ELECTRONICS Australia

with CB and HIFI NEWS

DECEMBER, 1977 AUST $1.25* NZ $1.25

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SONY'S NEW G SERIES SPEAKERS.
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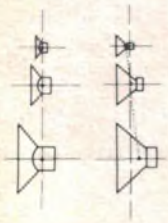

We admit it, for years our front name reputation in audio and video hasn't quite been matched by our speakers.
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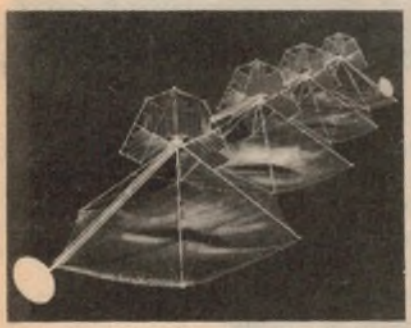
ELECTRONICS Australia

Australia's largest selling electronics & hi-fi magazine
On sale the first Monday of each month

VOL. 39 No. 9 DECEMBER, 1977

This easy-to-build electronic poker machine will provide Christmas fun for the whole family. Turn to p56 for the details.



A bold new concept to solve man's energy problems has been proposed by Boeing Aerospace Company — power stations in space! The story is on p8.

On the cover

Pictured is the recently released BWD 539D oscilloscope testing an AWA mobile transceiver at the laboratories of BWD Electronics Pty Ltd. You can find out more about the 539D on p108 of this issue, and how to win a unit for yourself on p49.

FEATURES

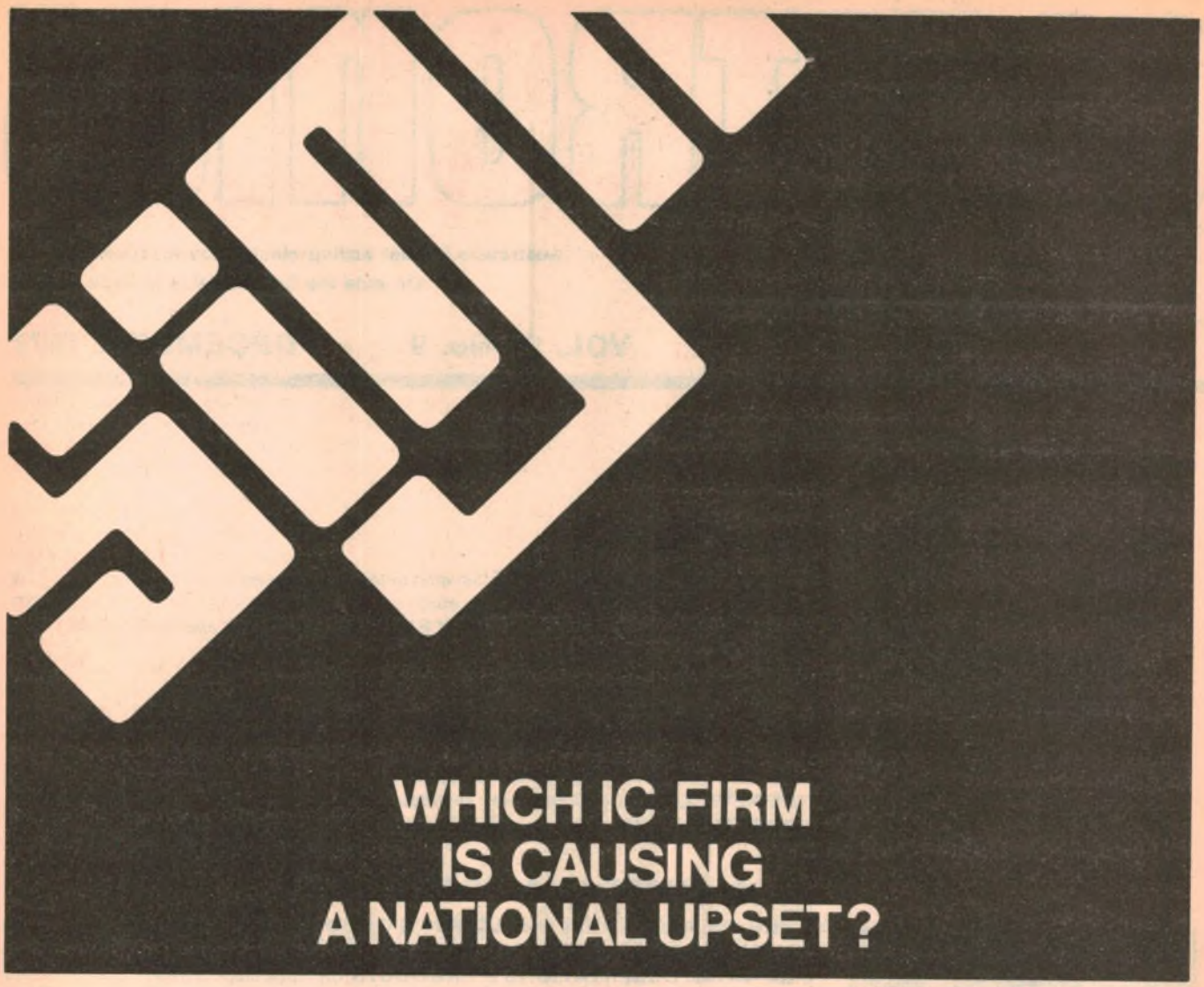
HIFI NEWS & REVIEWS

THE AUSTRALIAN CB SCENE

PROJECTS & CIRCUITS

COLUMNS

DEPARTMENTS



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Editorial Viewpoint

1978 — year of the microcomputer?

Well, here we are again nearing the end of another year, and it has been a fairly eventful one for the local electronics industry. The events have admittedly not been propitious for the manufacturing side of the industry, nor perhaps for the hi-fi marketing firms, but the importing and overall marketing situation seems to have improved significantly.

Without a doubt the main event has been the legalisation of CB radio, and the subsequent market growth. This has happened very rapidly, and things are still rather chaotic. There are dozens of brand names around, and almost every corner store is offering CB equipment. How many of them are likely to continue doing so is a matter of conjecture, as many of the imported transceivers have already been rejected for licensing by the PTT department. However local manufacturing firms are quietly preparing for production of UHF equipment, so that as marketing of 27MHz gear tapers off there should be a growth in the manufacturing sector to at least partly compensate.

Probably the other main event this year has been the accelerated growth in microprocessors and microcomputers. This area finally seems to be talking off now, here as well as overseas, and in both the industrial and hobby/consumer areas. New equipment manufacturers are appearing, hobby and consumer stores are springing up, new clubs have formed, and both academic bodies and industry organisations are holding conferences and seminars.

It is evident that a new growth industry is emerging, even if its gestation time has taken a little longer than many had predicted.

In the coming year the microcomputer area looks likely to be the main growth sector within the electronics industry. The biggest impetus is likely to come shortly with the appearance of complete low-cost systems suitable for really small businesses, schools and the home: the true "consumer" computer, as distinct from the hobby computer.

We have been doing our best, here at EA, to keep you abreast of these developments. And, judging from the reaction to many of our recent features, most readers seem to appreciate our efforts. It has been particularly encouraging to see the response to some of our construction projects — like the Mini Scamp microcomputer, for example, of which more than 700 have apparently been built to date.

It has been an eventful year, then, and one which seems to be drawing to a close on a reasonably optimistic note.

On behalf of all of us here, may I wish all of our readers, advertisers and friends a very happy Christmas season, and all the best for 1978.

Jamieson Rowe

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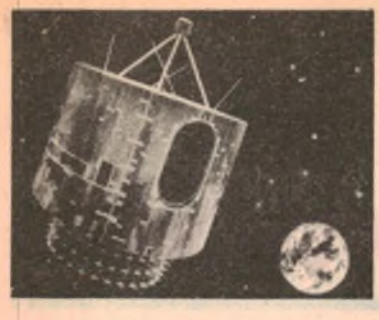

News Highlights

Chess Challenger — you play the computer!

It's you against the computer! The first microprocessor based chess game is now available in Australia.

Called the Chess Challenger, the new game is based on the Intel 8080 CPU. It also utilises an 8224 clock generator/driver, an 8228 system controller, 512 8-bit bytes of random access memory to store the position of the chess pieces, and a 16,384-bit read only memory.

The firmware (inside the ROM) contains such elements as the rules of chess, the relative importance of the various pieces, and allowable moves and strategies. The Chess Challenger plays by the book, working on the weighted value of the pieces, and completely scanning the board for the best available move each time. It plays aggressively, tries to control the centre of the board, and, if it's in trouble, will try for a stalemate.

The keyboard can be used to verify the position of each chess piece at any time during the game. The player can select from four levels of difficulty at the start of the game, can choose offence or defence, and can even commence in mid-game should he wish to set up a chess problem. All the moves of chess can be made, and the Chess Challenger is programmed to castle at the first opportunity.

Chess Challenger is easy to play and, according to the manufacturer, can be beaten by an average player 25%-70% of the time, depending on the level of difficulty selected. It costs $385.25 and is available from Futuretronics Pty Ltd, 527 Tooronga Rd, Hawthorn East, Victoria 3123.

Communications for deep sea divers

In Britain, a cooperative formed by two specialist firms and the Admiralty Experimental Diving Unit has been working for some time on a fibre optics communications system for deep sea divers. One of the companies, J. and S. Marine, has developed a multiplex data transmission system. This encodes information for transmission along a single fibre line, and decodes and presents the data at the receiving end.

Conventional diving equipment involves an umbilical line that tends to be heavy and cumbersome. The big advantage of the fibre optic technique is that it reduces quite dramatically the diameter of the speech and data lines between the diver and the diving bell, or between the bell and the surface vessel.

The system developed by J. and S. Marine is designed to carry 16 of the diver's medical parameters, including pulse rate, body temperature, heartbeat, physiological and life support details, and diving suit temperature. This system now forms part of a four-line communications system. Two of these lines provide two-way speech communication, whilst the fourth line is spare.

Apart from giving the diver freedom to work with the minimum of extraneous equipment and the lightest possible umbilical line, the system's most important contribution to safety is its immunity from outside electrical interference. In such a complex piece of equipment as the modern diving suit, designed for use at great depths, it is inevitable that a great deal of static electricity is generated. The effect in shallow water is likely to be negligible, but in deep conditions it can mean the loss of data essential to the survival of the man at the end of the line.

In fibre optic transmission no electric current passes along the line, and it therefore is immune from electrical interference. This is important because the diving suit and the support systems, to say nothing of the gear employed on the seabed, are all potential generators of interference.

Device beats radar detectors

In their war on speeding motorists, traffic police have had a formidable weapon at their disposal for some years now — radar speed indicators. Just recently, though, motorists began to hit back, using radar detectors to (hopefully) detect the presence of a radar trap and provide adequate advance warning of its presence.

Now, according to the American magazine "Electronics", the police have another weapon. The device is a small traffic radar that uses a microprocessor to help in camouflaging itself from the barrage of radar detectors now on the roads.

The radar, from Kustom Signals Inc, is programmed with a hold feature that suppresses the microwave transmission until a target vehicle is within sight. That way, it is invisible to radar detectors until it is fired, and by the time it is seen, the radar has recorded the target's speed.

National looking sharp!

A feature of the Haco Distributing Agencies stand at the recent Consumer Electronics exhibition in Sydney was an ultra-thin "National" pocket radio developed by the Matsushita Electric Industrial Company, Japan.

The new radio measures a compact 71mm wide by 127mm long, and is just 12.7mm thick. Weight is 130g with batteries.

Recommended retail price for the new model, due for release last September, is around the $40 mark.

Record turnover for Dick Smith

Dick Smith Electronics Pty Ltd has announced a successful trading year for 1976-77.

Mr Ike Bain, General Manager, said that turnover increased from $3.5 million in 1975-76 to $7 million in 1976-77, these figures representing tremendous growth. According to Mr Bain, CB radio contributed significantly to this increase, although the traditional hobby electronic lines were still responsible for the majority of turnover.

Omega agreement has been signed

The Minister for Transport, Mr Peter Nixon, recently signed an agreement between the Australian and US Governments for the establishment of an Omega long-range navigation facility in Australia.

The facility, which will be built in Gippsland, Victoria, will be designed, operated and maintained by Australians. Mr Nixon said that the Government had approved the purchase of the 308 hectare site at Darriman, about 25 kilometres from Yarram.

The Omega establishment agreement between Australia and the US provided that:

- The Australian Government would be solely responsible for operating, maintaining and staffing the facility;
- Australian made materials and resources would be used in establishing the facility; and
- The 400 metre aerial tower would be designed in Australia and built from Australian steel. Australian materials would be used throughout the project as far as practicable.

Mr Nixon said that the Australian Omega facility would complete a world-wide network of eight Omega stations. The others were in North Dakota, Hawaii, Argentina, Liberia, Norway, Japan and Reunion Island in the Indian Ocean.

Touch tune Toshiba from EMI

Backed by a full 3-year parts and labour warranty, this Toshiba Model C-830 43cm colour TV receiver features electronic touch tuning and a "Blackstripe" picture tube with in-line guns. A hinged fascia panel conceals the major controls. Enquiries to Toshiba-EMI (Australia), 16 Mars Rd, Lane Cove 2066.

GE to develop new electric vehicle

A two-year $5.98 million contract for the development and construction of two experimental four-passenger electric cars has been awarded by the US Energy Research and Development Administration, now part of the Department of Energy (DOE), to the General Electric Research and Development Centre.

Under the terms of the contract, GE will deliver the two cars to DOE in the first half of 1979. Called "integrated test vehicles", the new subcompact-sized electrics will be based on a design to be developed jointly by GE and Chrysler Corporation.

Electrical and mechanical innovations will be developed by the GE Research and Development Centre, Schenectady, NY, and by its team of consultants and subcontractors. GE also will supply the electrical drive system.

Chrysler Corporation, Detroit, Michigan, will design and fabricate the body and chassis. Globe-Union Inc., Milwaukee, Wisconsin, will provide high-energy lead-acid batteries. GE and Chrysler will jointly test the integrated vehicle.

Technical and mechanical specifications for the new electric cars have not yet been detailed. However, GE's program plan calls for a separately excited direct current (DC) motor powered by a 108-volt lead-acid battery system.

The GE cars will have regenerative braking to permit braking energy to be used in recharging the 18 batteries. Advanced electronics will provide the vehicles with smooth and efficient performance.

Built especially for stop-and-go urban driving, the new vehicles will have an urban driving range of 120km before the batteries need recharging and will be capable of cruising at speeds of 90km per hour. Another DOE objective is that design of the new electrics be conducive to mass production, with purchase price and operating costs comparable to conventional cars.

NEWS HIGHLIGHTS

Canberra microcomputer conference

These two candid shots were taken at the recent microprocessor conference in Canberra, run by the Canberra branch of the Australian Computer Society and the Canberra College of Advanced Education. A lot of keen enthusiasts attended, including both amateurs and professionals. The photos are by courtesy of Dr Bill Caelli, the conference convenor.

Increase R&D spending, says ATDA

Australia, of all reasonably developed nations, is at the bottom the list for government funded industrial research and development according to the Australian Telecommunications Development Association.

The ATDA has made this claim in its submission to the Senate Standing Committee on Science and the Environment's inquiry into research and development in Australia.

The association says in its submission that technical and manufacturing capability and capacity are at present lower than they have been for many years.

The main causes for this are:

- the present economic recession,
- substantially reduced ordering of communications equipment by Telecom Australia and by Government Departments,
- currency realignments, substantial tariff cuts, and an escalating wage structure.

"The reduction in available work has led to extensive retrenchments, resulting in a considerable loss of technical expertise and capacity. In the past three years the industry has reduced its R & D staff by about 30 per cent," according to the ATDA.

The association's submission points out to the Senate Inquiry that a healthy and active electronics industry is essential for Australia. The industry provides vital telecommunications equipment for Telecom Australia, for the defence network and in the private sector.

Changes at Arlunya

Arlunya Pty Ltd has advised that its manufacturing and importing activities are now being carried under a new name: The Arlunya Division of The Dindima Group Pty Ltd. Ownership and control of the Dindima Group Pty Ltd remains in Australia, and is essentially the same as for Arlunya Pty Ltd, prior to the change.

The purpose of the change is to facilitate the growth of the company and to allow the gradual separation of the local manufacturing and importing activities into separate divisions. The company intends concentrating on increasing sales and improving support for high grade products from a limited number of top overseas firms.

Australian developed electric car

An electric vehicle, currently under development at Flinders University, Adelaide, is reaching the stage where it could be put into full commercial production.

The project, based on the Fiat 127 coupe, replaces the internal combustion engine with lead acid batteries and two printed circuit motors. The motors drive through the vehicle's original automatic transmission.

"DXers Calling" scrapped

The Australian Radio DX Club (ARDXC) has been advised that its long running program "DXers Calling" will no longer be broadcast by Radio Australia. The program, especially for short wave listeners, had been on air every week since July 1946.

The ARDXC feels that letters of protest may succeed in reversing this decision, as "DXers Calling" had a wide audience in Australia and NZ. Readers should direct their letters to The Assistant Director of English Programs, Radio Australia, GPO Box 428 G, Melbourne 3001.

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Space satellites the size of small cities — the concept sounds fantastic. But this is just what the US Boeing Aerospace Company is seriously proposing as a solution to the world's energy problems.

Power stations in space!

That man must develop new sources of energy other than fossil fuel is a fact beyond question. It is the essence of the energy crisis. Most believe the solution will be found in the development of a non-depletable source of energy which can be transformed into usable electricity.

Man's primal energy source, the Sun, offers an attractive answer. By harnessing its rays in space, where they exist without night, and transforming this power into electricity usable on Earth, we would tap a power more durable than mankind.

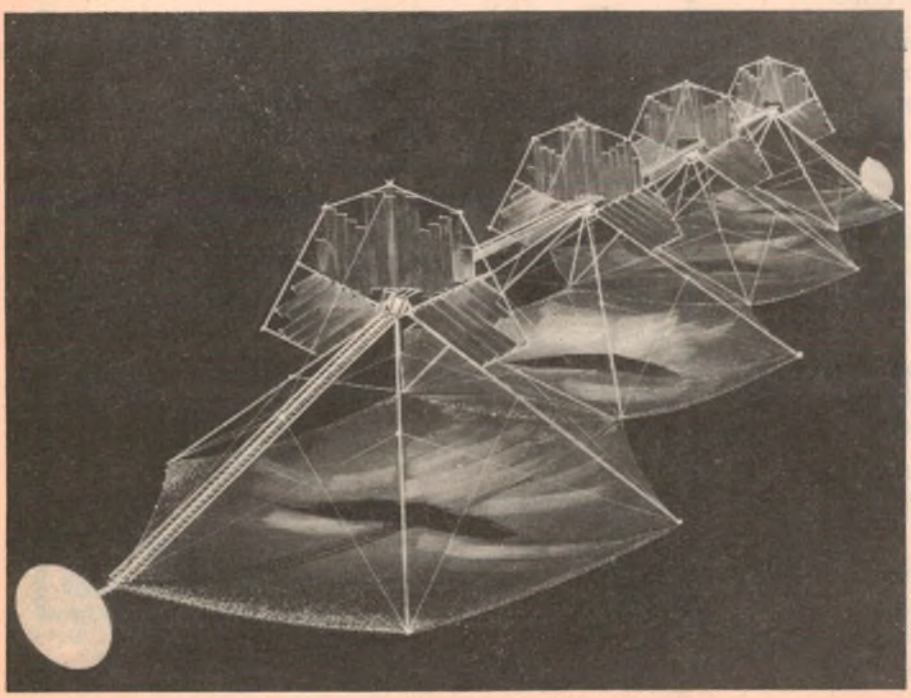
This feat may be accomplished through the use of solar power satellites, according to the Boeing Aerospace Company, Seattle, USA. Boeing's concept calls for the orbiting of a number of satellites, each capable of producing twice the usable power generated by Grand Coulee, the largest hydroelectric power station in the USA.

The Boeing satellites, each of the size of a small city, would be deployed some 36,000 kilometres above the equator in geosynchronous orbit, and would appear stationary when viewed from Earth. They would be bathed in sunlight 99% of the time, passing through the Earth's shadow only for very short periods in spring and autumn when it is late at night on Earth.

