ..... 4 for $1.00
DS 150A 50c
DSY 130YO 50c
OA 636 ..... 50c
HR 15 ..... 50c

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½ Meg 30c
1 Meg 30c
100K 30c
100K Switch 50c
50K Double Pole Switch 50c
7.500 ..... 30c
10K Switch 50c
250K 30c
50K 30c
20K 30c
10K Min Pots 25c
50/Ohm 50c
½ or 1 Meg Switch 50c

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PP NSW $2, interstate $3, WA $4.

HOR Drive 3021 transformers for colour TV $2
TV Colour Convergence Units 11270 44 x 6 ..... $3

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Screw in 6.3V ..... 10 for $10.50
24V ..... 10 for $1.00

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- Toggle switches, 25c
- 2 position push button switch, 50c
- 6 position push button switch, $1
- 4 position push button switch, 75c
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- In-line fuse holders, 4 for $1
- 4 pole 2 position rotary switches, 50c

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Audio Technica AT6 diamond stylus stereo $12

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BASS TREBLE
TAPE IN OUT AUX
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INTERSTATE $3
WA $4

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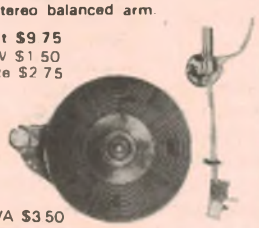
Interstate $2.75
WA $4



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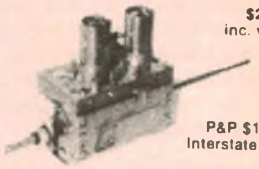
TV TUNER VALVE TYPE



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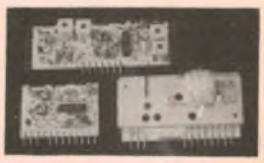
P&P $1.00
Interstate $2.50

SUPER SPECIALS

FM STEREO TUNER KITS



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12Kn 100uA **$2.00**

PHILIPS TV TUNERS

Transistor NT3024, NT3030, NT3032, Colour — P&P $1.

$10 ea.

something would be done along the lines you suggest.

I hope that my letter is not the only one to reach you regarding this. (M.N., Melton, Vic.)

● Rest assured M.N. that yours is just one of many letters urging us to describe a radio control system for models. We promise to take a look at the situation soon.

12-230V INVERTER: I am presently constructing the 12-230V inverter which appeared in the February 1979 issue of "Electronics Australia". On both the circuit diagram and the component overlay, capacitors C3, C4 and C10 (all 1uF) are shown as metallised polyesters. However, the parts list specifies that these are tantalum capacitors.

Would you please tell me which type of capacitor is correct. I have been unable to find any reference to this in more recent issues. (A.P., Parkville, Vic).

● The circuit diagram and the component overlay are correct. C3, C4 and C10 should be 1uF metallised polyesters

OSCILLOSCOPE PROJECT: I am writing to enquire whether you have a circuit diagram for building a cheap oscilloscope. Electronics is one of my hobbies and I would like to own an oscilloscope as part of my equipment. I am presently considering the article "TV CRO Adapter" presented in the May 1980 issue of EA, but would like to know your answer to the above question before starting construction.

There is an advertisement by C.Q. Electronics on page 70 of the May 1980 issue indicating the cost of a CRT and a circuit diagram for an oscilloscope which was taken from a magazine called "Practical Wireless". I have been unable to obtain a copy of this magazine and therefore cannot estimate the cost of the oscilloscope. (K.V. den B., Como, WA).

● The last oscilloscope project described by us was in 1968 – just on 12 years ago! This used a DG7-32/01 tube and valves and is now thoroughly outdated. Unfortunately,we cannot entertain the idea of publishing a modern circuit as oscilloscope tubes are difficult to obtain in quantity and are too expensive, in comparison to the cost of commercial CRO's.

REMOTE CONTROL: I am writing to enquire whether or not you have ever published a circuit similar to my needs.

I have recently obtained a solenoid cassette deck, which has a remote control unit attached to the deck by a cord and an 8-pin plug. I wish to make this remote unit wireless. Only seven of the eight pins are used - one each for play, record, fast forward, rewind, pause and stop, and the seventh for common.

I have opened my remote unit up and found it to contain a number of switches that just connect the desired function to common. If you have not published a remote control circuit would you consider it? I am sure many readers with solenoid-operated decks would be interested. (N.W., Toowoomba, Qld).

● Sorry N.W., but we have no plans for a multi-channel control unit along the lines you suggest.

CDI & TACHOS: After reading about the problems encountered by readers with tachometer operation on vehicles fitted with CDI, I would like to submit a method I have used successfully to overcome the problem. This consists of connecting two series 10k/5W wire-wound resistors across the ignition coil primary circuit terminals and using the centre junction between the two resistors as the tacho take-off point. (P.B., Croydon Park, 2133)

● Thanks for the information P.B. Readers should note, however, that while this technique may work for some tachometers, it will not be successful in all cases.

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ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

EPROM Programmer . . . ctd from page 77

To erase your EPROMs prior to programming you will need a source of ultraviolet light with a wavelength of 2537 Angstroms. A suitable source is the TUV 15W lamp (cat no. 57415P/40), available from Philips. It fits in a standard 20W fluorescent light holder, and should be ordered from an electrical or lighting store.

With the window of the 2708 about 25mm from the tube, an exposure time of approximately 30 minutes will be required. Note that the UV output of the lamp is also dangerous to eyes and skin so you should fit a cover over the unit while it is in operation.

NOTES & ERRATA

12-230V INVERTER (February, 1979, File No. 3/IT/10): the parts list should read 3 x 1uF polyester capacitors; not 3 x 1uF 16V tantalum.

PLAYMASTER GRAPHIC ANALYSER (February 1980, 1/SC/10): The 220k and 2.2M resistors shown connected to switches S2c and S2b on the circuit diagram should be changed to 56k and 180k respectively.

PLAYMASTER 300W AMPLIFIER (June 1980, File No 1/MA/55): The circuit on page 55 shows the 47uF capacitor reversed in polarity. The component overlay diagram on page 59 is correct in this respect. Also note that the input impedance of the amplifier is 4.7k, not 47k.

TRANSISTOR–ASSISTED IGNITION (December 1979, File No 3/TI/15): A few cars have displayed symptoms of misfiring or a "flat spot". This has proved to be due to the effects of severe point bounce which can be cured by increasing the 0.1uF capacitor associated with the diode D1. The capacitor may have to be increased to as much as 0.47uF in really severe cases. Note also that the tacho connection should be to the coil (collector of Q4) and not to the points.

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VIC.

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S.A.

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