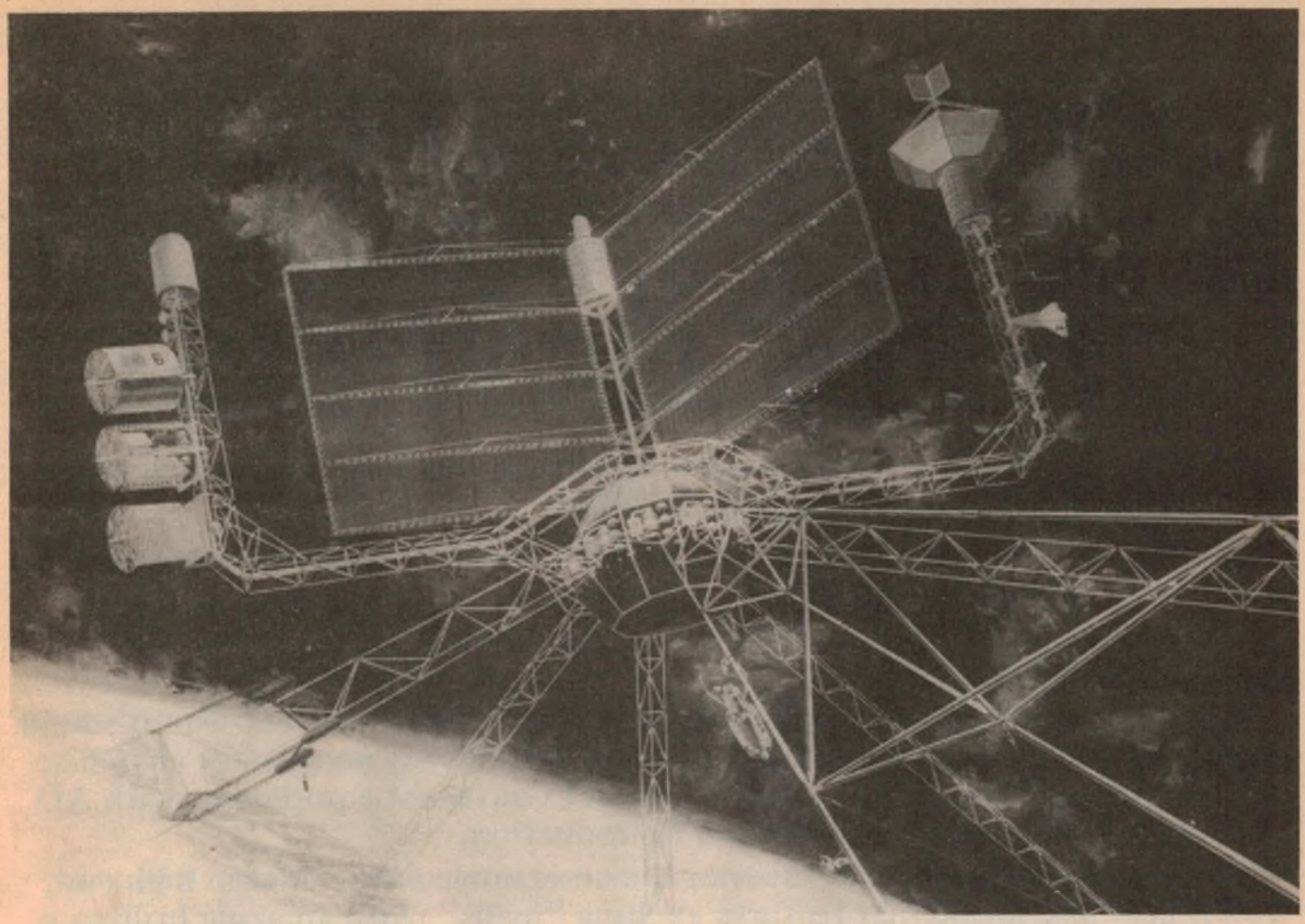
The theory behind collecting solar energy in space is that the Sun's rays there are almost uninterrupted, and there is a virtual infinity of space for the collecting equipment. Boeing estimates that the solar energy available per unit area in space is six times as great as in the American deserts and 15 times as great as in typical north-eastern industrial areas.

The energy collected in space would be concentrated and transmitted back to collecting stations on Earth. These collecting stations would be elliptical in shape, measuring about 8km across and 12km in length. This represents a huge saving on space compared to the ground needed for direct collection of solar energy on Earth, and would greatly increase the chances of locating collector stations near industrial centres instead of in remote desert regions.

According to Boeing, 45 to 50 of the satellites it proposes would be able to match the present electrical power generating capacity of the United States, freeing oil, coal and their derivatives for other crucial needs. A few more than as many again would



Boeing concept for four-segment power satellite array stretching 23.7km across space. Structures above each solar collection module are panels which radiate unwanted heat from the spherical thermal generators which they girdle. The round discs seen lower left and upper right are transmitters which beam microwave energy back to earth for conversion into usable electricity.



This photograph shows Boeing's concept of the thermal engine section of a power satellite being assembled in orbit. Also shown are the spidery legs which would eventually join the thermal engine to a huge array of mirrors serving as a solar concentrator. Scale is indicated by Space Shuttle docked to the structure, upper right.

provide the present energy requirements of the Earth.

Boeing has been involved in studies related to solar power satellites since 1972, both with its own research funds and under contracts from the National Aeronautics and Space Administration and other government agencies. Studies have centred on two basic configurations for the satellite — photovoltaic and Brayton heat engine. Each would be capable of producing 10,000 megawatts of usable power — enough to fill the needs of a million homes.

The photovoltaic satellite would be rectangular in shape and cover an area of about 24.8 kilometres by 5.2 kilometres — an area of almost 128 square kilometres, or the size of a small city. On this vast platform would be mounted about 14 billion solar cells. This spacecraft would have a mass of about 80,000-100,000 tonnes.

The satellite's solar cells would transform sunlight directly into electrical energy, the same way solar cells power small satellites.

The Brayton heat engine satellite would use a series of four parabolic dishes, each about 5.6 kilometres across. Together, they would stretch some 23.7 kilometres across space. Each dish would be made up of thousands of steerable, extremely thin plastic reflectors. These reflectors would direct the Sun's rays into a domelike cavity absorber — a solar furnace — located over each dish.

The concentrated sunlight would superheat gases which would expand and drive a series of turbo-generators girdling the absorber. These generators would produce the satellite's electricity.

Once through the generators, the heated gases would be piped into large fin-like radiator panels in which the gases would cool before being recirculated back into the cavity absorber to begin a new cycle. The Brayton heat engine satellite would weigh about the same as the photovoltaic satellite — 80,000-100,000 tonnes.

The photovoltaic system is the less complex system, Boeing says, but solar cells at their present state of the art are less efficient than thermal cycle engines. They are also quite expensive and require exotic manufacturing techniques.

Brayton heat engine satellites, on the other hand, are complex systems using complex devices. They have a higher conversion efficiency, process large quantities of power and already have been proved through the large-scale production of energy on Earth.

Boeing says that while each system has definite attractions and drawbacks, both appear feasible.

The solar power satellites — whether heat cycle or solar cell — would produce direct current electricity. This would be converted to microwave energy which would be channeled through two transmitters on each satellite. The antennas would be about 1km across and, except for size, would be an extension of current radar technology.

The antennas would direct the microwave beam to ground receiving antennas which would rectify the microwave energy to produce direct current electricity.

These rectifying antennas — or "rectennas" — would resemble chain link fencing mounted in strips high

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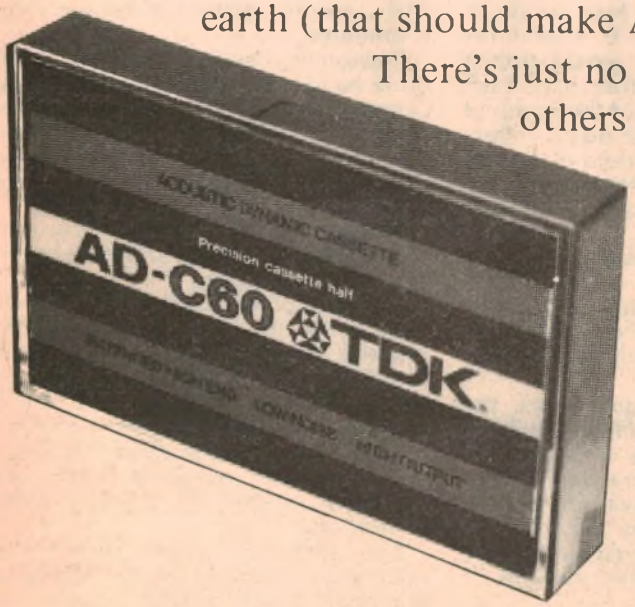

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Power stations in space — solution to the energy crisis?

enough off the ground for the area beneath it to be used for animal grazing or farming.

Microwave levels outside the antenna area and even beneath the antenna would be below the already stringent standards now in use in the United States. The beam itself would be of a low enough intensity to allow birds and other forms of life to pass through it without harm. The peak intensity at the beam centre would be far below lethal levels even at long exposure. It would have no effect on aircraft or their passengers.

"The construction of things in space the size of small cities is entirely outside human experience. But it is not beyond a reasonable extrapolation of the state of the art," says Boeing's official background sheet.

The satellites would be so large that they would have to be put together in space — either in low Earth orbit and then launched into the higher geosynchronous orbit, or else constructed directly at the higher orbit. The decision as to which is still under intense study.

The proposal is that large unmanned freighters, known as heavy lift launch vehicles, would carry outsize cargo pallets into low Earth orbit where these pallets would be deposited and directed to docking stations at a space construction base. These freighters would have to be entirely reusable and available for relaunch within a week to justify the economics.

Today's Space Shuttle Orbiter with minor modifications would be the backbone of the manned transportation system, carrying the several hundred men needed on the orbiting construction base.

Orbital transfer vehicles to carry men and equipment from near-Earth orbit to geosynchronous orbit would also be needed, as would propulsion units to carry satellites or their major segments to this stationary position.

In all, man may be shipping from Earth almost one million tonnes of hardware each year — an astounding amount. Engineers foresee the day, possibly within the next 20 years or so, when huge space freighters will be departing the likes of Kennedy Space Centre at a rate of four, or five — or even 10 — a day.

Far fetched? Yes, at first blush, but studies by Boeing and others show that no technological breakthroughs are needed for all this to come about, only a natural growth of today's technologies.

In fact, the greatest apparent stumbling block may be psychological, not technological. Ralph Nansen, Boeing Space-based Solar Power Program manager, calls it: "Concept shock."

Satellites the size of cities and the weight of battleships seem illogical. Launch schedules resembling airline timetables seem highly improbable. The manufacturing of complex structures from basic materials by hundreds of persons in space seems impossible.

But hardnosed engineering studies show that, while challenging, all this is technologically achievable within a relatively short time.

In an engineering sense, Kubrick's "2001" is upon us. After all, 2001 is less than 25 years away, and for today's ideas to become reality in that time span, they must be visible on our drawing boards now.

The cost? We really don't know. Boeing and other manufacturers are currently attempting to determine this through government-funded and company-funded studies.

We do know that, to be feasible, solar power satellites must be constructed and operated to allow amortization of their costs by the revenue collected from the users of the electricity they furnish.

Simple arithmetic shows that the revenue from one solar power satellite producing 10,000 megawatts of electricity sold at a rate of three cents per kilowatt hour would produce $78.8 billion in 30 years. Forty-five satellites would produce more than $3.5 trillion (three cents/kWh currently is the cost of electricity generated by new oil-burning plants).

Of course, this is simple arithmetic, and such economics seldom are simple. Any power generator has times when it is not totally in service or is producing energy at a rate above that which is being purchased at the moment.

However, we do know that the cost of electricity produced from today's energy sources is headed only one way: up. As the cost of depleting fossil and nuclear fuels rises, so will the costs of power they generate.

Solar power satellites, on the other hand, may be expensive to bring on line but are not dependent on fuel costs. The Sun's rays are free.

A step-by-step studied approach to space-based solar power generation is needed. Boeing already has recommended in Congressional testimony that the US Government embark on a carefully phased plan which would progress from concept definition to technology verification to subscale demonstration. This would establish confidence that satellite power systems are technically and economically viable. Only then would the nation embark on the more expensive full-scale development.

As Jacques Cousteau, the French explorer, has observed, our present-day energy solutions either cheat on the past or cheat on the future. It is time we became honest with ourselves.

Photo below shows how 30 power satellites in geosynchronous obit would look, as viewed from eastern Washington.

Brian Dance gives some good advice on

Choosing a calculator

. . . a look at what's available and the things you need to know

The modern electronic calculator is a highly complex piece of equipment which can perform complex calculations very quickly and with great accuracy. However, there are now so many different types of calculator on the market that the selection of the type most appropriate to one's own particular requirements can pose quite a problem. This article has been prepared to help readers formulate the criteria they should consider when selecting a calculator.

An electronic calculator contains one or more lsi (large scale integrated) circuits of extreme complexity to perform the logic operations. In addition, the calculator must incorporate a suitable keyboard and a display (or possibly a printer). Even the display is more complex than one may think; when the instrument is just displaying a number, each digit is illuminated in turn at such a fast rate that the eye sees a continuous display.

This type of sequential display is necessary in order that an integrated circuit with a reasonable number of connecting pins (often 24) can be used to cause each digit to indicate one of 10 possible numbers and still leave enough connecting pins available for inputs from the keyboard, etc.

It is not so many years ago since the first electronic calculators replaced the large, noisy mechanical types of desk calculator. However, the early electronic types employed numerous digital integrated circuits and were therefore suitable only for use as large desk machines. The very rapid expansion of the pocket calculator market during the past few years has been made possible by work on lsi technology specifically for calculator use.

During the past five years, calculator prices have fallen by nearly a factor of 10. This is obviously due to the large market created by the falling prices, although prices are still tending to fall slightly even if one makes no allowance for inflation.

The early pocket calculators were simple four function machines, these functions being addition, multiplication, subtraction and division. Simple four function machines are now available at very low prices. At the other end of the market, one can obtain complex programmable machines which can tackle problems for which a computer would previously have been required.

Indeed, the pocket or desk calculator has an advantage over a computer in that one does not have to learn a special programming language to use the instrument and one can feed the data in oneself; the disadvantages of a calculator are that the data and program memory stores are much more limited in volume that those of a computer and one does not normally have a fast line printer available.

IMPORTANT FACTORS: Perhaps the most important factors to be considered when choosing an economical calculator are (1) the type of power supply used; (2) the type of readout; and (3) physical size, layout of keyboard, personal preferences, etc. In the case of more complex calculators, there are many factors to be considered, such as the functions provided on the keyboard, the ease of programming, the size of the program memory, etc.

POWER SUPPLIES: The most economical types of pocket calculators are powered by small disposable "dry" batteries so as to keep the cost to a minimum. If such a calculator is used frequently, the cost of battery replacement will be fairly high because the current taken from the battery is typically about 100mA when all of the digits are glowing. However, the current is much smaller when only one digit is being displayed. These remarks are not applicable to the liquid crystal type of display which will be discussed shortly; indeed, the power supply requirements are very closely related to the type of display employed.

The typical operating time of a small calculator from disposable cells is around 12 hours. Apart from the cost, the necessity for replacing such cells can be a nuisance — especially if one does not have a spare cell at the time.

An alternative to the use of batteries is the use of a mains adaptor which usually consists of a small box with one lead going to the mains and the other to the calculator. The box contains a small mains transformer which, together with associated circuitry, supplies a low voltage to the calculator through a small jack plug. Such an adaptor can be used with many types of pocket calculators.

If the adaptor is an optional extra, it is normally well worth the extra cost unless one will be mainly using the calculator where no mains supply is readily available. In the case of desk type calculators designed mainly for use in an office, a mains power supply is almost universal. Mains power supplies are also often used with printing calculators, since they can easily supply the larger amount of power required by such instruments.

The most satisfactory type of power supply for a pocket calculator involves the use of nickel-cadmium rechargeable cells inside the instrument. It is unfortunate that such cells are quite expensive, but almost all high quality portable calculators incorporate such cells together with a mains adaptor for charging. A rechargeable battery pack and mains adaptor are available as optional extras with some calculators.

Nickel-cadmium cells should have a life of at least 500 charge-discharge cycles, so the extra cost is generally well worthwhile if one expects to use the calculator fairly regularly. The cells are automatically charged when a mains unit is plugged into the calculator; the time required for a full charge varies from one calculator to another, but is generally in the region of four to 12 hours. The calculator can also be used whilst being charged, although this does increase the time required for a full charge.

Excessive overcharging should be avoided, since this can result in the escape of gas from the cells with subsequent reduction in their storage capacity. The calculator should never be operated from the charger without the nickel-cadmium cells in position, as the supply voltage may be too large and the instrument may be damaged.

One should also appreciate that the time for which a nickel-cadmium cell can retain its charge is limited. A typical fully charged nickel-cadmium cell will lose about half its charge in two months, whilst very little charge will remain after a year. Thus regular charging is fairly important. The storage capacity of the batteries will, in any case, fall over a period of years.

Some calculators incorporate automatic switch off facilities in order to conserve the batteries. The display is automatically switched off about 30 seconds after the last entry is made on the keyboard, but the display can be restored for a further 30 seconds by operating a suitable key.

TYPES OF READOUT: Three types of visual display are used in currently available calculators. One of the first types to be used employed red light emitting diodes. The other type found in many cheap calculators employs a "Digitron" vacuum tube in which electrons cause fluorescence of a phosphor so that green light is emitted. Liquid crystal displays are generally somewhat more expensive than the other two types, but have the particular advantage that their power consumption is far smaller than that of either of the other types.

The digits used in the red light emitting diode displays are usually fairly small and it may not be easy to read them in bright light. However, such displays are very robust and reliable; indeed, as far as is known, the life of a light emitting diode display is indefinitely long. The digit height may be only about 3mm, but a magnifying lens is sometimes placed in front of each digit; this has the disadvantage that the field of view is restricted. Most of the more expensive programmable pocket calculators employ light emitting diodes in the display.

Green fluorescent displays employ digits which are generally larger than those used with light emitting diode displays. In addition, the green displays appear quite bright in a new machine, so they look impressive in a store.

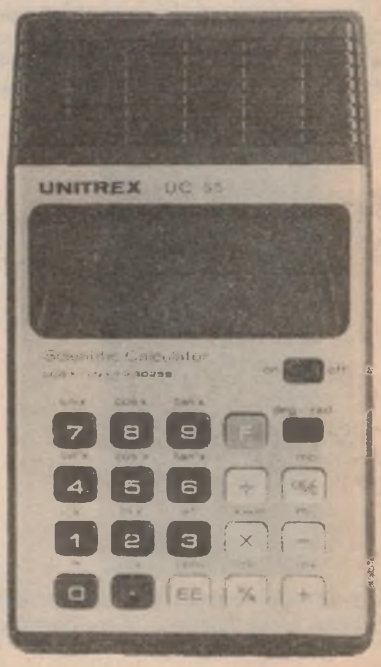
Unfortunately the vacuum tubes used with such displays are likely to be broken if the machine is dropped. The Digitron tubes are also relatively expensive and fitting them can be quite difficult — a calculator with a broken tube is often just discarded. In addition, green fluorescent displays tend to fade over a period of a few years.

So if you expect a calculator to last for a long time, it may be wise to choose another type of display!

Green fluorescent displays require more current than most light emitting diode displays, but one should remember that a calculator with a bright display will normally consume a larger current from the battery than an instrument with small, less bright digits. After all, the light energy can come only from the battery. Many desk machines employ large green fluorescent digits, but as they are operated from the mains supply, the relatively large current consumption is unimportant.

Liquid crystal displays require a current in the microamp region, so a cheap disposable battery can last for a very long time. Indeed, the life of the battery may be virtually equal to its shelf life and one may forget to remove it after it has started to leak. Some calculators using liquid crystal displays therefore employ miniature silver oxide cells. In some cases the cells

The HP-21 scientific calculator from Hewlett-Packard features Reverse Polish Notation.



This low-cost scientific calculator from Unitrex retails for around $15.00.

provide a life of some 3000 hours of normal use.

As the power cells used with liquid crystal displays can be quite small, this type of display is usually employed in very thin calculators (perhaps only 5mm in thickness) which can be fitted into a small carrying wallet and not make one's pocket bulge. The life of liquid crystal displays has been somewhat suspect, since any electrolysis can damage the cells, but current types appear to have a much longer life than the early types used in watches. This type of display also has the disadvantage that a fraction of a second elapses before the display is clear.

Liquid crystal displays do not emit any light and therefore cannot be seen in darkness; they merely reflect different fractions of the incident light from various parts of the display. Unlike the other two types of display, though, liquid crystal displays are easily read in bright sunlight. Note that liquid crystal properties suddenly disappear above a certain temperature (about 40°C), but reappear on cooling.

Novus Mathematician PR, a specialist calculator from National Semiconductor.

The now famous HP-65 programmable pocket calculator. Magnetic cards enable it to use pre-recorded programs.

PRINTING CALCULATORS: Most printers are relatively large and have in the past been confined to desk-top machines. Recently, however, a pocket calculator with a printer has come onto the market. Although the "hard copy" provided by a printing calculator is very useful, printers are relatively slow, require considerable operating power and are relatively expensive. Most types operate with a roll of paper 75mm in width.

NUMBER OF DIGITS: Almost all calculators have a display which shows eight significant figures. A few of the earlier types had a six-digit display, whilst some of the more expensive types show 10 significant figures in addition to any of the exponential digits to be discussed shortly.

Four types of display may be used, namely "fixed point", "floating point", "exponential" (also known as "scientific") and "engineering".

In the fixed point display, the decimal point is fixed in position. This is convenient for financial calculations where one may require two digits after the decimal point to show the number of cents. Any further figures may be used in the calculation, but are automatically rounded off to the nearest cent. Some of the higher quality calculators have a facility whereby the number of decimal places in the fixed point mode may be set to any required value.

The type of display most commonly used in pocket calculators is known as a floating point display, since the decimal point automatically moves to any part of the display so that as many significant figures as possible are shown. If a small number is to be displayed, the decimal point is at tne left hand side, whilst if a large number is to be shown the decimal point moves towards the right hand side so there is space for quite a number of digits in front of the decimal point.

In the "exponential" or "scientific" display, an extra two digits on the right hand side of the display show the power of 10 by which the number must be multiplied. A number such as 3.24 x 10^{74} is displayed as 3.24 74. The greatest number which can be handled is just a little less than 10^{100}. This type of display can also handle very small numbers, 6.8 x 10^{-86} (for example) appearing in the display as 6.8 -86. A calculator equipped with this form of display will automatically switch over to it when the quantity to be displayed is either too large or too small to be accommodated on the floating point system. Ideally the calculator should automatically return to the floating point display when the number to be displayed can be accommodated in this form.

In the "engineering" type of display, the exponential digits are always a multiple of three. For example, if one has just calculated a capacitance of 2.34 x 10^{-10}F, this will automatically be displayed 234 -12 so that one immediately knows that the result is 234pF. The writer feels that this form of display is no great advantage over a normal exponential display, since it is so easy to convert to the normal engineering form.

Most scientific calculators display eight digits as the mantissa plus two exponential digits. However, another type of display can accommodate eight digits which completely fill the display space; if the number to be displayed requires an exponential form, the number of digits in the mantissa is reduced to a maximum of five or six so that the two exponential digits can be accommodated on the right hand side.

The earlier Texas Instruments pocket calculators displayed 10 digits plus two exponential digits. Changes have been made to later models, however.

The TI-57 displays only eight digits in the floating point mode and eight digits plus two exponential digits in the exponential mode. The more sophisticated TI-58 and TI-59 calculators have a 10-digit floating point display available when no exponential digits are required, but for very large and very small numbers this 10-digit display is converted into an eight-digit mantissa plus two exponential digits!

The extra two digits can then be found by multiplying the displayed number by a suitable power of 10 to obtain a 10-digit display.

ACCURACY: In very simple calculations, such as addition, the calculator will usually give the answer as accurately as possible with the available display. However, all calculators show some errors when one uses trigonometric functions (especially in the degrees mode) and there may be some errors when using exponential and logarithmic functions.

High quality calculators work to a greater number of figures than those shown in the display; for example, an instrument which displays eight digits may calculate to 11 digits and round off the calculated result to the nearest eighth digit. The use of the extra digits (known as guard digits) greatly increases the accuracy of a calculator.

If one is considering the purchase of a medium priced calculator, it is well worthwhile testing for the rounding off facility. If, for example, one enters five and divides by three, the result 1.666666 is displayed. If one now multiplies the

result by three, a cheap calculator without any guard digits will produce the result 4.999998 instead of five. However, any good quality instrument will produce the result five owing to the presence of one or more guard digits.

A more complex test is required to check the accuracy of a high quality calculator. One may, for example, put the machine in the "degrees" mode and enter a certain number of degrees. One then successively operates keys such as sin, cos, tan, tan ^{1}, cos ^{1} and sin ^{1} so that each operation is cancelled by an inverse operation. Ideally this should result in one obtaining an answer equal to the number of degrees with which one commenced the calculation.

In the highest quality calculators, one may expect an error of the order of three parts per million, but some fairly good machines will produce errors of the order of 100 parts per million. The errors increase rapidly as one approaches 90° as the figure with which one commences the calculation.

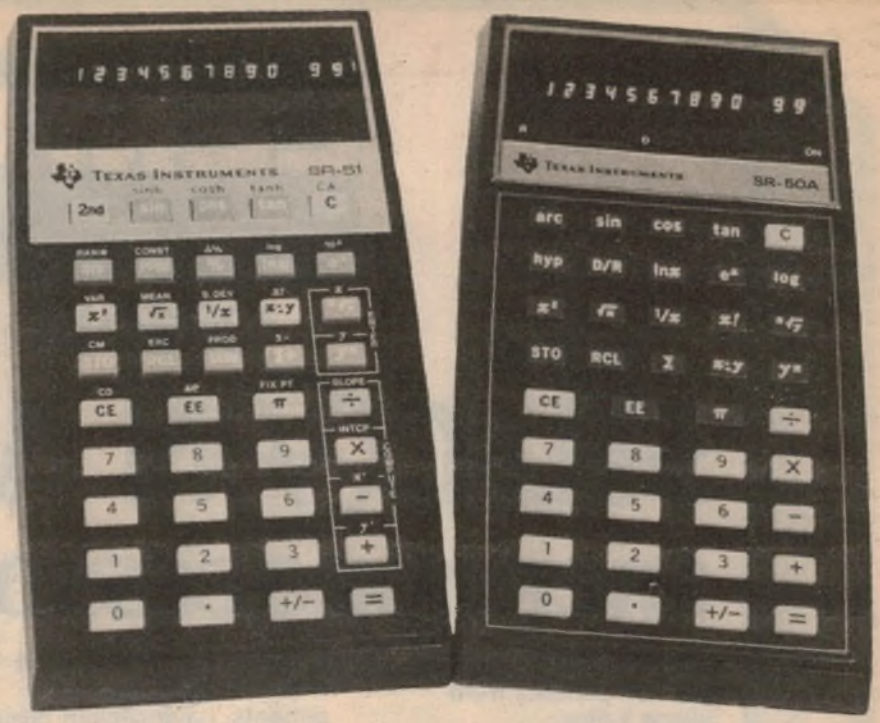
Whilst carrying out this test, it is well worthwhile noting whether each of the answers appears without any delay, since some machines calculate much more quickly than others. If one attempts to enter a number whilst the calculation is still in progress, the new entry will be ignored and this could cause confusion. A slow calculator can cause problems and this would obviously be greatly accentuated in a programmable instrument where a whole sequence of operations must be performed.

CALCULATOR LOGIC: Almost all cheap calculators use an "algebraic" logic system in which one enters a problem more or less as it is written. For example, if one wishes to divide seven by three, one presses the four keys 7 — 3 = in that order. The answer then appears virtually immediately. However, problems can occur with simple algebraic logic even when the problem is simple.

For example, if one enters 1 x 2 + 3 x 2, one may hope that the calculator will perform the two multiplications before the addition so as to produce the answer 8. However, most cheap calculators will first multiply one by two and then add three to produce five before multiplying the last figure by two to produce a final answer of 10.

This trouble can be avoided by using a calculator employing an "algebraic logic system with hierarchy" in which multiplication and division are given priority over addition or subtraction.

The "Algebraic Operating System" or "AOS" used in Texas Instruments machines employs a particularly comprehensive hierarchical system. Trigonometric, hyperbolic and logarithmic functions which involve only a single variable number are evaluated first, followed by power calculations and root extractions (y^x and $x\sqrt{y}$). These are, in turn, followed by multiplications and divisions, with additions and subtractions performed last of all. This system enables the problem to be entered into the calculator almost as it is written down.



SR-51 and SR-50A scientific calculators from Texas Instruments. Both feature scientific notation with a 10-digit mantissa and an exponent up to plus and minus 99.

Brackets can be employed to change the normal order of operations. On a calculator with brackets, the problem discussed above could be entered as 1 x 2 + (3 x 2) = to ensure that the final multiplication would be completed before the addition. It is not necessary to place the first two items in brackets, since this multiplication will in any case be carried out as the first operation. Brackets are also known as parentheses, each item within brackets being regarded as a separate calculation in itself which must be evaluated so that the result can be used in the main calculation.

The use of brackets involves the storage of numbers. If, for example, we consider the problem 2 + 4 x (3 — 2 ÷ (5 — 2)), the initial 2 is stored with the + sign so that the addition can be carried out later. Similarly the 4 x must be stored until the contents of the next bracket have been evaluated. In addition, the 3— must be stored and the first item to be evaluated is the innermost bracket, namely 5 — 2.

The fact that brackets involve memory operations implies that the number of brackets one can place inside other brackets is limited; the number of levels of nested parentheses (or brackets within brackets) may be 10 or 15 in some programmable machines, but in some relatively economical calculators, brackets are not permitted within other brackets.

REVERSE POLISH NOTATION: Another logic system which was widely used in some of the earlier scientific calculators, and which is favoured by Hewlett-Packard in their hiqh quality instruments, is known as Reverse Polish Notation or RPN. The main difference between this type of logic and the algebraical systems discussed previously is that in RPN the operator key is pressed after both numbers have been entered.

Thus to multiply 2 by 3, one can press the four keys: 2 enter 3 x and the answer appears immediately after the operator key is pressed (x in this case). The "enter" key signifies that one has completely entered the first number and that the next digit will be part of the second number. Sometimes the enter key is marked with an arrow pointing upwards.

There is no = key on an RPN machine, so this can be used to distinguish the type of logic used. Brackets are not used in RPN. Both RPN and the algebraic system have their own advantages for certain types of problem and any user will quickly learn to use either system.

Basically, RPN machines solve the problems in the same order as they would be worked out by a person, starting with the innermost bracket; this is not the order in which the problems are written down. One of the advantages of RPN is that intermediate results can easily be inspected and corrected if necessary before the remainder of the

calculation is completed. Intermediate results are stored in a register stack.

PROGRAMMABLES: A programmable calculator will store a set of instructions containing the information about the calculations it will be required to perform. If, for example, one wishes to calculate $x^2 + 1/(e^y+1)$ for many different values of x and y, one could instruct the calculator to store the first number (x) fed into it and, after the second number (y) has been fed into it, the calculator can be instructed to compute the required function.

When the calculator has memorised the instructions, one merely enters the value of x, presses the program "run" key, enters the value of y and then presses the "run" key again. The value of $x^2 + 1/(e^y+1)$ will appear in the display.

It can thus be seen that one of the main advantages of a programmable calculator is that any number of similar calculations can be performed when the instructions have been entered only once. A programmable calculator can also be used as a normal calculator whilst retaining the program instructions which have been fed into it.

It is clear that programmable calculators are very useful when one wishes to perform many similar calculations of the same type; apart from the fact that one only has to enter the operations once, one eliminates the possiblity of errors which could occur if one had to operate the individual keys each time one fed in a new set of numbers. However, the ability to perform repetitive calculations is only one of the advantages of a programmable calculator.

Almost all programmable calculators have conditional branching facilities which enable them to work in closed loops. The program works along a certain list of instructions until it comes to a conditional instruction such as "GO TO 64 if $x \geq y$."

In this case if x is greater than y, the program execution will move to position 64 in the program memory and continue from there onwards until it comes to the same conditional test again. It will continue working around this loop until x no longer exceeds y, whereupon it will ignore the GO TO instruction and come out of the loop.

The simple example we have chosen includes a direct conditional address where the program is instructed to move to a definite place, namely step 64. However, it is also possible to have indirect addressing in which the program is instructed to move to a program location stored in a particular memory register. This stored number can alter during the execution of a program and so the program can be instructed to move to different places at different stages of the program.

Other methods of transferring the program execution point are also available in some calculators. For example, one labels a point in a program by a symbolic label name, such as "A". One can incorporate an instruction "If a flag is set at a certain point, then transfer the program to point A."

Another facility which adds greatly to the power of a programmable calculator is the "isz" (increment and skip on zero) or "dsz" (decrement and skip on zero) key. The program passes around a loop and each time it passes this key a memory register is increased or decreased by unity until the contents of this register become zero. The branching instruction that follows the key is then skipped and the program comes out of the loop.

Thus, by entering the appropriate number into the register before the calculation commences, the program can be made to pass around the loop any desired number of times.

Programmable calculators provide a means of quickly evaluating polynomial expressions and for carrying out many iterative procedures. Indeed, when used intelligently, they have an enormous potential.

PROGRAM SIZE: The complexity of a calculation is limited by the amount of memory or storage space in a programmable calculator. The size of the memory is normally expressed as the number of program steps which can be stored, although this is not a very satisfactory way of quoting the maximum program size. Many high quality calculators have facilities whereby certain sequences of key steps occupy only one space in the program memory so that the memory in such machines is effectively much larger than one might expect from the number of key steps.

A typical programmable calculator is about three times the price of a good quality "scientific" non-programmable instrument, but provides far greater calculating power. The smallest programmable calculator currently available has a 36-step program memory; although the programming facilities of this Sinclair instrument are rather limited, one must remember the price is about one half to one third that of other programmable machines.

Pocket calculators having 72, 100 and 224 memory storage steps are common, whilst desk machines often have 500 to 1000 steps with the option of additional memory space. One should remember that it can be tedious to check a program having hundreds of steps if one does not have a printer available, and the printer is likely to cost twice as much as the calculator itself.

The CZ8100, a low-cost easy to use scientific calculator from Sanyo.

Another low-cost scientific calculator from Unitrex, the 901SN.

If one has a long program, it requires some effort to enter it into the program memory using the keyboard. Unfortunately the program is lost in most machines as soon as the power is switched off. However, a few calculators have a "non-volatile" or "continuous" memory which retains a program even after the calculator is switched off.

Examples of instruments with a non-volatile memory are the Hewlett-Packard HP-25C, their new HP-29C, and the HP-19C pocket model incorporating a printer. The new National Semiconductor 7100 model will also have a non-volatile memory.

The CMOS memory used in such models consumes a negligible amount of power so that the rechargeable battery pack can ensure that the program is stored for an indefinite time. The ordinary data memories of

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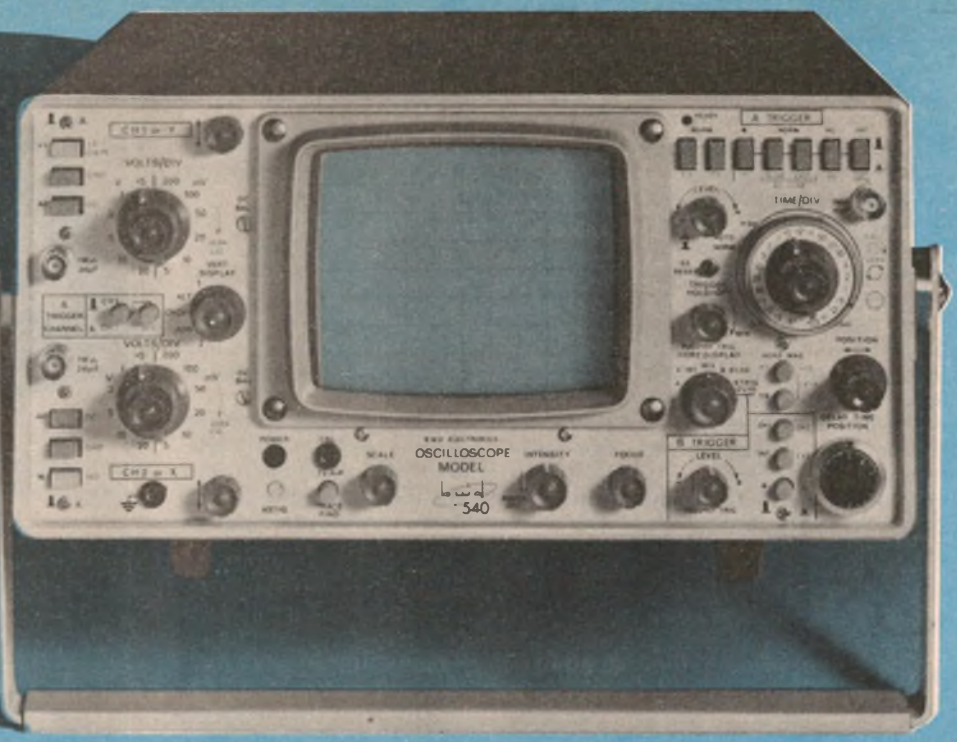

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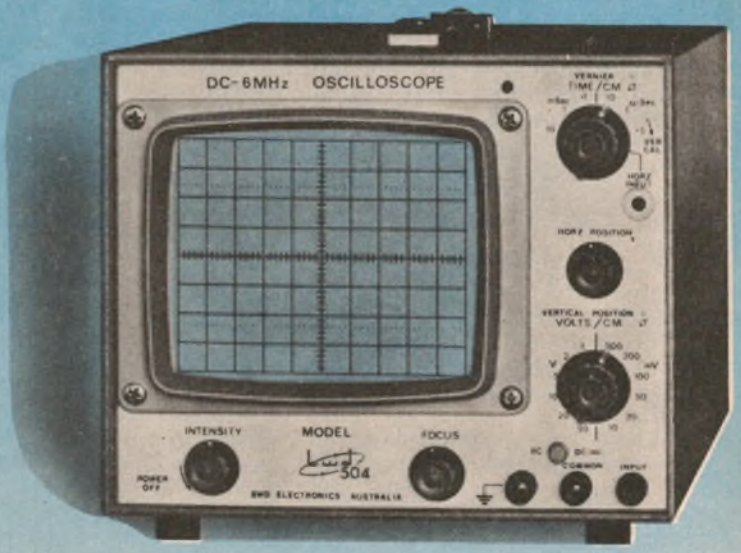

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these machines can retain data even after the calculator has been switched off.

If one wishes to keep a program for later use without having to go to the trouble of entering all of the key steps again, one should consider obtaining one of the magnetic card programmable calculators. In most of these instruments a small magnetic card (rather like a credit card in shape and size) is drawn into the calculator by an electric motor and the stored program is magnetically recorded onto the card. When one wishes to use the program at some later date, the card is again passed into the machine. The program is then read into the calculator memory whilst still remaining recorded on the card for further use.

Magnetic card programmable calculators are very convenient to use and one can keep a small library of programs available on cards. Cards can be purchased with programs already recorded on them. One of the main disadvantages though is that magnetic card programmable calculators are about three to four times the price of a similar calculator which is only key programmable. The program storage process also takes a considerable amount of power.

The Casio PRO fx-1 machine is a card programmable calculator in which the card is passed across the reader by hand rather than by means of an electric motor; it is thus more economical than most other magnetic card programmable instruments.

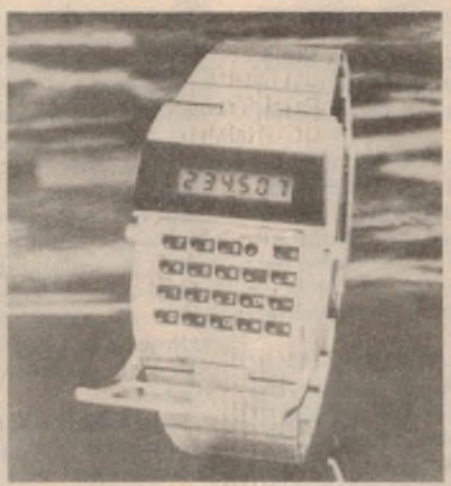
An interesting development from Texas Instruments is used in their new TI-58 and TI-59 calculators. Small modules about the size of one's thumb nail can be plugged into these calculators and provide as much program material as can be accommodated on many magnetic cards. Unfortunately only programs recorded during the manufacture of the modules can be made available at present in this way. A single module contains 5000 x 8 bits of read-only-memory which is equivalent to some 5000 program steps, all of these steps being available through the keyboard as sub-routines, etc.

PARTITIONABLE MEMORY: The TI-58 and TI-59 calculators have another unique facility, namely a partitionable memory. This type of memory can be divided between program steps and data storage according to the requirements of any particular problem. When first switched on, the TI-58 provides 240 program steps and 30 memories, but memories and program steps can be interchanged on the basis of 80 program steps being equivalent to 10 memories. Thus one may have 60 memories and no program steps, 50 memories and 80 program steps, 40 memories and 160 program steps, etc.; or even 480 program steps and no memories.

The still more powerful TI-59 has 60 memories and 480 program steps when switched on, but one can have 960 steps and no memories, 160 steps and 100 memories, or some other combination.

The facility to partition the memory between program and data storage greatly increases the versatility of a calculator. One can handle many data points with a simple program, or a few data points with a program which can be very complex.

POSSIBLE DEVELOPMENTS: Pocket calculators have developed extremely rapidly during the past few years and it seems likely that many more advances are yet to come.



The state of the art: combined scientific calculator and digital wrist watch from National Semiconductor.

One of the limitations of present machines concerns the limited amount of data which a calculator can display at any time. One wonders whether there will not be some facilities on calculators of the future to enable them to be coupled to a television screen display.

Data could be modulated onto a radio fequency carrier which could be fed into the aerial of a television receiver. The amount of data on a single display could be quite large and graph plotting, etc., may be possible.

At the present time, magnetic cards offer the best form of long term program storage, but there is certainly a need for a less expensive technique for use with pocket calculators. It remains to see what new techniques are eventually developed.

It seems certain that more calculators in the future will have non-volatile memories, but this enables only one set of program steps to be stored at any one time. It may well be that more plug-in modules will become available, for use with certain calculators, which contain a large selection of programs for use as subroutines. Both the new Texas Instruments and the new National Semiconductor calculators have plug-in facilities for program modules.

SOLAR CELLS: One unusual type of calculator requires no mains supply and contains no batteries, since its liquid crystal display is operated by light falling onto an array of solar cells at the top of the front face. This "Solar 1981" model made by Imperial Business Equipment Ltd of Leicester, England, has 36 solar cells, but is a simple model without any trigonometric or special mathematical functions. Although its price is considerably greater than that of other general purpose calculators, the savings on battery costs over a long period should be considerable and one never has to remember to recharge or replace a battery. Perhaps some sophisticated solar cell calculators will emerge in the fairly near future.

Calculators are also emerging in new forms and one of these types can be strapped to one's wrist like a watch. One very cheap wrist calculator with eight digits and a memory is available in Europe, whilst Hewlett-Packard have introduced a calculator/wrist watch in the USA at about US$650; it will be available throughout the world later this year. This Hewlett-Packard HP-01 instrument has six finger-operated keys and another 22 "keys" operated by means of a stylus.

The HP-01 incorporates an alarm, timer-stop watch, a digital watch and the various functions can be combined in interesting ways to do such things as continuously display the increasing cost of a telephone call with time, store a telephone number, show the number of days between any two dates, etc.

A very small calculator has been made available in the USA in the form of a ball-point pen, and it seems likely that various other forms of miniature calculators will come onto the market. A crystal controlled calculator, stop watch and alarm clock is available from Casio as their CQ-1, the timing accuracy being ±3 minutes per year.

Some calculators have been developed which can calculate in fractions and display fractions in their readout, but it seems doubtful if there will be a great demand in the future for this particular facility.

The writer is indebted to Mr Peter New of Taylor-Wilson Systems Ltd of Solihull, Warwickshire, England, B93 8HQ for assistance in the preparation of this material.

BASF Ludwigshafen is really big!

BASF is one of the industrial giants of Europe and its factory complex at Ludwigshafen is the largest in Europe — or near to the largest — depending on which statistics one chooses to quote. From Ludwigshafen comes a huge range of products including raw materials for the one for which BASF is best known amongst E.A. readers — BASF magnetic recording tape.

by NEVILLE WILLIAMS

Although BASF has been marketing its products in Australia for many years through distributors, it has only just recently set up its own Australian subsidiary, with operations currently centred in Melbourne and Sydney.

In setting up the new local subsidiary, one problem which faced Australian Managing Director Ross Whoell was that of getting across to Australians the true size and resources of the company behind the name BASF.

As Ross explained to the writer, BASF was well known in Australia as a manufacturer of high quality magnetic tape but, for many customers, the image stopped there. They did not know that the company was active in Europe in audio/video/computer hardware, as well — let alone the fact that the entire "electronic" activity was but one facet of a company with huge manufacturing, research and development resources.

Learning the writer would be in Europe on holiday, Ross Whoell suggested as a "must" a visit to BASF. It was largely as a result of this, that I found myself in the Excelsior Hotel at Ludwigshafen on the Rhine, with a view over a mushrooming post-war pattern of rail lines, expressways and bridges and, in the somewhat murky distance, the huge BASF complex of factories and chimney stacks.

Murky distance?

A couple of weeks earlier, on a boat trip along the Rhine, the air had been clean and the sun had shone brightly but, in the dead calm of an autumn day during this second visit, the atmosphere was heavy with smog, at least as heavy as anything I've seen in Japan, Los Angeles — or Sydney!

My host for the visit, sales engineer Hinrich Spuhler hastened to assure me that very little of the smog could be attributed to the BASF complex despite its concentration and size, in a huge triangle embracing an area of 2½ square miles and stretching for 3½ miles along one bank of the Rhine.

Rigid controls had virtually obviated harmful discharges into the atmosphere, while the Company's huge water purification plant, and an artificial river harbour to accommodate barges handling chemicals were not just preventing pollution; they were making a positive contribution to the purity of the water in Europe's busiest river, leaving it cleaner than they found it.

But, leaving aside such peripheral matters, a visit to BASF's Ludwigshafen complex is not just a matter of donning a regulation safety helmet and setting out on foot with a guide; it is much too large for that, unless you have a lot of time and energy to spare.

The first stop is at a large landscape model in the foyer of the administrative building, where the Ludwigshafen complex is revealed as a self-contained city of factory buildings, with a maze of internal streets and rail lines, its own amenities, medical and emergency services, and its own fully equipped fire brigade with a half-dozen or so tenders standing at the ready.

Strangely (for Europe) discarding metric terms, the handout literature points out that 56 miles of paved roads thread their way between 1500 permanent factory buildings, along with 120 miles of standard gauge rail track, 1160 miles of overhead pipelines, 220 miles of buried pipes, and 1438 miles of underground electrical cables. The plant absorbs about 1.3 million tons of fuel per year and uses 5250 million kWh of electricity, to produce 5000 product lines, aggregating eight million tons per year by weight. Almost half of the total inward/outward tonnage is carried by Rhine barges.

But, immense as they are, the Ludwigshafen works are still growing, spreading into the rural land at the large end of the triangle, and also nibbling at the residential fringe to provide access, amenities and parking space for the 50,000 employees in this one complex.

Reverting to the model, the guide pushes buttons, in turn, which light up buildings throughout the site concerned in the manufacture of a few major product lines — these by way of example.

The patterns of light are seemingly random for each product line but the guide explains that this is due to the fact that individual chemicals can be the starting point of — or involved in — a variety of different activities and that processes have been added over a period of many years. The dispersion and the varied array of buildings and structures along the factory streets is therefore partly the result of planning, partly of natural growth.

However, every effort is made to minimise the separate handling of chemicals from building to building and anything that can be piped from point to point is moved in that fashion. Not surprisingly, therefore, there are pipes overhead running in all directions, each painted in a distinctive colour to give firemen or other emergency teams some clue as to what is being carried inside.

To see the actual buildings and structures displayed in the model landscape, one has to board a company coach and be driven slowly along the streets — just as one might do a "city tour" anywhere in the world.

An aerial photograph of the BASF works at Ludwigshafen. The plant occupies most of the area covered by the photograph, and includes the artificial harbour at lower right. It employs 50,000 people, produces more than 5000 different sales products, boasts 56 miles of paved roads and 120 miles of standard gauge railway track, and consumes 5,250 million kWh of electricity each year.

The guide goes into his accustomed patter — facts, figures and well rehearsed quips, providing the continuity between reference to the installations on either side: "the building on the left is the heart of the . . . making plant. Of course, I could say we make dynamite in there, and you'd be none the wiser . . ."

Unless one happens to be a chemical engineer — and I do not — that last phrase is more a truism than a quip. One could recognise some installations; for example, the distinctive stain on the drums is sufficient to indicate the production of indigo dye, one of BASF's earliest activities, dating back to last century. But the hundreds of other buildings could as easily be devoted to the production of dynamite or hashish!

Nor is one necessarily much wiser after a visit to one of the many process control centres: row upon row of knobs, buttons, meters and pen recorders tracing out green graphs — electronic gadgetry that is at the one time familiar, yet no less inscrutable than the mountain of pipework outside that it monitors and controls.

But, overall, the prevailing impression that comes through to the visitor is the sheer scale of the BASF operation at Ludwigshafen — enormous by any standards — and larger than most people will ever be likely to see.

To get back to more familiar ground — BASF magnetic recording tape — the production and quality control of such a product would appear to be no great problem for such a complex. In fact, however, the actual manufacture of coated tape, compact cassettes, video cartridges and reel tapes for audio and computer application is concentrated at an entirely separate factory at Willstadt — some 60km from Ludwigshafen. In the Black Forest area, the atmosphere is substantially free of the pollution that plagues the Rhine Valley and it is much easier to ensure that the only particles which are deposited on to the tape are the ones that are meant to be!

But the Ludwigshafen works are significant in another way to BASF activities in the tape and EDP field. Heinz Ritter, export manager for BASF EDP Productions, pointed out to me that the works provided a full-scale living laboratory in which his department could test EDP methods and systems. With a huge staff and wages bill — over 50,000 employees at Ludwigshafen alone — highly complex stock movements, and a proportionately large financial turnover, methodology was more likely to be scaled down to typical user needs, rather than up.

In developing new systems, BASF's EDP Department was able to operate in parallel with the Company's main computers to assess how the performance compared with that of an existing system.

(The manufacture of magnetic recording tape in the Willstadt factory will be described in a later issue.)

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ANY MISCONCEPTIONS

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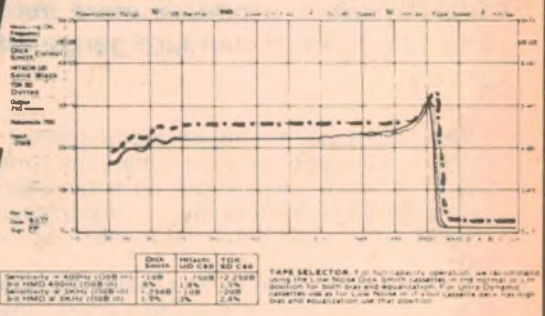

(Dot and dash upper line represents Dick Smith UD tape)

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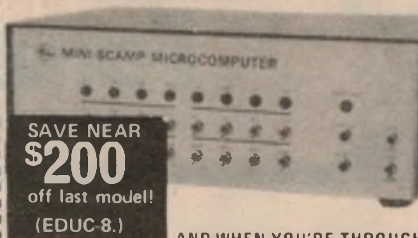

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See EA Sept 76

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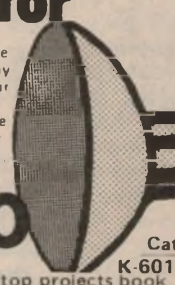

4.50
Cat K-6016

See eti top projects book for original strobe project

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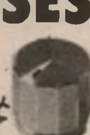

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Small Cat H-3742

REALLY BEAUTIFUL KNOBS — they really make any unit look so-o-o good! These knobs are fully imported by Dick — and they are exclusive! If you want to give that amplifier a million dollar look put some of these knobs on it!

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Forum

Conducted by Neville Williams

Is it just trendy to listen to FM?

AM broadcasting need not be the poor relation of FM, according to a reader from the Australian National University in Canberra. If the hifi industry was to apply itself to the task, AM radio could be developed and promoted to a much more important role in the scheme of things.

The item which prompted this retort appeared in "Forum" for September under the title: "Is AM to remain the poor relation?" Perhaps the key paragraph read thus: "AM, on the other hand, has had its day of glory and is now filling mainly a utility role: news, current affairs, sport, talkback, pop music and background music, with a relatively small number of culturally based programs."

To this our correspondent replied:

Dear Sir,

I read with interest the letter from LJ and your reply about medium wave AM.

While it is true that AM has had its "day of glory" and that FM has upstaged AM, this is not entirely due to the superior audio and interference immunity qualities of FM. It is also more trendy to listen to FM and to extol its virtues!

That there is little pressure from consumers for better AM is no argument for lack of action from manufacturers. The assertion that the consumer is sovereign perpetuates the myth that there is a free market. Today, the situation is a complex interaction between advertising and consumer choice, amongst other variables. Therefore it seems to me, that if the electronic industry wanted to, it could promote AM and create a new market for itself. The promotion would probably have to be on a large scale, including press releases, so that promotion gets into editorial space.

Personally I still listen mainly on AM. I use a wide-band tuner designed by EA back in the fifties. It uses valves, a band-press aerial filter and band-pass first IF transformer and a switched in/out ordinary narrow band second IF transformer for variable selectivity. I shaped the pass-band of the first IF transformer by inserting IpF top coupling into an ordinary IF transformer. This achieved a more fixed pass-band shape across the tuning band than the arrangement you originally had. In the future I intend to connect the selectivity switch to switch top coupling in and out the second IF transformer to try to lessen the gain change between the two selectivity positions.

As it is, I get good audio quality from wide-band AM. It's virtually indistinguishable from FM. My 10kHz whistle filter is always in, so no whistle is bothersome. These days there are ceramic IF filters and ICs. In fact EA has a wide-band tuner of much more recent design than mine using ceramic IFs.

All in all I can't understand why manufacturers haven't jumped in on a hard sell of "wide-band AM" as a means to sell more radio sets. If AM stereo is developed they would have even more scope.

As for interference, Telecom have long standing tricks to beat the man-made variety. These EA also published back in the fifties and they are still valid.

VB (ANU CANBERRA)

Perhaps there is some justification in our correspondent's observation that it is "trendy" to listen to FM, and trendy to own an FM tuner that costs the earth and has "state-of-the art" specs. I have certainly not noticed any special modesty on the part of FM devotees and, if one was at all sensitive in this area, one could be excused for feeling that there is a certain amount of "keeping up with the Jones's".

However, one of the less fortunate overtones of the word "trendy" is the implication that it is the strongest reason for something being so. It may thus be trendy to wear long hair or short hair — without the need for any other or logical reason for so doing.

But it would be selling FM short to conclude that the world-wide swing to FM was merely, or even substantially, a matter of fad and fashion. Maybe such an element is present, and ably exploited by industrial stylists and advertising copy writers, but it is also a fact that FM has some very practical things going for it: lower noise, reduced interference and distortion, wide frequency response, balanced stereo and even matrix quad.

Similarly, if it is trendy NOT to listen to AM, the reaction would be reinforced by its very real technological limitations.

Nevertheless, without being quite as enthusiastic as our correspondent, I must agree with him that AM reception could be — and should be — a lot better than it is for a lot of listeners, and it is encouraging to read his appreciation of our own efforts.

It might also be conceded that the plight of AM radio around the world is, in part, due to (for AM) an unfortunate sequence of events. In the very early days of broadcasting, AM gained the ascendency and dominated the scene until the arrival of television in the post-war decade. In consequence, it was AM radio that took the brunt of competition from television, having to seek out a new "utility" image as a means of survival. It became thoroughly identified with that image.

When, later, the fascination of television began to subside, a new kind of radio with some highly saleable features was waiting in the wings having, in fact, been nourished by television itself — in the form of the FM sound channel. Tucked away inside millions of TV sets, one-time problems like limiters and discriminator transformers had been cut down to size.

But that is now history and, in practical terms, it is appropriate to view the two systems as they now exist, rather than dwell on the reasons why.

From this point on I tend to digress from the views expressed by VB. He writes off as a "myth" the idea that the consumer is sovereign, although he does concede that "the situation is a complex interaction between advertising and consumer choice, amongst other variables".

Presumably, this can be interpreted to mean that, if not "sovereign", the

QUIET DAY IN NSW

It happened after our November issue was printed but before you had time to read it.

October 21 was nominated by the NSW State Government as "Quiet Day". The first such day in Australia, its purpose was to draw public attention to the problem of noise pollution.

And, guess what was demonstrated: A gadget which would silence a PA system automatically if an acceptable sound level was consistently exceeded.

consumer is at least an important factor in the formula.

You can say that again!

Back in the 1950s I was involved personally in some of our early efforts with wide-band tuners and they earned reasonable support from readers, partly because radio listening had only limited competition from disc records, none from tape and none from television. A number of suppliers found it worthwhile to market kits of components to meet the demand, and eveyone was happy!

More recently, and despite the availability of improved components and technology, our efforts in this area have been more sparse, being dictated as much by the feeling that "we ought to describe a tuner" rather than by any strong conviction that it would be reproduced by a significant number of readers.

Missing also has been a conviction that suppliers would play their part by stocking the necessary hardware and other components. Without a ready, over-the-counter supply of "bits", any project is likely to wither and die. Would-be constructors simply become discouraged.

But let's say that we did come up with a design that we felt was really exciting; that we took it around to every parts supplier we could find in the country, trying to get them to stock kits, advertise kits, arrange window promotions and so on; that we tried to arrange coverage in the hifi columns of daily papers and started a round of broadcasting stations, seeking their support for a project that would ultimately increase their audience.

It would not take long to discover that mere enthusiasm for a technical design would not alone be enough to get it off the ground.

Before suppliers will invest in stocks, or editors or others will respond in a positive fashion, they have to be convinced that out there in the marketplace are people who are good prospects to buy, build and use such equipment.

But convincing them requires facts and figures rather than mere convictions, no matter how sincere they may be.

I judge that that's the way it is right now with the manufacturers of consumer type receivers and tuners. The buying public will pay any amount of money for the presentation they like and the facilities they think they want. But they will baulk at paying extra money for something they have already convinced themselves — however wrongly — that they don't need.

This being so, the marketing manager of a big hifi manufacturer will hesitate to be a pioneer (no pun intended) and to commit his company to a development, manufacturing and marketing project which is not supported by marketing research, by positive feedback from his dealer chain, or by a

FORUM: trendy to listen to FM?

success story from his competition.

He would have to be very convinced, very dedicated, very stubborn and very secure in his position to take the reverse view and try to force an unsought product onto an unwilling public.

Thinking back a while, I remember the well publicised attitude of Dr. Nakamichi that tone controls were both superfluous and undesirable on hifi equipment, provided all steps had been taken to ensure that the response of the equipment was intrinsically flat. Yet it is only a few months back that Dr. Nakamichi unveiled his latest superbly engineered FM tuner-preamplifier — with tone controls. When questioned about it, he admitted that the controls had been included because his dealers had reported that customers were demanding them!

Curiously, the very same hifi tuner that included the tone controls in response to dealer/customer demand, ignored the AM broadcast band altogether.

VB is convinced that wide-band AM reception could be popularised, if only the entire industry would co-operate with that end in view. Maybe it could be, but I wouldn't put my money on the chances of it happening.

With this much I will agree: if AM stereo is developed successfully and adopted by enough AM broadcast stations, it will supply a tangible reason for designers, manufacturers and the public to take a fresh look at AM. So motivated, they would logically look at the whole fidelity problem, whether for stereo or mono.

But well before that happens, I think that VB will have had to re-tune his adjacent channel filter to 9kHz and learn to live with a further increment in night-time "monkey chatter", as the broadcast stations are pushed that much closer together.

Last but not least, we have included in a panel a letter to Dr. R. Small of Sydney University from Professor Peter Felgett, of Reading University in the U.K. regarding recent developments in quadraphonic sound reproduction. We reproduce it as being of interest in its own right.

As a side issue, however, it might be argued that quadraphonic sound provides an example of how the combined resources of many powerful hifi manufacturers failed to create the kind of market which they had hoped for. For sure, they did a lamentable job of launching quadraphonics but, looking back on the enormous effort and expenditure involved, the many companies with egg on their corporate face may be less ready than our correspondent to dismiss the sovereign consumer as a myth.

Be that as it may, it would appear that the initiatives of Peter G. Felgett, of the BBC and IBA in Britain, together with Nippon Columbia and others, are gradually edging towards an acceptable universal formula. It will be interesting to see whether the industry will then be able to re-launch surround sound against some pretty strong "anti" prejudices.

Recent developments in surround sound

Dear Dr. Small,

Because of the kind interest you have shown in the work, I thought it might be useful to outline briefly some recent developments.

As you may recall, the BBC encountered criticism of their "Matrix H" surround broadcasts. However, their engineering press statement 1500, dated 8th June 1977, revealed that they had approached us and were now collaborating with us in the choice of the best two-channel encoding specifications.

Meanwhile two broadcasts of Mahler's Eighth Symphony took place from Radio City, Liverpool, under the auspices of the Independent Broadcasting Authority, with more to follow, using our recommended encoding 45JB. We continue to co-operate closely with our Japanese colleagues in Nippon Columbia, who have constructed prototype domestic equipment compatible both with their UD-4 records and the Ambisonic recommendations.

All this means we are moving well along the road to practical commercial availability of surround material using the Ambisonic technology, and in particular international agreement on encoding specifications.

I have the feeling that there is in Australia considerable interest in surround reproduction which would go beyond the limitations of so-called "quadrophony" and I therefore thought that the availability of the Integrex unit might be of interest to you or your friends. Exact details of price etc, are not yet available.

Integrex will probably also wish to keep the design a little fluid until the BBC make up their minds.

Yours sincerely,
Peter Fellgett.

Meet the New Leader....

S.500D Specification Features

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* Power Bandwidth +0, −1dB from D.C. to 20KHz.
* Very low Transient Intermodulation Distortion. Restricted rise time, fast slew rate.
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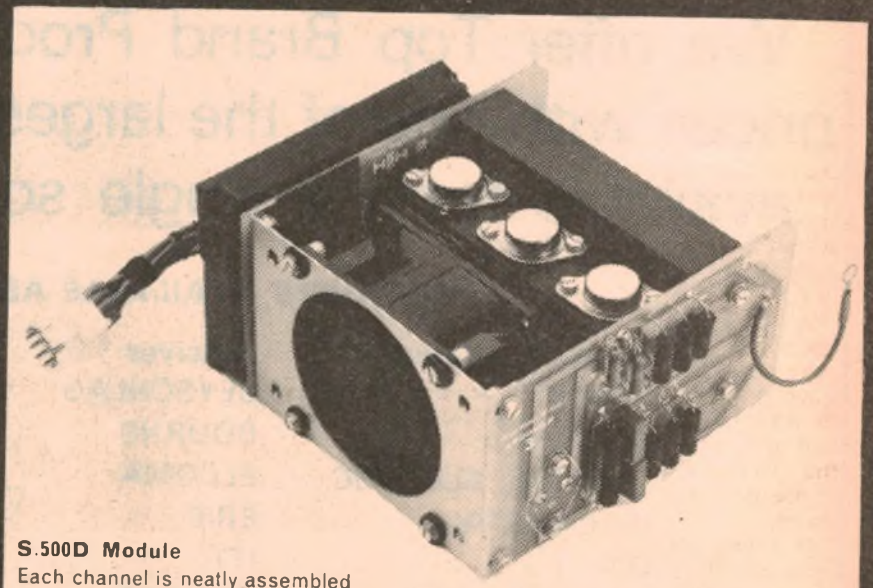

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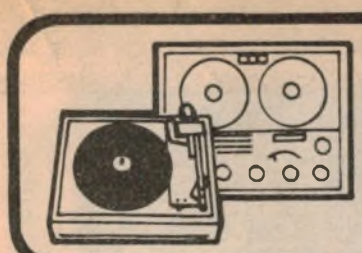


Hi Fi News

NEW 2x350W CLASS-A+ SYSTEM TO BE RELEASED BY TECHNICS

Whether or not all the current talk about crossover and transient intermodulation distortion is justified in terms of the subjective result, it has certainly intensified interest in unusual circuit design approaches. Latest on the list is the new SE-A1 power amplifier from Technics offering a power output of 350W RMS per channel from a system which they refer to as class A+.

by NEVILLE WILLIAMS

Back in the days of valve-type hifi amplifiers, great store was set on operating the output valves (triodes, of course) under pure class A conditions. The appropriate supply voltage was applied to the plates and the bias was adjusted so that the no-signal current was about half-way between zero and the peak current which it was anticipated that the valve(s) might draw under full signal drive.

In consequence, a class A output stage drew considerable current, with or without signal, and this has always had to be considered, both in terms of the dissipation in the output valves (or transistors) and the load on the power supply.

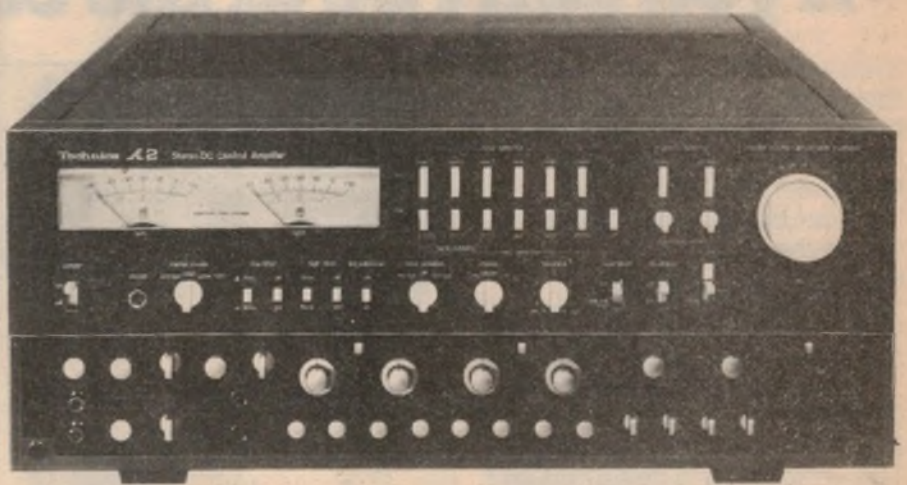
In a well designed class A valve output stage, the relationship between the input (grid) signal and the output (plate) current or voltage was almost completely linear and the intrinsic distortion of the stage was quite low. If used at all, negative feedback served as a final "touch up" rather than as a corrective for major distortion.

When designers began to swing over to solid state circuitry, they found that it was not very practical to operate power output transistors under class A conditions. If biased to about half their anticipated peak output current, they would become very hot, tending to become thermally unstable, with the danger of "running away" and self-destructing.

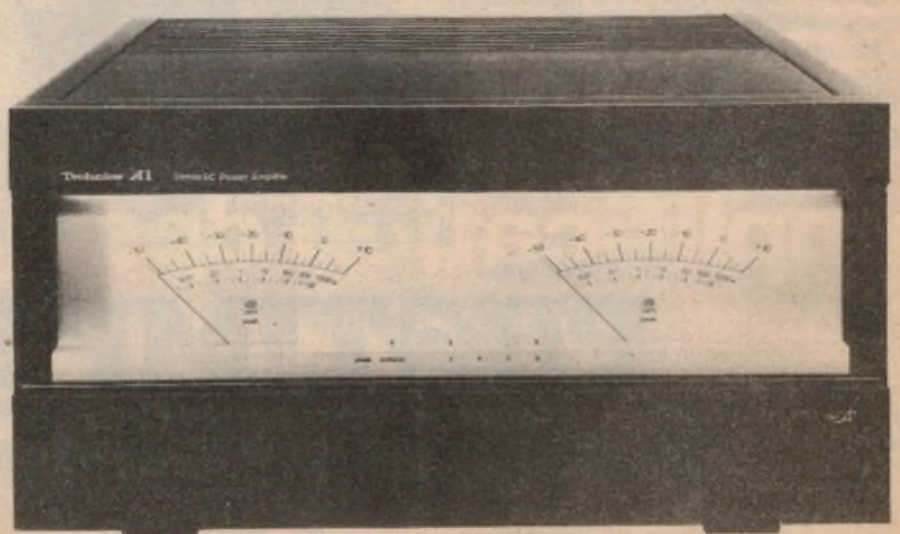
With class A virtually denied to them, designers resorted almost universally to the use of push-pull class B output stages, with the transistors biased so that they drew very little current in the absence of signal. Class B operation minimised heat rise in the output transistors and power supply alike, and allowed power output figures to be obtained generally well in excess of competitive valve amplifiers.

But practical class B output stages are comparatively poor in terms of input/output linearity and quite high orders of negative feedback have commonly been used to reduce the harmonic and intermodulation distortion, as measured.

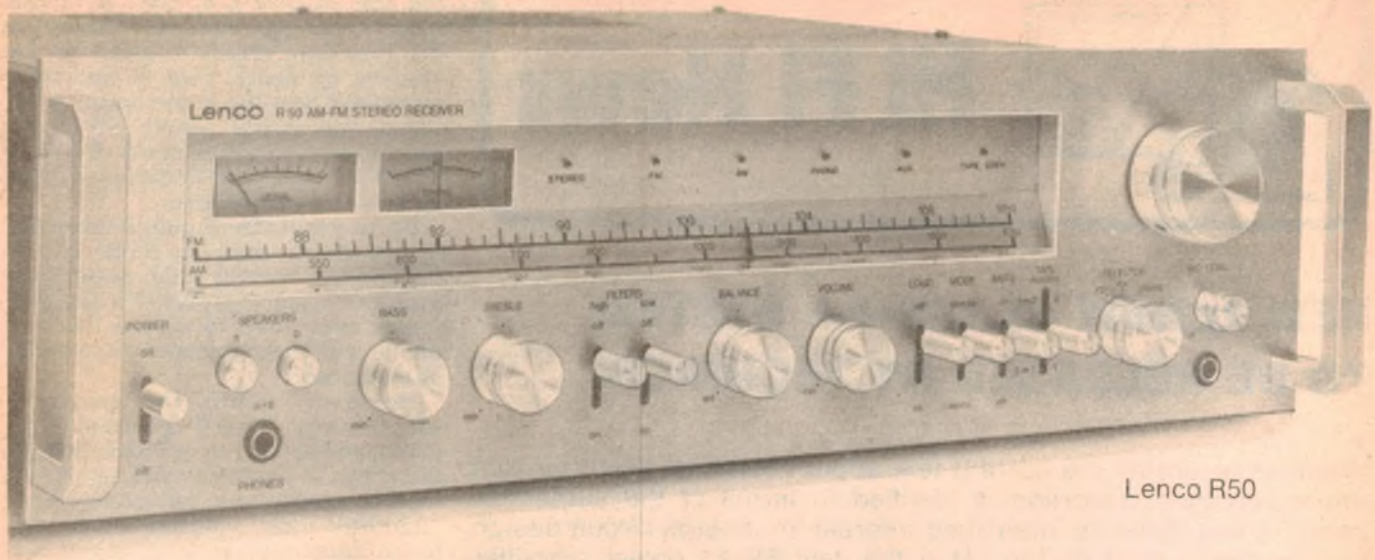
However, while the resulting specifications looked impressive on paper, and by valve amplifier standards, there was a persistent and significant level of complaint in hifi circles about "transistor tone". Initially, this tended to be discounted as a subjective bias against transistors but more careful observation established that, while many transistor amplifiers produced low distortion figures at high output levels, the distortion at low levels was bad. It followed from the fact that, at



Above: The Technics SU-A2 direct-coupled stereo control amplifier. Apart from impressive electrical specifications a most extensive range of controls, including touch type selector switches which have a fade-in fade-out characteristic, obviating plops.



At right, the direct-coupled power amplifier type SE-A1, which offers a response down to "DC". It weighs 51kg and measures 450 x 249 x 550mm. The control amplifier is about the same size but weighs 38.5kg.



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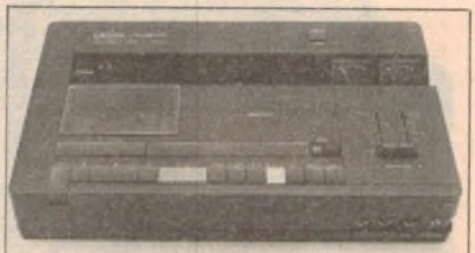

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JOHANNUS RECITAL ORGANS USE FREQUENCY DIVIDERS

Electronic organs have become fairly well established in large churches and concert halls, those traditional strongholds of the pipe organ. However, most electronic organs installed in such places have been of two main types: the multiple-oscillator organ, in which each note is generated by a separate oscillator, or the more recently developed "digital computer" organ, in which note waveforms are stored and reproduced by digital means.

The frequency divider type of organ has gained only limited acceptance, despite the fact that such organs are widely used in homes and smaller churches and in popular entertainment situations. The usual explanation for the distinction is that, because the notes from a divider organ are derived from a single source, they are "locked" together with fixed phase relationships. This is alleged to make such organs sound acoustically less satisfying than instruments using multiple sources.

The problem with this explanation is that the "locked" phase relationships are broken up as soon as the signals are acted upon by reverberation — either natural or synthetic. It may well be that divider-type organs have been "looked down upon" in serious music circles through prejudice, coupled with a scarcity of instruments designed specifically for demanding situations.

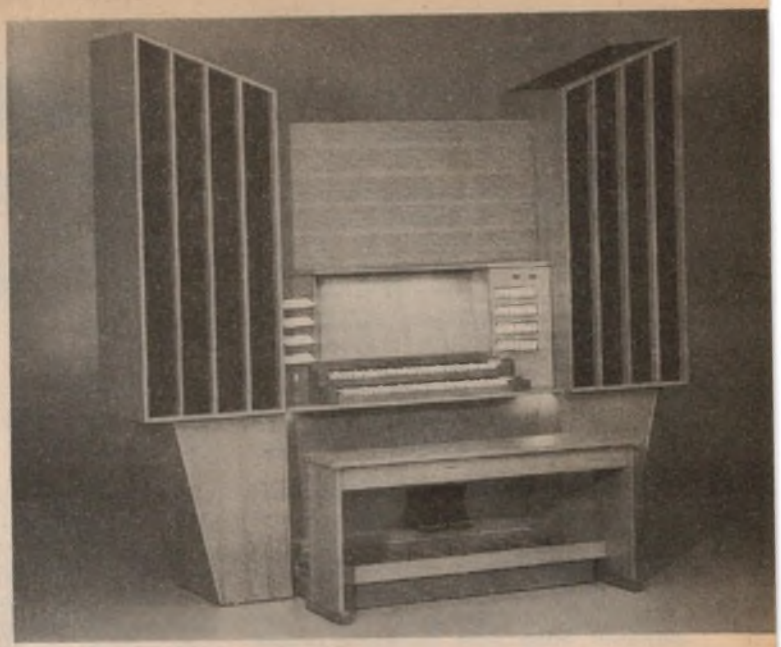
There is good evidence to suggest that if a divider-type organ is carefully designed and set up to suit a large church or concert hall, it can be just as satisfying musically as any other electronic instrument.

For the last six years, a Dutch organ builder named Johannus Versteegt has been putting this conviction to the test. A man with over 20 years' experience in the design of electronic organs, Versteegt has had some 60 of his designs manufactured commercially by various firms.

Around 1971 he decided to forego the "commercial" mass production approach, and try making instruments in the time-honoured "workshop" fashion used by the old pipe-organ builders. The idea was to produce organs based on modern electronic technology, but individually built to order and provided with the extensive voicing and tonal adjustment facilities necessary to allow true matching to the acoustic environment.

The degree of success he has achieved may be gauged by the number of "Johannus" organs now installed in churches and concert halls in many countries. Several hundred are now in use, including large concert instruments in cathedrals in Portugal, France, Italy and Canada.

There are nine basic models in the current Johannus range. The smallest, known as the Opus 15, is a small two-manual instrument with 31 stops and internal speakers designed for home practice. At the other end of the range is



the Opus 110, a three-manual concert organ with 76 stops and an external speaker system comprising 18 channels of 100 watts rating each.

The instrument pictured is the Opus 80, in the middle of the range. This offers two manuals, 48 stops and a baroque-style console with five 60W speaker channels.

All of the organs are based on modern solid state circuitry, with its very high reliability and tuning stability. Two master oscillators and frequency divider chains are used, so that at least one complete manual is playable even if a major fault develops. To the basic tone generation facilities are added extensive voicing and tonal adjustments, to allow optimum results to be achieved.

Johannus organs are now available in Australia, thanks to the initiative of a young organ enthusiast named Charles Lamb. On a recent trip to Europe with his wife, Mr Lamb came across some Johannus organs and was so taken by their unique looks and performance that he made a special trip to Johannus Versteegt's workshop in Veenendaal, Holland. The result was a special agreement to allow Mr Lamb to become the Johannus organs representative in Australia.

As yet, there aren't many Johannus instruments installed in Australia. However the word is getting around, particularly as the instruments compare very favourably in price with other electronic organs suitable for church and concert use.

For those interested in hearing what a Johannus organ sounds like, Charles Lamb has demonstration discs and Dolby cassettes available. They feature the Dutch organist Feike Asma playing a selection of pieces by Bach, Franck and other composers, on one of the big Opus 110 organs.

For these and for further information on Johannus organs, readers can contact Charles Lamb at 5 Douglas Haig Street, Oatley, NSW 2223 or telephone (02) 570 2171.

HIFI NEWS — continued

low signal levels, operation was predominantly centred around the "crossover" portion of the input/output transfer curve, where the linearity was poorest and the negative feedback least effective.

Therefore in the critical low-volume region where a class A valve amplifier showed negligible distortion (and gave its "sweetest" sound, &c), a class B transistor amplifier was at its worst.

More recently, the subject of transient intermodulation distortion has come in for a lot of discussion — a problem quite distinct from class B "crossover" distortion, but relating particularly to amplifiers using high orders of negative feedback.

As is commonly appreciated, negative feedback reduces the gain of an amplifier by feeding portion of the output signal back into an earlier point in the circuit in such a phase and amplitude as partially to cancel the input signal. But it takes a finite time for the signal to pass around the loop and it is possible for a very abrupt transient to enter the amplifier and cause some portion of it to overload before the feedback signal has time to counteract it. And here's the rub: while the transient itself may be of such short duration as not to be audible, the overload condition may persist long enough to have a perceptible effect on other components of the signal; hence the term TID — transient intermodulation distortion.

Growing awareness of these potential problems has produced a variety of

reactions among the designers of hifi amplifiers.

The most natural is closer attention to the design details of conventional class B amplifiers to ensure the greatest possible intrinsic linearity, unaffected by voltage or temperature changes; this along with precautions against TID effects. If manufacturers' literature is to be believed, the performance of such amplifiers leaves nothing to be desired in terms of subjective listening and there is no need to explore other approaches.

Another quite different reaction is to accept that class B has its problems and, for reasons which are variously purist or commercial, concentrate on the use of output transistors under pure class A conditions. Assuming that such an amplifier must offer sufficient power output to be competitive in the marketplace, it will inevitably involve large power transistors on large heatsinks, probably fan-cooled, plus a large and expensive power supply. Understandably such amplifiers have not had very wide appeal.

A more elegant approach, adopted notably by Yamaha and Sony for some of their models, involves the use of power FETs rather than conventional bipolar power transistors (Electronics Australia, May 1975). Power FETs have dynamic characteristics uncannily like those of a triode valve and make possible the design of a power amplifier which is a solid-state near equivalent to a class A or class AB1 valve unit.

Perhaps deterred by patent or supply problems, other manufacturers have come up with their own different and interesting answers as, for example, the QUAD "current dumping" amplifier described in our January 1976 issue. At low levels, output is delivered to the load from a small and economical class A stage. As the signal level increases to what would normally overload this stage, supplementary class B output transistors powered from a second supply take over automatically, the whole system, including the feedback, being designed to ensure that the transition is smooth and distortion-free. At least, that is the claim.

Perhaps predictably, a significant number of hifi devotees have begun to question why we ever abandoned valves. Responding to this, various designers catering for the purist market have come up with amplifiers using valves in the power stages, or the ultimate (?): valves in all stages. Such amplifiers are often described as being basically "musical" and are credited with a quality of tone far superior to any solid-state amplifier, specifications notwithstanding. There is too much concurrence to dismiss such claims out of hand but, equally, considerable allowance has to be made for earnest self-delusion!

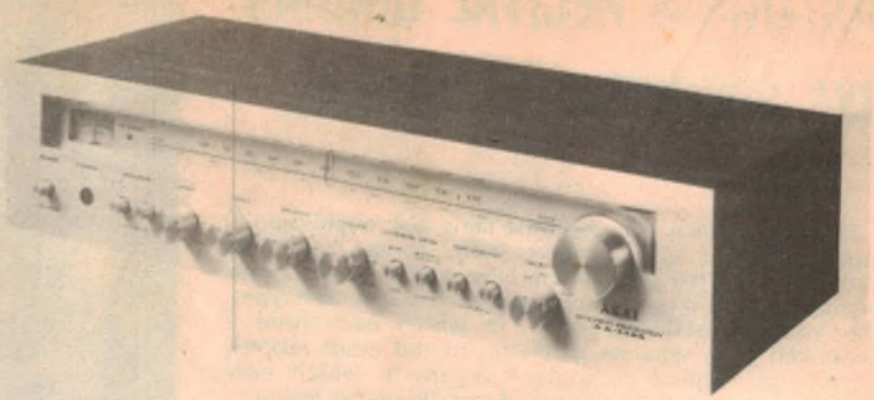
It is into this context that Technics have introduced their SE-A1 power amplifier, designated as all solid-state direct-coupled class A+. The immediate problem is that they do not clarify what is meant by the last term in their introductory literature. They only hint obliquely at what it is not!

It is NOT pure class A; if it were, Technics would obviously have said so. It offers 350W RMS per channel into 4 ohms from a unit that, they claim, is not fan-cooled and not larger than what a normal 100+100W class A amplifier would be. Fairly obviously, the designers are using some dynamic modification to the output stage mode to allow it to idle like a 100W unit but to rise to the demands of 300W peaks.

But having made it clear that the SE-A1 is not a switching amplifier (not class-D), they question also the validity of existing circuits which operate class A for low-level signals and class B for high level; and circuits which operate from lower voltage for small signals and higher voltage from large signals. Such schemes, says the literature, involve switching or transitional phenomena within the signal path and merely exchange one problem for another.

But having made that point, the literature still leaves one with the impression that the SE-A1 exploits at least the last mentioned technique, although presumably in a way which avoids or minimises the disadvantages. By the time you read this, I may have been able to put the questions directly to the engineers involved but, in the meantime, the SE-A1 can be classified only on the implications of the term class A+: augmented class A?

Terminology apart, the rest of the information about the SE-A1 could scarcely be more impressive. Eight distinct power supply branches separate the stereo channels and stages within the channels, involving four capacitors of 100,000uF each and another four of 22,000uF each. Entirely separate thermal servo amplifiers stabilise the unit against temperature effects, while



Styled to meet the needs of someone wishing to combine compactness with versatility and high performance, this AA-1125 AM-FM stereo receiver has just been announced by the Akai Electric Co Ltd. Power output is 25W per channel at 0.3% THD, with provision for two loudspeaker systems. Up to three tape decks can be connected with tape-tape dubbing possible or simultaneous recordings from a single source or two separate sources. Other specifications and facilities are in line with modern practice. For those with more modest needs, Akai are offering their new AA-1115 receiver, almost identical in frontal appearance but with somewhat reduced tape facilities and a power rating of 17+17W RMS.

AUDIOSOUND MONITOR AMPLIFIER

The Audiosound LD 40 PM is a professional monitoring amplifier, which offers high gain, low noise and low transient intermodulation distortion. It can be used in stereo mode with an output of 40W RMS per channel into 9 ohms, or bridge connected to deliver 120W into a single 8-ohm system. The LD 40 PM is being used widely by the Australian Broadcasting Commission. For details: Audiosound Electronic Services, 148 Pitt Rd, North Curl Curl, NSW 2099. Their telephone number is (02) 938 2068.

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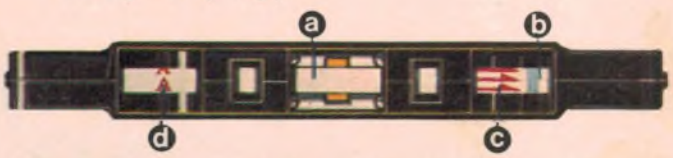

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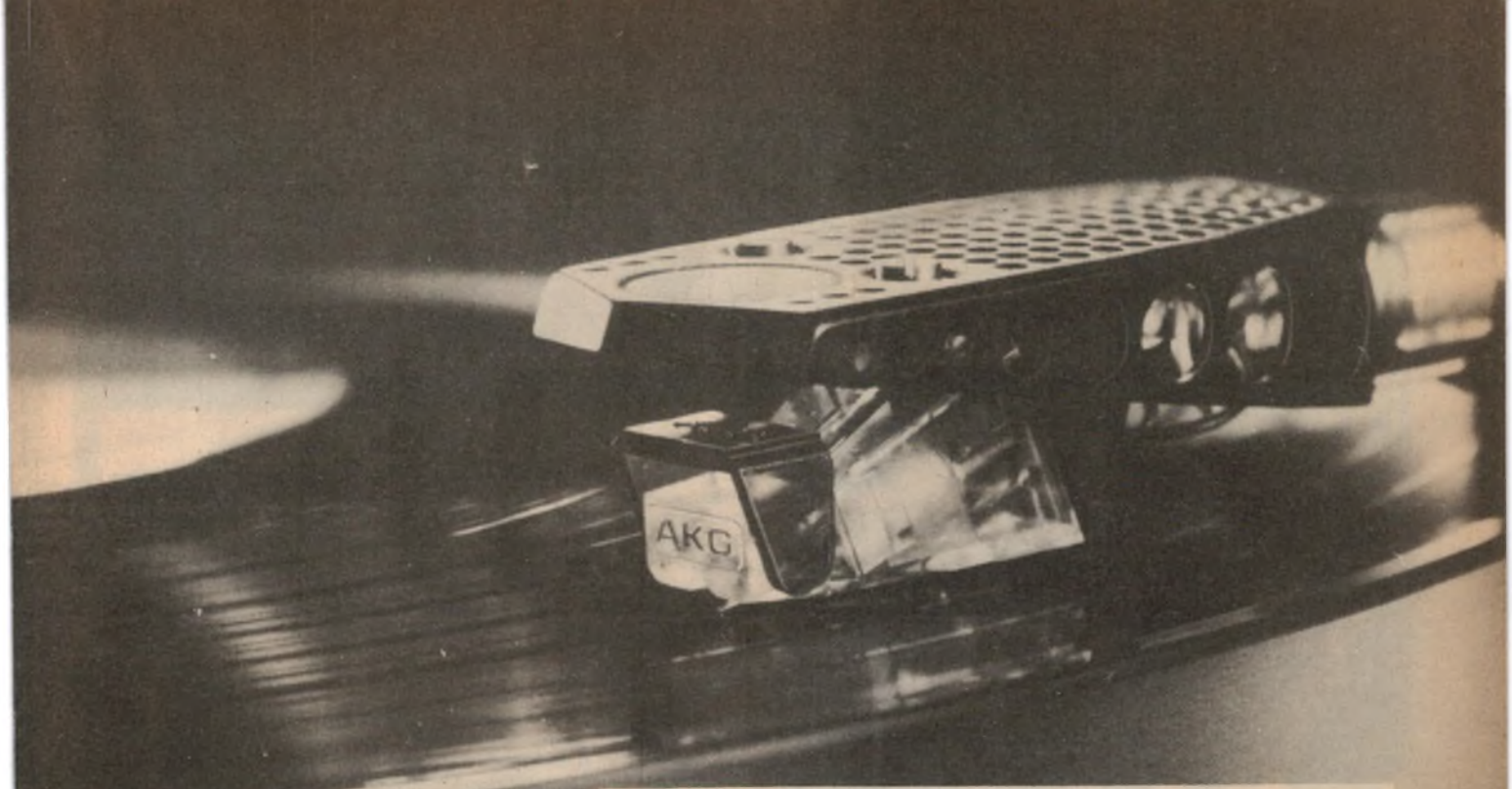

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Farrell Keyboards summer synthesizer school using the Roland System 100.

Electronic music in Australia is growing rapidly both for professional performance and home use. Synthesizers seem to be appearing everywhere, and are finding acceptance as a musical instrument that can be understood, played, and enjoyed by all. To this end, a new opportunity is available to the public and the music industry — the System 100 Synthesizer Club.

The Club caters for synthesists using the Roland System 100 or System 700 as their basic instrument. Its aim is to increase awareness of electronic music, and the enjoyment of playing synthesizers, and to help synthesists reach their highest potential.

This will be achieved through an exchange of information and ideas, newsletters, and a cassette lending library. A board of advisers will be available as a resource, as well as product demonstrations and concerts, and a national yearly seminar.

The club is based on the Roland System 100 because of its sound flexibility, quality of construction and value for dollars spent. It is usually chosen as the smallest and least expensive synthesizer that qualifies as a quality musical instrument, having the controls and layout to lead on to a true understanding of synthesis.

The club is being sponsored jointly by Farrell Keyboards in Brookvale, Sydney, and the Roland Corporation of Australia.

Farrell Keyboards is so convinced of the status of the Roland System 100 that last January they held their first annual summer synthesizer school (25 hours of intense instruction based mostly on the two Roland systems). They are now holding a regular night course that is free and open to the public.

For further information about the System 100 Synthesizer Club, send a self-addressed, stamped envelope to the System 100 Synthesizer Club, PO Box 393, Brookvale 2100.

HIFI NEWS: Class A+ amplifier

elaborate sensing protects the amplifier itself against traumatic malfunctions, and also protects the loudspeakers against unnatural voltage across the amplifier output terminals.

The SE-A1 delivers its full rated power between 20Hz and 20kHz at not more than .003% harmonic distortion. At half-power at 1kHz, the distortion is unmeasurable with any normal test equipment. Frequency response is extremely wide (DC to 200kHz at —1dB), and the power bandwidth is 5Hz to 100kHz at —3dB and .01% THD.

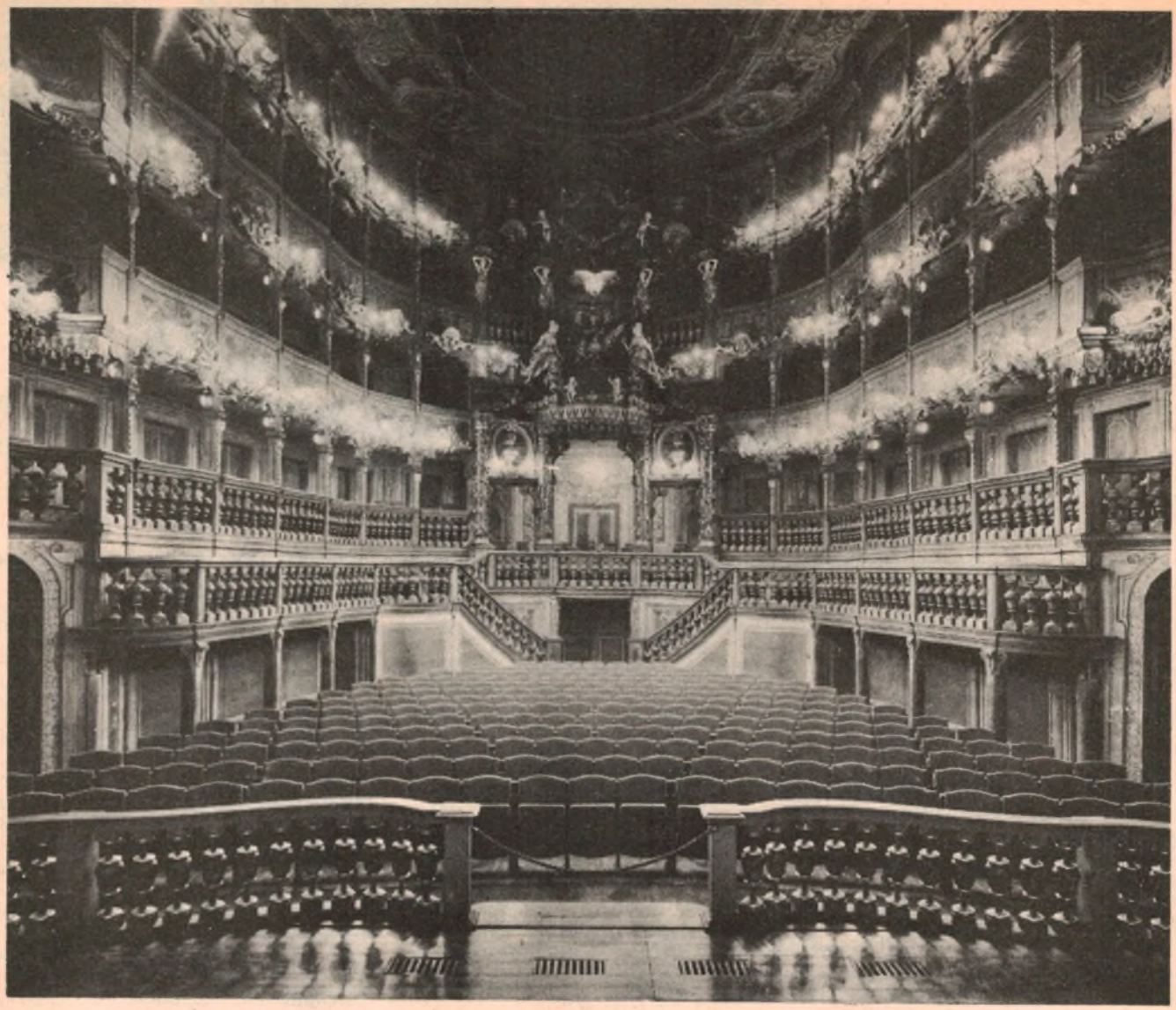
The peak reading power meters are credited with the ability to respond to a single transient at 20kHz, while their behaviour and accuracy are such that it is not necessary to switch ranges to read the amplifier output.

Connection is possible to four sets of speakers with level controls adjustable down to —20dB. This unusual feature makes it possible to adjust the volume level according to the needs of the different speaker locations or, alternatively, to match volume levels for effective A—B comparison testing.

Companion unit for the SE-A1 power amplifier is the stereo control amplifier SU-A21 also pictured. This is so far removed in concept, facilities and performance specifications from the usual control amplifier that it warrants a special article in itself.

Sufficient to say here that the internal circuitry is completely direct-coupled, offering harmonic distortion figures at full rated output of .003% or .005%, depending on the function. Excellent as these figures are, they are overshadowed by the signal/noise ratio quoted for magnetic phono cartridge: 95dB relative to 2.5mV, which means in practice that the new Technics preamplifier is at least as quiet on phono input as the average amplifier is on the "Aux" channel.

But more about the SU-A2 later.



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ABOVE: Marketed by Pacific Film Laboratories Pty Ltd, Pacific C-60 and C-90 cassettes are intended primarily for the user who wants a good, reliable ferric oxide cassette, at an economical price from readily accessable sources. Pacific C-60 blank cassettes carry a maximum recommended retail price of $1.65 (C-90 cassettes are $1.85) and are available from local pharmacies and camera stores — the same outlets as handle Pacific colour film. For further details, contact Pacific Film Laboratories at 298 Railway Parade, Carlton, NSW 2218.

But TDK says:

. . . that their AD (Acoustic Dynamic) blank cassette is the finest standard bias, pure ferric tape pack that you can buy. It's not quite as good, they admit, as their Super Avilyn (SA) tape but then not everyone has a deck with the appropriate bias and compensation to take advantage of the SA formulation. But, not to worry: AD tape ensures very low noise, low drop-out, wide dynamic range and an improved top-end performance, which is especially compatible with the requirements of Dolby noise reduction circuitry. Mechanically, AD tape has been housed in the same "super-precision" cassette as used for SA, adding up to a very impressive product.

HIFI ACCESSORIES

M. R. Acoustics of PO Box 110, Albion, Qld 4010 advise that they have added two handy new hifi accessories which they are marketing in Australia on behalf of QED of Britain.

The first is the disc switch unit 10/1, which is suitable for wall mounting and which allows the user to select which of two turntables is to feed the hifi system. Its most obvious role is for domestic record players where a second, less exotic deck is provided for casual or party situations. The price is $22.00.

For the other end of the amplifier chain, two types of loudspeaker faders or volume controls are available, type 4/8 for 8-ohm drivers, type 4/4 for 4-ohm speakers. M.R. Acoustics point out that the usual devices sold for this purpose are adapted from wire-wound potentiometers, with a power rating of about 3 watts. The QED controls use 5-position switches and PC boards to support the associated resistive network, with ventilation holes for heat dissipation. Suitable for wall mounting, their price is quoted as $39.00.

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The Australian CB SCENE

PHILIPS-TMC 40-CHANNEL UHF IS LOOKING GOOD

Having spent the best part of a day at Clayton, Victoria, looking through the Philips-TMC factory, and talking to production executives, I came away convinced: not only is the company committed absolutely to local CB production, but to a kind of CB communication that is a world away from the current schermozzle on 27MHz. If you're disillusioned with the present situation, read on.

by NEVILLE WILLIAMS

The philosophy of Philips-TMC in relation to CB radio was reported in very broad terms in our last issue but what was said there was based mainly on press releases, and in print before we had a chance to look at their ideas and preparations at first hand.

The interest by Philips in CB-style communication is not new, of course. Earlier in the year they had strongly backed what was then one of the options open to the Minister for Posts and Telecommunications: the licensing of Citizens Band transceivers only on the UHF band, typically in the region of 470MHz.

Consumer reaction to the company's stated policy was immediate and spirited, and highly reminiscent of what had been said of local support for relegating FM broadcasting to the UHF portion of the spectrum:

- It would delay practical development, perhaps for years;
- It would prevent consumers from buying and using readily available imported equipment;
- Local manufacturers were motivated not by the best interests of consumers but by a desire to create a "closed shop" for Australian produced equipment.

In due course, the Minister for Posts and Telecommunications settled for what, in retrospect, was the inevitable compromise: to legalise CB operation on both 27MHz and UHF, the former to be phased out by mid 1982.

The numerous and highly vocal champions of US-style CB interpreted the announcement as a decisive victory on the basis that, having been granted legal access to the 27MHz band, the sheer weight of numbers would make it most unlikely that the allocation could ever be effectively withdrawn.

In the face of competition from 27MHz, locally inspired UHF CB could never be more than an exercise in futility! So said the knockers.

But things have changed, in the past few months, to modify sharply this easy dismissal of UHF CB:

- Legalisation and cut-price marketing have released a flood of 27MHz transceivers to the public, adding to the 100,000-odd units that were already operating illegally. Many individuals with identifiable communication needs have become thoroughly disillusioned by the mass of jargon-ridden chatter on the channels. To this whole group, UHF CB has emerged as a highly desirable alternative.

General Manager of Philips-TMC, Ian McKenzie (left), and CB Radio Product Manager, Ian Miller, with a prototype of their Australian made UHF CB unit.

- Philips-TMC has promised to supply the vital missing link — a high-performance 40-channel UHF transceiver, to be on sale in early 1979, for about $300, including antenna.

The Philips FM320 will be marketed in a distinctive carton, complete with a detailed operating manual and a booklet detailing the warranty and back-up services.

At last: Dick's Australian SSB CB

SCORPION SSB BASE

What have the Hy-gains, the Cobras, the Presidents, the Kracos, the Trams, the Universes, etc etc etc got in common? **They're all American rigs, in some cases 'dumped' in this country.** What have the Scorpion, Hornet, Wasp & Bumblbee got in common? **They're DESIGNED FOR AUSTRALIA, by Australia's No. 1 CBer, Dick Smith!**

Here it is — Dick's brilliant new 'Scorpion' SSB/AM base station. 18 channel, designed for Australia — with built-in power supplies for both 12V & 240V. Has LED readout, SWR meter (both meters are huge, easy-to-read types) and the finish is the latest 'black is beautiful' with contrasting chrome trim. An absolutely brilliant apppearance — our drawing just can't do it justice! If you want outstanding value for money in an outstanding set, you can't go past the Scorpion!

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A magnificent educational kit for both the inexperienced and advanced experimeter. Beautifully detailed manual describes in step by step instructions, how to make up to 150 different electronic projects. No soldering is required and the complete kit operates off harmless low voltage battery power. An enlarged transparent I.C. (integrated circuit) clearly shows the electronic layout of these most complex space age devices. As no soldering is required (connections are spring terminals) all components can be re-used time and time again. The kit includes the following electronic devices: Cadmium sulphide cell, solar cell, micro-ammeter, radio tuner, poteniometer, relay, I.C., speaker, signal light, microphone, earpiece, morse key, slide switch, transformer, etc. The separate projects are too numerous to list however, it has been said that the only thing that cannot be made is a television! Supplied in a sturdy wooden case. Dimensions 406 x 216 x 89mm. Batteries required:1 x 9 Volt, 2 x 1.5 Volt.

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Their "exercise in futility", so called, may well turn out to be a real winner and a trend-setter on an international basis!

Looking at the emerging position back in July last (for publication in the August issue) we foresaw the possibility that Australia could be "in a position to set a lead with switched channel receivers operating around 470MHz". However, we were less than optimistic that Australian electronics manufacturers could "learn to manufacture transceivers down to a price, while still meeting the requisite standards".

". . . it would be quite unrealistic to think in terms of beautifully made Australian transceivers at $700 apiece, when the up-market CB limit is less than half that figure."

Right now it looks as if Philips-TMC is going to show up our pessimism for what it possibly was and this is one time we won't mind in the least being proved wrong!

But how are they managing to pull the UHF rabbit so neatly out of the hat?

Seeking to answer that question, Philips-TMC General Manager Ian McKenzie said that the Philips organisation had a long-standing connection with radio communication and had played a prominent part in the development and installation of such things as mobile radiotelephones, "wireless" telephone systems, personal paging systems, and so on. His company was communications orientated, with a particular interest in "personalised" communications.

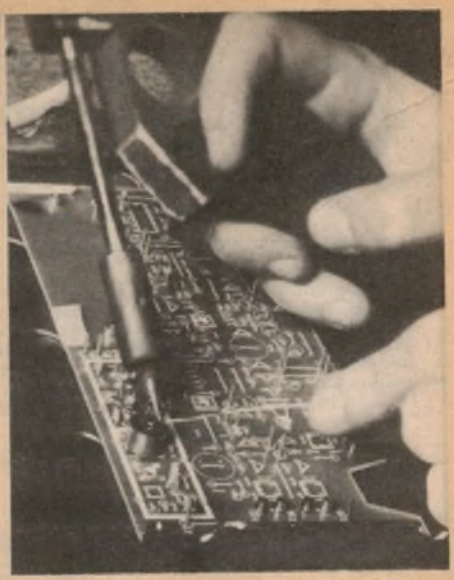
They saw the present high interest in CB radio not as an isolated phenomenon, but as a natural flow-on from every person's urge to communicate. When motoring, for example, he/she would like to know about road conditions; be able to summon assistance, and to inquire ahead about accommodation, etc — the things on which the case for CB was largely built.

But, according to Ian McKenzie, the allocation overseas of 27MHz was an unfortunate "technical accident", being just about the worst frequency possible for such a service:

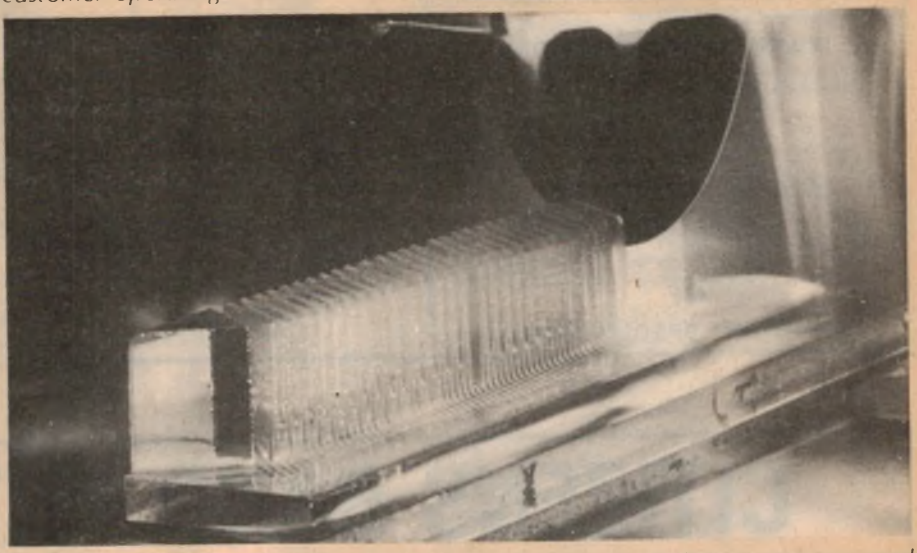
- It suffers badly from electrical interference;
- It penetrates readily into audio and other electronic equipment;
- Antennas are too large to permit efficient operation on vehicles;
- While not optimum for short-range communication for the above reasons, 27MHz signals are still subject to ionospheric "skip", making them randomly audible hundreds, or even thousands, of miles away from the transmitter.

In terms of planned communication, the 27MHz CB band therefore tends to be something of an aberration — an uncomfortable mix of point-to-point communicators, and would-be amateurs and DXers, and a "cult thing" for teens and twenties, as well.

By comparison, operation on 470MHz would largely eliminate interference problems from both reception and transmission, simplify antenna requirements, provide much more predictable local communication, obviate ionospheric skip and generally shift the whole bias back towards the



On Philips UHF transceiver assembly line each assembly operator is responsible for their own quality checks, including a multifunction test of the sub-assembly. Each completed transceiver is ultimately tested under simulated customer operating conditions.



Philips-TMC is the only electronics manufacturer in Australia set up to cut and grind crystals for use in their own communications equipment. The photo shows crystals being cut from a rod of synthetic quartz after the precise cutting angle has been determined to ensure optimum oscillator characteristics. The FM320 UHF CB rig uses one such crystal for the basic frequency source and two other crystals in its filtering and frequency division circuitry.

In the crystal filter assembly and tuning section of the Philips-TMC manufacturing centre at Clayton, Vic, operators individually tune each crystal to its correct frequency by depositing gold particles on to the crystal face with a vacuum process.

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The HMV Electronics Division of EMI have recently announced release of their "Roadhound" range of CB transceivers. Designed to meet Australian specifications, the TX44 is an AM unit intended to retail at $119. The TX55, illustrated, has similar electrical specifications to the TX44 but has additional controls and a LED channel readout. The price quoted is $139. Top of the range is the TX77, featuring AM and SSB operation and retailing at $239.

utility service that CB radio should provide.

For the time being the Philips Consumer Division will almost certainly handle an 18-channel 27MHz transceiver, but only to maintain a complete presence in the marketplace. As far as Philips-TMC is concerned, their whole emphasis will be on the production, distribution and servicing of Australian-made UHF CB. And, for this role, the company is particularly well placed.

Of the 11-odd companies supplying the Australian mobile radio market (excluding CB) Philips-TMC claim to have the "lion's share" with about 45% of the total market.

A great deal of effort has been directed towards minimising production costs and their success is shown by the fact that, in round terms, the price level of mobile radio units has remained substantially unchanged since 1955. They still average around $500.

At the present time, according to Ian McKenzie, Philips-TMC transceivers are fully competitive in Australia against units manufactured overseas. More than that, they are competing very successfully in the Pacific and Asian regions, even to the point where they dominate the market in Hong Kong.

Because a significant proportion of the systems operate at UHF, a great deal of Philips-TMC research at Clayton has been concentrated in this direction. In fact, the design team at Clayton provides project leadership in UHF mobile technology for the entire Philips group, worldwide. About 7% of Philips-TMC turnover is diverted to research and development, and to what they define as "quality assurance".

When the possibility emerged of a CB allocation in the UHF band, it was natural that the Clayton team should take it up, partly to meet the immediate challenge in Australia, and partly with a view to the possibility of other countries following suit.

And the stakes could be quite high. Based on figures from the USA, and allowing for a higher rate of acquisition (as happened with colour TV), it seems likely that one Australian in every 10 will own a two-way radio five years from now.

That adds up to a million or more sales!

So, in April of this year, TMC's Ian Miller was named as CB Product Manager, heading up a team covering every facet of the new venture — planning, design, procurement, production, marketing and so on. Within six months, the team had generated provisional specifications in collaboration with the P&T Department, produced mockups to test customer reactions, run propagation tests with adapted existing transceivers, and produced their first working prototypes.

On the occasion of my visit to Clayton — and despite the crippling Victorian power strike — work was in progress to relocate offices and stores in order to clear a space for an assembly line that, next year, should be turning out many thousands of UHF transceivers.

Present expectation is that addition of the CB line will treble the number of units flowing from the Clayton factory. This has made it possible to order a whole new array of tooling, automatic production equipment and test jigs, which will not only speed the production of the new CB units, but also expedite production of existing radiotelephones.

To my question about price, Philips say they are still sticking with their figure of "about $300", announced earlier, for a 5W mobile transceiver, complete with microphone, cradle and antenna. This is possible, they say, mainly because the CB transceivers will be completely standardised and produced in a long, unbroken run. Transceivers for commercial users have to be produced to smaller orders, set up for different frequencies, etc, and this adds to the cost.

Specifications for the CB units may also not be quite so tight, but the differences will not be all that great. Because of the number of CB transmitters which are likely to be in use, there will be little room to relax specifications on spurious radiation, in particular.

The production prototype of the FM320 CB transceiver, which I handled at Clayton, is smaller than the average AM/SSB transceiver and also much lighter. It has a particularly versatile cradle arrangement, which should allow it to fit neatly beneath the dash of most cars. It has a built-in loudspeaker, a socket for an external speaker and an audio power output of 2W. No provision is made for public address — an omission with which the writer heartily concurs!

Unlike the usual 27MHz CB transceiver, the FM320 employs narrow band FM rather than AM or SSB. This confers a high degree of immunity against noise interference, heterodyne whistles and crosstalk — the latter due in part to the "capture effect" of an FM system.

Also, unlike the usual 27MHz CB transceiver, the FM320 has no channel selector knob, although it does have a LED readout to indicate which of the channels is in use. To change channels, the operator pushes a spring-loaded toggle switch on the panel, which causes the transceiver to cycle through the 40 channels in the direction required.

A second toggle switch has three indexed positions. In the centre, it allows the selector to operate as described. The outer positions override the sequencing and tune the transceiver respectively to the emergency channel, or to a particular channel which the user can have preset by a simple internal adjustment.

Responding to would-be user reaction at the NCRA CB conference in Canberra, in September, Philips engineers decided to bring forward one or two modifications which they had envisaged for a Mark II version.

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Chief of these was the provision of a second channel-select toggle on the body of the microphone. It has occasioned a small delay into the start of production but it means that the up-date will be included right from Mark I, No. 1.

No less interesting than the transceiver itself were the prototype antennas which I saw in the Clayton conference room.

At 470MHz, the length of a conventional quarter-wave antenna is only about 15cm; mounted on the roof of a car — which provides an effective groundplane at this frequency — the radiation pattern should be a relatively symmetrical "doughnut". Compared with 27MHz antennas, the 470MHz spike looks very tiny indeed, yet it radiates at full efficiency.

However, at about 38cm overall, a five-eighth wave base-fed antenna is also entirely practical for rooftop or gutter mounting and offers about 3dB of gain relative to the quarter-wave spike.

Yet another antenna I was shown comprised a base-fed five-eighth bottom section, surmounted by a lumped inductor self-resonant on 470MHz with a half-wave on top of that again — broadly equivalent to a two half-waves in-phase configuration and giving a dB or so of gain above that of the five-eighth radiator alone. But the length is still only about 70cm, making it practical for mobile and very attractive for a base station installation.

But the really smart antenna was a skirted quarter-wave (or dipole) in which the coaxial cable passes up through a metal skirt, one quarter-wave long, to feed a quarter-wave spike on top. This still-tiny assembly is mounted on top of a suitably modified broadcast antenna, with the 470MHz feed cable passing down through the latter to the CB set. A single-hole mount suffices for both antennas and, because the CB antenna is mounted high up and well clear of the car body, it gives a good all-round pattern with an effective gain, Philips claim, of about 5dB over a quarter-wave spike at rooftop level.

And what does all this add up in terms of that final and vital consideration — range?

In a typical situation, neither notably good nor notably bad, car-to-car range is typically around 10km. From base-to-car, with the base antenna just above roof height, about 15km. But the range can double, triple, or quadruple quite predictably if either end of the circuit is operating from a topographical prominence.

On the assumption that most users, for most of the time, will be working from average locations, there is room in a typical large city for three or four station groups to be using the same UHF channel without mutual interference. Since there will be 40 channels available, these multiply to 120 or more.

As I said at the outset, I came away convinced!

SHORTER IS SAFER

Mr Len Francis, Chief Electrical Inspector for Victoria, has emphasised the need for care when installing the tall antennas which are commonly used for 27MHz CB base stations. He said that, during 1976, one insurance company in the USA had 26 reports of do-it-yourself installers fouling overhead power lines when erecting CB radio or television antennas.

"Fifteen of these accidents were fatal and, in the other cases, most survivors received severe burns."

Mr Francis said that accidents with CB antennas had most commonly involved lightweight vertical omni-directional antennas mounted on top of long metal masts. While publicity had already been given to the dangers of long, mobile whips, it was necessary to be no less careful with base station antennas.

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'Go anywhere' CB transceiver

With about four weeks to go before the P&T Department ceases to license 23-channel CB transceivers, Dick Smith Electronics are offering their customers a last chance to acquire one of their 13-861 Midland portables at a very attractive price — $135.00.

Modest in size and weight, the Midland 13-861 lends itself readily to portable applications, as above. With batteries delivering normal voltage and using its own telescopic rod antenna, the transmission range is about 3 miles in average terrain. In the Lo-power position, it is likely to be about 1 mile.

As will be evident from the photographs, the 13-861 is styled rather like a military packset, allowing it to be carried and operated while bush walking, etc, using its own self-contained batteries. Alternatively, it can be operated in a car, slung from an under-dash cradle, or as a base station, powered from a mains unit and coupled to a standard 50-ohm antenna.

The basic transceiver is conventionally styled — although very small — with a black and chrome front panel, chrome surround, and two vinyl covered metal lids to provide the main housing. It measures 11mm wide, 50mm high and 171mm deep, not including the knobs at the front or the connection facilities at the rear.

For portable use, the unit slips into a black leather-like carrying case, being retained by two knob-screws and with access holes for the speaker/microphone, antenna and battery charger. A separate pocket on the side of the case accommodates the battery pack which can take either eight penlight cells or 10 equivalent rechargeable nickel cadmium cells. It is for the latter that access is provided for a separate charger.

The antenna for portable use comes with the 13-861, along with a shoulder strap, as pictured. The antenna is actually in two parts — a swivel base which screws into the socket at the rear, and a centre-loaded telescopic rod which can be adjusted to a near-vertical position, irrespective of whether the transceiver is being carried, or resting on a flat surface.

An unusual feature, but a logical one in a portable set, is that the microphone serves a double role — as a mic. for transmission and as a speaker for reception. There is ample acoustic output for portable work but, for fixed situations, an external loudspeaker can be plugged into the rear of the transceiver, to make best use of the rated 2.8W of audio power.

To conserve battery power in portable service, a hi-low switch is provided on the panel, allowing the transmitter output power to be reduced for short-range working.

For use in a car or boat, alternative

The Midland 13-861 in its "Texon" carry case and with the speaker/microphone plugged in ready for use.

cradle brackets are provided, a shallow one to accommodate the bare transceiver in what would be a very compact installation, and a deeper one to accommodate the complete portable case. A normal red/black twin lead is provided for connection to a 12V electrical system and, as mentioned earlier, there is provision for use with a separately mounted loudspeaker. A standard antenna socket at the rear allows for direct connection of any ordinary 50-phm CB style antenna.

The same general remarks would apply to where the 13-861 is used in a base station role, except that the power

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supply would normally be from a mains unit delivering around 13.5V.

Controls on the front panel include the channel selector, the hi-low transmit power switch mentioned earlier, squelch control, volume control with off/on switch and a checklite switch. This latter provides temporary illumination for the channel selector and meter when the unit is operating from its own batteries. When powered from an external source, the illumination remains on.

The small edgewise meter serves three functions. With no input signal, it registers the supply voltage on a red/blue scale and therefore indicates the condition of internal batteries.

With normal input signal, it serves as a reverse reading S-meter and, on transmit, indicates relative power output. In practice, the battery condition reading is probably the most important of the three.

Electrically, the receiver is specified as a double-change superhet with intermediate frequencies of 11.275MHz and 455kHz. It features AGC and inbuilt anti-noise limiting. Sensitivity is given as 0.5uV for a 10dB S/N ratio, selectivity 8kHz at 6dB down and spurious rejection better than 40dB. Frequency control, by crystal synthesiser, is within $\pm 0.005\%$.

The transmitter is similarly crystal controlled and is rated to deliver an output of 1W (lo) or 3W (hi) in portable service or 4W in mobile or base station configuration.

A typical 13-861 was made available for our examination and we had no fault whatever to find with the presentation of the unit, complete with all accessories and a comprehensive manual in carton and rigid foam pack.

In the time available we did not have the opportunity to take the unit on a bush walking expedition, but we did set it up in base station configuration, with mains power supply and a 5/8-wave antenna.

Its behaviour on receive was completely normal for an AM transceiver, the only obvious difference being that the sound issued from the microphone rather than from the body of the transceiver. Gain, selectivity and S/N ratio were all well inside the requirements for normal CB working and a further check with a signal generator indicated that very little had been sacrificed in compressing the unit into its existing size.

On transmit, power output was generally in line with specifications and the modulation clean.

The Midland 13-861 is available, while stocks last, from the Dick Smith Electronics Group. (W.N.W.)

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NEWS, OBSERVATIONS & PRODUCTS

PIRATE STATIONS: A press release from Vicom International, over the signatures of Russell Kelly and Peter Williams, draws attention to the fact that about 50 per cent of all CB stations in the USA are currently unlicensed, despite the fact that licences are available free, on application. What hope, they ask, is there for CB licensing in Australia at a figure of $25 per set?

If the CB airwaves are not going to be dominated by "pirates", the money will have to be ploughed straight back into the system by way of an adequate team of inspectors equipped with adequate detection equipment.

UNITREX OF AUSTRALIA PTY LTD, part of the group which also includes Chiba Communications Aust Pty Ltd, advise that they share a new and common address at 12 Terracotta Drive, Blackburn, Vic 3130. Telephone number is 03 877 2922.

EXTERNAL SPEAKERS: Audio Telex Communications Pty Ltd point out, quite correctly, that the voice quality from the average self-contained CB transceiver is compromised by the necessarily small in-built speaker — as often as not directing sound towards the driver's feet, or to the floor or table-top in the case of a base station.

For all those situations where space is available, Audio Telex are recommending their AFS-KRIKET brand external speakers, housed in an acoustically treated Naugahyde case, and swivel mounted so that they can be directed conveniently and appropriately towards the operator.

Also available are special all-weather speakers and larger, higher quality units for specialised base station operation.

Their address is 54 Alfred St, Milson's Point, NSW 2061, or 828 Glenferrie Rd, Hawthorn, Vic. 3122.

MIDLAND CLAIM: No. 1. Figures released in the USA, indicate that Midland is the top selling CB there. Midland enjoy No. 1 position with 21.4 per cent of the US market in 1977. The next most popular set is Cobra with 12.9 per cent, the Realistic 11.9 per cent, followed by Johnson, Royal, Pace and Hy-Gain.

The figures were published in July 1977 Electronic Retailing and are based on figures supplied by Clarion Corporation of America and are accurate to plus or minus five per cent.

Above, a typical external speaker unit and below, a Kiket "Kamel" combination speaker and transceiver mount, with a Telex CB73 power microphone attached.

UHF CB CHANNELS

The frequencies nominated by the Authorities for the UHF CB band are set out in the table below:

Ch.	Freq.	Ch.	Freq.
1	476.425	21	476.925
2	476.450	22	476.950
3	476.475	23	476.975
4	476.500	24	477.000
5	476.525	25	477.025
6	476.550	26	477.050
7	476.575	27	477.075
8	476.600	28	477.100
9	476.625	29	477.125
10	476.650	30	477.150
11	476.675	31	477.175
12	476.700	32	477.200
13	476.725	33	477.225
14	476.750	34	477.250
15	476.775	35	477.275
16	476.800	36	477.300
17	476.825	37	477.325
18	476.850	38	477.350
19	476.875	39	477.375
20	476.900	40	477.400

Of the above, channels 1-10 and 36-40 may be used immediately and without restriction. Channels 11-35 will become available to the Citizens Radio Service (CB) at a date to be announced.

UHF licensing is on the basis of frequency modulated telephony with a maximum bandwidth emission of 16kHz and a maximum transmitter output power of 5 watts (mean power).

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The Australian supplier of Midland CB radios is Dick Smith Electronics. Dick Smith said recently, that "Midland has a significant share of the Australian market, possibly higher than the 21.4 per cent quoted as the US market share. Midland is a popular brand because of its quality control standards at the point of manufacture."

ANTENNAS: A new range of CB antennas has been released by Antenna Engineering Pty Ltd of Garden St, Kilsyth, Vic. The range includes both base and mobile antennas.

AEA model HT27 is a special high performance, low SWR, top loaded 5ft helical. Other mobile antennas include heavy duty 7ft bumper mounting helicals, base loaded roof mount models and 12-inch compact helicals. Accessories and mounting kits are available to suit.

For base operation, there is the model HV-27 helical dipole, as well as vertical ⅝ and ½-wave base loaded types.

AEA manufactures a wide range of antennas and associated equipment for TV and radio stations, military and government services, local government bodies, etc.

G.F.S. ELECTRONIC IMPORTS is a new company which has been formed to import and distribute CB accessories, along with novice and other amateur radio equipment. Its principals are Greg Whiter and Fred Stewart, both of whom have had considerable experience in the electronic communications field. The address of the company is given as 15 McKeon Rd, Mitcham, Vic. 3132.

OBC INTERNATIONAL MARKETING PTY LTD have been named as the sole agents in Australia for the HY-GAIN Electronics Corp, USA, according to a statement by Mr Roger Wilson, Manager of the General Products Division of OBC. The new arrangement will replace what were previously more diverse marketing methods.

OBC have arranged for one of their top technicians to visit HY-GAIN's plant in Lincoln, Nebraska, for training.

HY-GAIN technical staff will also visit OBC's plant in Melbourne to assist in setting up full local service facilities.

Pride of the HY-GAIN line at the moment is their model 16, described as "the world's first microprocessor-controlled, practically burglar-proof Citizen Band Radio system". It employs two modules — the main unit fitting in the boot and a dash-mounting control unit, which can be readily removed for safe keeping.

WINNING ENTRY —
The Dick Smith CB Cartoon Contest

Literally hundreds of entries were received for the CB cartoon contest announced in our September 1977 issue, ranging from primitive to professional. This one scored highest in a staff poll conducted by Editor Jim Rowe. The prize, a Hy-Gain 23-channel SSB/AM CB transceiver, goes to Mr William Chambers, 11 Valder Avenue, Hobartville, NSW 2753. We plan to publish other selected cartoons in coming issues, for which a publication fee will be paid.

Win this BWD 539 25MHz oscilloscope

The Project Competition:

Announced recently by BWD Electronics, the BWD 539D oscilloscope is a dual trace instrument with a bandwidth from DC to 25MHz and beyond. It is highly suited to such fields as colour TV servicing, education, microprocessor testing, and testing and adjustment of communications equipment.

BWD Electronics, in conjunction with "Electronics Australia", is offering EA readers an opportunity to win the unit pictured at right. It will go to the reader who can write the best article on how a modern CRO, with the specifications of the 539D, can be used for servicing and adjusting 27MHz CB or other transceivers, and/or amateur equipment operating up to 30MHz. (Note: specifications for the 539D are published in a separate review in the "New Products" pages.)

Rules and Conditions:

(1) The article must be submitted in a form suitable for judging and for possible publication in "Electronics Australia". It should typically be able to fill three pages of the magazine, including diagrams and/or photographs. It will need to be neatly written or, better still, typed double space. Diagrams should be clearly legible.

(2) All entries will remain the property of "Electronics Australia". Those suitable will be published with credit to the author, and will be paid for at ruling rates. Copyright of the article in the form published will then be vested in "Electronics Australia".

(3) Senior staff members of "Electronics Australia" will judge the contest. The decision will be final, and no correspondence will be entered into. The winner will be announced in "Electronics Australia" as soon as possible after the contest closes.

***See review elsewhere in this issue**

Donated by BWD Electronics: Total value, $465.00.

CONDITIONS OF ENTRY: Entries should represent the entrant's original work. Employees of Sungravure Pty Ltd, BWD Electronics Pty Ltd or any associated companies are not eligible to enter. Entries postmarked or delivered by hand later than February 28, 1978, will not be eligible.

ENTRY FORM

Complete this form and attach it to your entry, posting them not later than 28th February, 1978, to Oscilloscope Contest, c/o Electronics Australia, Box 163, Beaconsfield, NSW 2014. A letter may be used instead of the form in States where this requirement is illegal.

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eei parabolic

The original marketers of parabolic in Australia

can you afford not to use an EEI parabolic

REPLACEMENT STYLUS

WHAT IS AN EEI PARABOLIC?

EEI is the brand name that you can rely on when you need a replacement stylus or complete cartridge for your hi-fi.
If you look at our drawing "A", you will see the greater contact area of the natural diamond parabolic stylus in the record groove, compared with a standard elliptical, drawing "B".
The parabolic with its increased contact area greatly reduces the stylus pressure on the record groove, thus virtually eliminating any gouging effect on your records.
This feature also allows the EEI stylus to trace the complicated recorded signal with greater accuracy.
Some of the many benefits are listed on our chart "E".
An EEI parabolic assembly "C" is a brand new "slip-in" replacement for your cartridge "D".

WHY YOU NEED AN EEI

One of the hardest working items in your hi-fi is the record stylus, sometimes called "the needle".
Your stylus travels about 1/3 of a mile for each side of an L.P. record, and any appreciable wear means that the stylus will lose its original shape and therefore lose its ability to trace the recorded signal precisely, any sharp edges produced by wear will begin to shear the record groove walls.
The EEI parabolic greatly extends stylus life and the life of your valuable records — see wear comparison illustrations "F".

EEI PRODUCTS GREAT PERFORMERS

Ask anyone that uses an EEI

REFUSE SUBSTITUTES INSIST ON AN EEI

HOW LITTLE DOES AN EEI COST?

EEI Series 500 parabolic cartridge	$49.75
EEI parabolic replacement styli to suit the following:	
SHURE V15III	$49.75
SHURE N95ED	$44.75
SHURE N91ED	$41.75
SHURE M55E & M44	$24.75
ORTOFON M15E super	$41.75
STANTON 681EE & EEE	$41.75
EEI Series 500	$37.75
PIONEER PN135	$34.75
SHURE N75ED	$29.75
PIONEER PN11	$24.75
PIONEER PN12	$24.75

Plus many other types.

NEW RELEASE: EEI-400 ultra low tip weight elliptical cartridge $29.75.

Enquire about the new EEI Moving Coil Cartridge with Pre-amp. or EEI Moving Coil High Output Cartridge — does not require a Pre-amp.

prices quoted are Recommended Retail Only

HOW TO OBTAIN AN EEI

If you live in New South Wales you can phone Max Townshend of Townshend Electronics (02) 827 2937 for the name of your nearest suburban dealer, or if you live out of town, just add $1.50 to the price indicated and mail your order direct to Townshend Electronics, P.O. Box 185, Rozelle, N.S.W., 2039.

If you live in Victoria or any other state, phone Peter Wright of Elite Electronic Industries Pty. Ltd. (03) 93 1201 for the name of your nearest suburban dealer, or if you live out of town, add $1.50 to the price indicated and mail your order direct to Elite Electronic Industries Pty. Ltd., 36 Luxmoore Street, Cheltenham, Victoria, 3192.

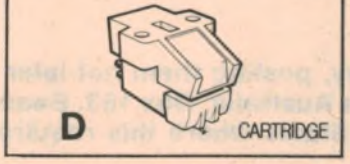
Depending on availability, we guarantee same day despatch.

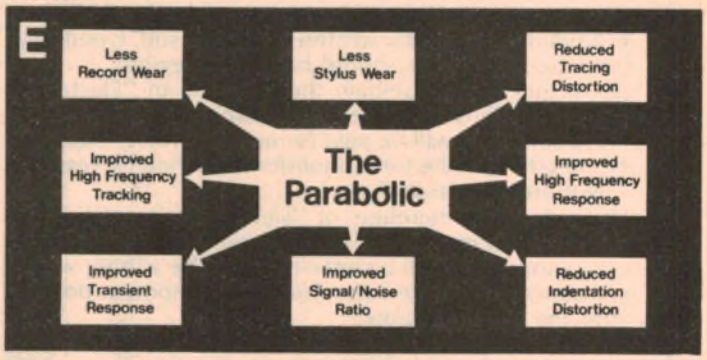
This is what AUSTRALIAN HI-FI has to say about EEI parabolic

On all counts the EEI Parabolic is an excellent cartridge It gives performance comparable with units at a much higher price

- Much better all round sound
- Diamond parabolic needle lasts up to 5 times longer
- Record life increased up to 10 times

Tests conducted in suppliers laboratory using SME arm, EEI 500 Parabolic and EEI 500 fitted with .0008 x .0003 elliptical natural diamond





EEI is used as standard equipment for FM broadcasting.

Elliptical Stylus caused excessive wear after 100 playings – magnified 12000 times

Same magnification – note almost complete lack of wear after 100 playings with an EEI Parabolic Stylus

ELITE ELECTRONIC INDUSTRIES PTY. LTD.

Manufacturers, Importers and Distributors of EEI products.

36 LUXMOORE STREET, CHELTENHAM, VICTORIA, AUSTRALIA, 3192

Interstate Agent — TOWNSHEND ELECTRONICS, P.O. BOX 185, ROZELLE, N.S.W., 2039.

EEI-Series-400 magnetic cartridge has elliptical stylus

Already known for their Series 500 magnetic cartridge with parabolic stylus, Elite Electronic Industries Pty Ltd now introduce this lower-priced unit with an elliptical stylus.

The EEI Series 400 cartridge works on the "induced magnet" principle and so, like most other cartridges, it has a removable stylus assembly. The Series 400 model also has the standard 12.7mm mounting centres and standard colour coded output terminals.

Mass of the cartridge is quoted at 6 ± 0.5 grams. Thus it is easily balanced by all current tone arms.

One point we should comment on is the lack of branding on the cartridge. Our sample had no identification on it at all. This could be a drawback in years to come, when the user wants a replacement and cannot find the original packing.

Mounting the EEI cartridge in most headshells is a straightforward process. The regular shape of the cartridge body makes correct alignment easy, and the body has drilled mounting holes rather than the abbreviated mounting feet on some other brands which make mounting a tedious process.

We found it necessary to remove the stylus assembly while the cartridge was being mounted, to avoid the possibility of stylus damage. Our sample cartridge was a pre-production model, supplied without the standard packaging or printed specification sheet. When their regular production models become available, EEI would do well to include a stylus protector of some sort, whether it is a clip-on or flip-down type.

According to EEI the elliptical stylus is a "natural" diamond, but we are not sure whether this means that it is a "naked" diamond rather than a diamond tip on steel shank, or merely that it is not a synthetic type. Either way will have minimal effect on the quality of reproduction. Tip mass is calculated by EEI at less than 0.4 milligrams.

Impedance of the cartridge is quoted as 2.5k at 1kHz, but this is fairly useless information to a user who wants to calculate the effects of cartridge loading. It would be more useful to quote the inductance and resistance.

Recommended load for the cartridge is 47k, with no figure specified for shunt capacitance. Recommended tracking force is 1.5 grams minimum, 1.75 grams optimum and 2 grams maximum. We found that the optimum figure was in fact 1.75 grams, with little to be gained by increasing the tracking force to 2 grams.

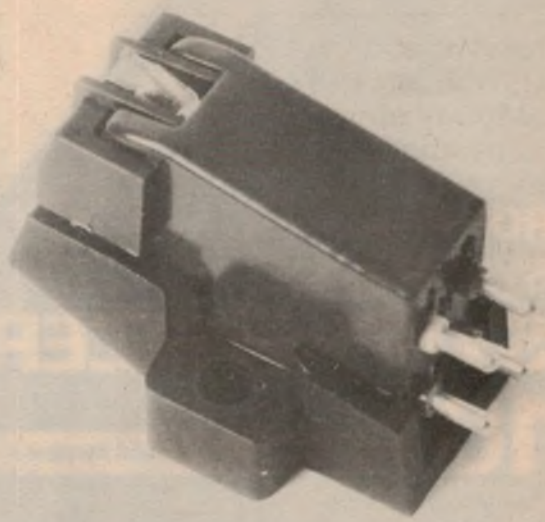
At the optimum tracking force the EEI 400 tracked the ±12dB drum test track of the W&G 25/2434 disc. On the Shure "Audio Obstacle Course" the tracking performance of the EEI 400 equates with typical medium quality magnetic cartridges.

Frequency response tests were made using the CBS STR 100 disc and with the cartridge loaded with a 47k resistor and cable capacitance of about 120 picofarads. The output voltage was monitored by a Hewlett-Packard 331a (functioning as an AC millivoltmeter) and oscilloscope.

Under these conditions the frequency response was within +1 -3dB from 30Hz to 20kHz. The response is actually slightly above reference 0dB at the two extremes, but has a droop of about 2 to 3dB from 4kHz to 12kHz. Channel balance is within 1dB and channel separation is 24dB in both directions at 1kHz and greater than 20dB from 200Hz to 16kHz. These are good results.

Waveform in the region of 10kHz to 16kHz is not good but this is fairly typical for most magnetic cartridges. Square wave response at 1kHz is good.

Output voltage of the cartridge was 3mV at 5cm/sec which is a little on the low side. EEI state that this will be higher in their regular production models. Fortunately the cartridge appears to be reasonably well shielded, and problems with hum induction were not experienced.



The EEI Series 400 cartridge works on the induced magnet principle and has a removable stylus assembly.

Sound quality of the cartridge is very good, particularly on stringed instruments. This is to be expected from the well-maintained HF response. Bass response is also fully up to standard.

In short, the EEI Series 400 cartridge can be regarded as providing good performance at reasonable cost. Recommended retail price of the unit is $29.75 plus $1.50 post and packing. Enquiries should be directed to Elite Electronic Industries Pty Ltd, 36 Luxmoore Street, Cheltenham, Victoria 3192 or their interstate agent, Townshend Electronics, PO Box 185 Rozelle, NSW 2039. (I.D.S.)

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Leak 3050 loudspeaker has time-delay compensation

Like the other units in the Leak 3000 series, the 3050 is "time-delay compensated". This is achieved with a staggered baffle, although the outward appearance is quite conventional. The Leak 3050 is a two-way system but has two woofers and one tweeter. Power rating is 50 watts.

With the trend to odd-shaped loudspeaker cabinets, the Leak 3050 is a fence-sitter. It has an irregular baffle, but manages to conceal it with the grille cloth frame. The reason for the staggered baffle is to apply "time-delay compensation" to the tweeter. This approach is otherwise entitled "linear phase" (or similar) in other brands of loudspeaker.

The time delay results in any multi-speaker system where the voice coils are in differing vertical planes, as they must be when all the loudspeakers are mounted on the same vertical baffle. The solution, as provided by a number of manufacturers, is to tilt, bend or stagger the baffle so that the wavefronts from each of the drivers in the cabinet all arrive at the listener's ears at the same time.

Naturally, the time-delay compensation provided by these methods is a compromise and will only be ideal at a specified distance from the cabinet. In the case of the Leak 3050 the staggering of the baffle appears to be optimised for a listening position some three to four metres from the unit, with the cabinet sitting on the floor.

Instead of being made of timber the complex baffle of the Leak 3050 is a large plastic injection moulding. It is quite heavy and rigid and appears to be non-resonant. It is attached to the timber cabinet by four wood screws and a cleat at the bottom. This does not look very impressive, but the cabinet did seem to be airtight.

Two woofers, each with an effective diameter of 125mm, handle the bass and mid-frequencies up to 4kHz. Above that, a 20mm dome tweeter takes over and carries on to well above the limit of audibility. The crossover network has a stack of inductors and other components, and gives attenuation slopes of 18dB/octave.

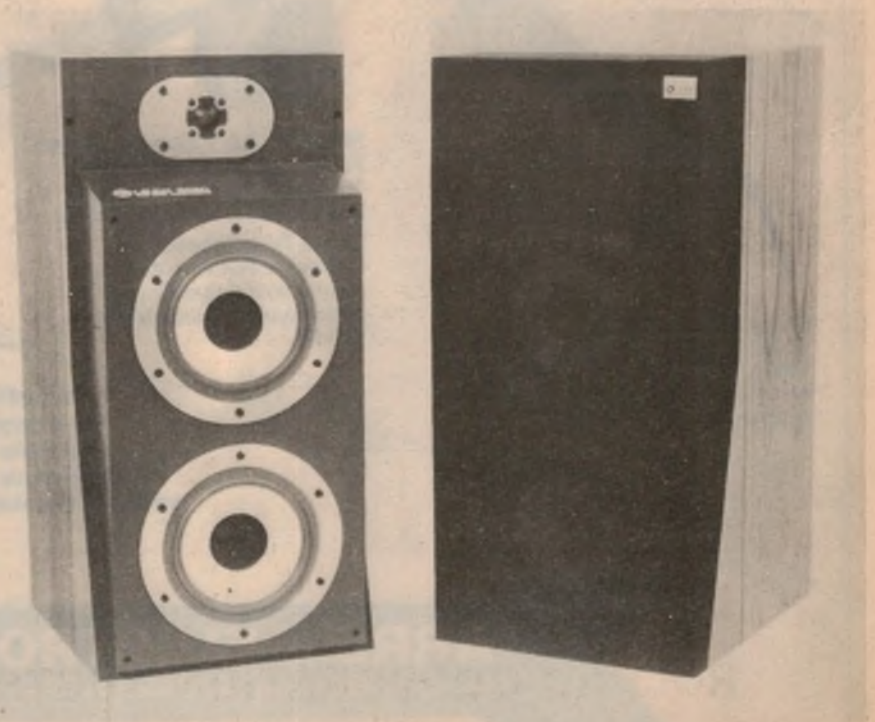
We were pleased to note that the dome tweeter has a measure of protection from clumsy fingers and errant screwdrivers, in the form of a light mesh cover. We would still prefer that the grille cover be not so easily removable (as with most other loudspeakers) but the Leak grille is at least better in this respect that the foam grilles of some of its competitors.

Volume of the sealed enclosure is 40 litres and most of this is packed with an acrylic fibre material to control the system resonance. The enclosure panels are also treated to reduce unwanted resonances. Connections to the amplifier leads are made via DIN socket or thumbscrew terminals.

Nominal impedance of the Leak 3050 is 8 ohms. Measurement showed that the actual impedance (modulus) was between eight and 12 ohms over the range from 20Hz to 20kHz, except at the system resonance of 60Hz and also at 1kHz where the figure was about 23 ohms.

Power rating of the system is quoted at 50 watts (DIN) and the manufacturers recommend amplifiers of 12 to 60 watts. Our experience indicates that amplifiers under about 30 watts would be run into overload.

Frequency response tests revealed a strong and well-maintained bass response down to below 50Hz. At the high end, the treble had a rising characteristic above about 8kHz and this tends to give an impression of higher than actual efficiency. In the midrange, two deep troughs at around 700Hz and 2kHz could cause a few problems, depending on the tastes of the listener.



The staggered baffle of the Leak 3050 is concealed by the grille cloth.

Christmas Gift Ideas for Hi Fi Enthusiasts

If you are looking for a gift for a "hi-fi buff" you'll find the perfect answer at Arrow Electronics. Say "Merry Christmas" with something that will give a discerning music lover many years of added listening pleasure.

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The sure way to up-grade a stereo system–a phono cartridge he would choose himself... from $18.

Famous Koss Stereo Headphones
The choice of discerning music lovers the world over...from $30 pair.

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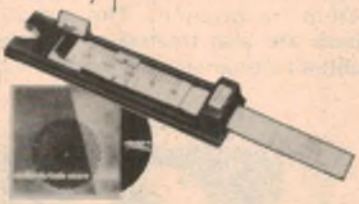
A superior record cleaner system comprising specially designed brush and a bottle of D3 fluid, $19.95.

Zerostat Anti-static Guns
Eliminates dust-attracting static charge on records, dust-covers, film, etc. Price $27.50.

Dust Bugs for $2.99

Decca Brushes $12.95



Shure Stylus Pressure Gauge
For accurate adjustment of Tracking force for maximum trackability. Priced at $12.75.

Shure Test Record
Cartridge Test Record for testing sound quality and performance of cartridges, $10.00.

Shure Microphones
Shure Unidirectional Dynamic Mikes are used by Paul Anka and other wellknown artists in show business. From $24.50.

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AE126/FP

Listening tests confirmed the bass response of the 3050. In fact, with program material other than rock, the bass tends to predominate. We found that for best overall results the cabinet should be raised about 30cm above the floor and kept well out of the corners of the room. This not only prevents undue augmenting of the bass response by floor and corner reflections, but it also cleans up the lower midrange response.

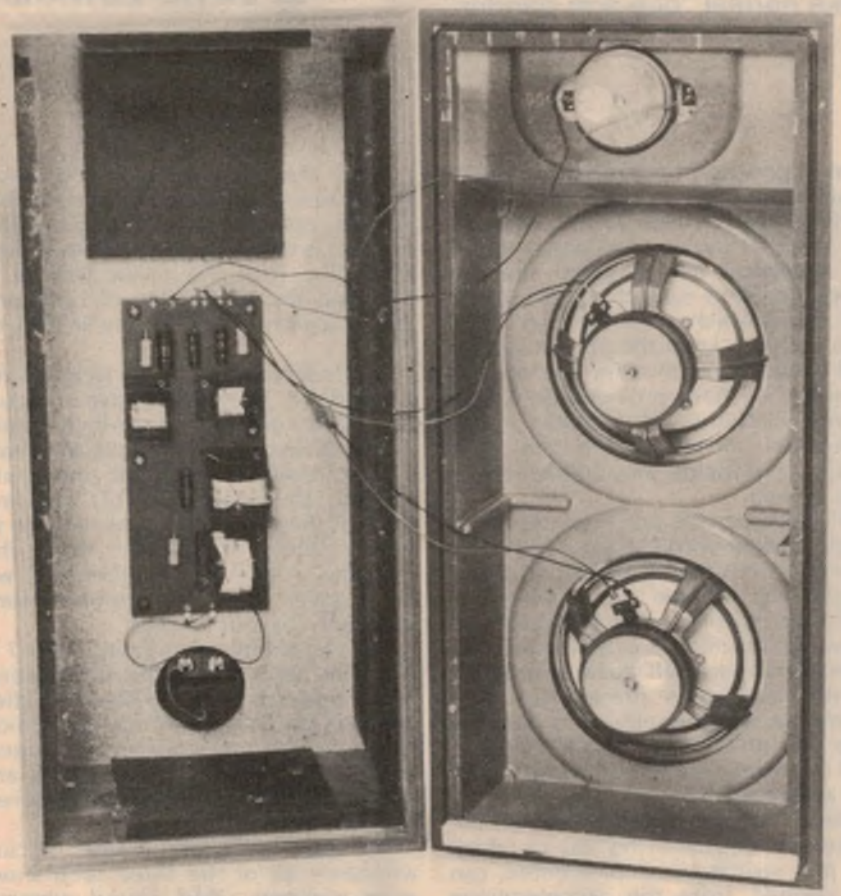
Unfortunately, raising the cabinet off the floor negates any beneficial effect of the time-delay compensation. So be it. Time-delay compensation is an arguable advantage anyway.

The rising treble response above 8kHz will be preferred by those listeners who like a clean and well defined treble end. But it needs to be modified a little with the treble control, otherwise tape hiss and disc imperfections are over-emphasised.

At low listening levels the 3050 sounds very pleasant, probably as a result of its general response giving a degree of "loudness" compensation. At higher levels, the irregularities in the midrange can make the music sound distant. In some ways this is a good deal better than the exaggerated forward sound resulting from the excessive midrange response of some Japanese and American loudspeakers.

To sum up, the Leak 3050 is a system which can give good results on rock and most instrumental music but some listeners may find its reproduction of vocal material somewhat lacking.

Recommended retail price of the Leak 3050 is $682 for a pair. Further information can be obtained from hifi retailers or from the Australian distributors for Leak products, Rank Industries Australia Pty Ltd, 12 Barcoo St, East Roseville, NSW 2069. (L.D.S.)



With the acrylic fibre filling removed the interior of the Leak 3050 is still fairly busy. The baffle is a large injection moulding which has a rubber gasket to achieve an airtight seal.

Christmas fun project:

Electronic Poker Machine

For those interested in games of chance, we present here a simple Electronic Poker Machine. The completed unit is fully solid state, and is easy to build at low cost. Unlike normal "one-arm bandits" you don't have to pay to play!

by DAVID EDWARDS

A poker machine is essentially a random number generator, coupled to a payout mechanism. Electronically, it is fairly simple to implement an effectively random number generator, and to light up payout indicators on specified numbers. Implementing the mechanics of accepting and paying out tokens or coins, however, is much more difficult, and is beyond the scope of an electronics magazine. So this article will be confined to describing only the required electronics.

Part of the attraction of a poker machine is in the visual display it provides, involving wheels rotating and stopping at random. A typical machine will have three wheels, which will stop one after the other, with any prizes showing only when all wheels or reels are stopped.

We have elected to represent these reels using three seven segment displays. Each display is driven by a BCD to 7 segment decoder, which in turn is driven by a decade counter. The clock pulses for each counter are supplied by a voltage controlled oscillator, which is arranged to run rapidly at first, and then to slow down progressively before finally stopping.

The outputs of the decade counters are sampled by logic circuits when all the oscillators have stopped, and appropriate lights turned on to indicate any prizes which may have been won.

In order to keep the project simple, and hence to minimise the cost of components, we have provided only basic scoring circuitry. This provides visible indicators of wins, with the main jackpot producing an audible indication as well.

All components are mounted on a single printed circuit board, which is intended to mount directly behind an appropriately lettered front panel. In order to further minimise costs, we have not specified a case. Instead, we have left it up to individual constructors to suit their own preferences. Our prototype was mounted in a wooden case assembled from scrap materials, and the main cost involved was that of the author's time.

Details of the construction of the prototype case, and the way in which the play switch was implemented, can be gleaned from the accompanying photographs. The play switch consists simply of a momentary action toggle switch, whose toggle was extended using a piece of plastic rod obtained from an old alignment tool.

A full size reproduction of the front panel accompanies this article, and it may be traced or used direct as required. Alternatively, we have made copies of our artwork available to those companies which normally supply front panels for our projects, and these should be available through the normal channels in due course.

Before discussing the circuit in more detail, we will consider first the theory behind the payout logic. The major prizes have all been chosen to involve various combinations of 7s, as this number is relatively easy to detect electronically. Thus the major jackpot is 777, and the probability of obtaining this in any one "pull" is one in 1000, or .001.

Similarly, the two minor jackpots are 77- and -77. These both have an equal probability of occurring, which would normally be one in 100 or .01. But since 777 is reserved here for the main jackpot, the probability of achieving each of these combinations reduces to nine chances in 1000. To make the machine a little more interesting, we have given the two combinations different "payout" scores.

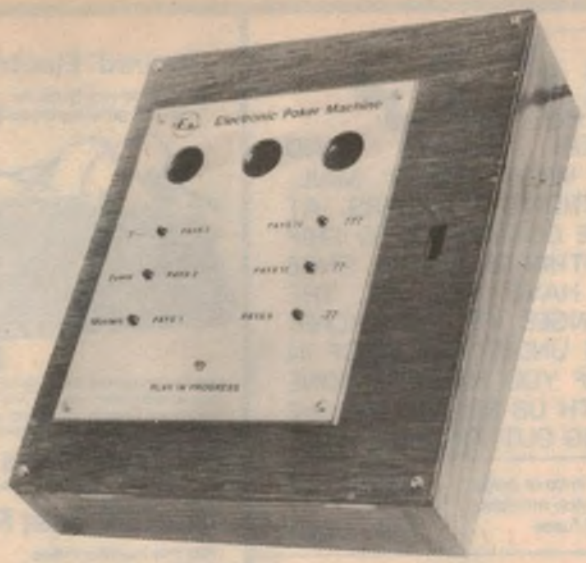
The remaining prize based upon 7 is 7- -. This has a probability of occurring in any one pull of 90 in 1000 or .09, after allowing for those combinations which produce the previously mentioned prizes. The remaining two prizes are rather unusual, and will be considered in more detail.

The prize labelled "Evens" occurs whenever all of the three reels show even numbers. Thus typical winning numbers are 246, 082, 444 and so on. There are a total of 125 numbers such as these, giving the chance of winning this prize as 125 in 1000 or 0.125.

The remaining prize, labelled "Mystery", is just that. To a casual glance, it appears to pay on numbers which are unrelated, such as 319, 001, 191 and 987. However, an astute observer may be able to see a pattern in these and the remaining 176 paying combinations.

In fact, there is a pattern in these numbers. Firstly, they are all odd. Secondly, the middle digit, when expressed in binary, does not contain a 2. In other words, only the following digits can form part of the prize: 0, 1, 4, 5, 8 and 9. And the most significant digit of the number must not contain a 4

This photograph of a winning combination shows both the displays and the prize indicating LED.



PARTS LIST

SEMICONDUCTORS
- *3 555 timers*
- *3 74C90 decade counters*
- *3 74C48 BCD to 7-segment decoders*
- *3 DL704 or similar common-cathode displays*
- *1 4011B quad 2-input buffered NAND gate*
- *1 4023 triple 3-input NAND gate*
- *2 4025 triple 3-input NOR gates*
- *1 7805, LM340T-5.0 or similar three terminal regulator*
- *4 1N914 or similar silicon diodes*
- *2 EM401 or similar silicon diodes*
- *4 BC558 or similar PNP transistors*
- *8 BC548 or similar NPN transistors*
- *6 red LEDs*
- *1 green LED*

CAPACITORS
- *1 2500uF 16VW electrolytic*
- *3 22uF 16VW tantalum*
- *1 10uF 35VW tantalum*
- *3 1.5uF 35VW tantalum*
- *6 0.1uF polyester*
- *3 0.01uF polyester*

RESISTORS (all ¼W)
- *1 680k, 1 220k, 1 150k, 1 100k, 11 10k, 1 3.9k, 1 3.3k, 1 2.7k, 3 1k, 1 220ohm, 28 150ohm, 1 100ohm.*

MISCELLANEOUS
- *1 printed circuit board, coded 77pm12, measuring 152 x 177mm*
- *1 transformer, 240V to 15V CT. DSE 2155, A&R 2155 or PL1.5-18/20VA or similar*
- *1 mains plug, 3 core flex, cord clamp and terminal block*
- *1 momentary contact SPDT toggle switch*
- *1 front panel and case (see text)*
- *1 miniature buzzer, 6VDC operating voltage*
- *Circularly polarised red film, 130mm x 30mm.*
- *Scrap aluminium, solder, hookup wire, tinned copper wire, PCB pins, tapped spacers, machine screws and nuts.*

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

when expressed in binary, allowing only the following digits: 0, 1, 2, 3, 8 and 9.

The significance of these strange combinations of numbers is that they are all easily detected using digital logic. In fact, the "Mystery" prize requires only one three input gate and one inverter. The probability of pulling this prize is 180 in 1000, or 0.18.

The values of the payouts for the various prizes were determined so that overall, the machine would have a payout rate of 95%. In other words, if you play for long enough, you will get back 95% of your input, assuming that one token is required for each pull. If you want the machine to be completely fair, increase the jackpot "prize" value from 70 to 120.

The Payout Calculation Table shows in condensed form the way in which the individual prizes are combined to give the total value of the payout. As you can see, there are 414 different winning combinations, so that on average a prize should be awarded at least once every three pulls.

For example, a test run on the prototype showed that after 100 pulls, 41 prizes had been awarded. The total value of the prizes was only 67, made up as it happened from the three smaller prizes.

Turning now to the circuit diagram, we can examine the operation of the circuit in more detail. At the heart of the unit are three 555 oscillators. A voltage controlled current source has been added to each oscillator, in place of the usual charging resistor, so that they function as voltage controlled oscillators.

The control voltages for the oscillators are developed across the three 22uF capacitors. When these are discharged, the oscillators are stopped, while their frequencies increase as the control voltage increases. When the play switch, which is debounced by two cross-coupled gates, is operated, gate 1a turns on the BC548 transistor, which charges the three capacitors to approximately 1/3 of the supply potential.

The diodes in series with the charging path are intended to isolate the capacitors from one another after the play switch is released. The capacitors then discharge via the base bleed resistors, which have been chosen so that the oscillators stop in sequence from left to right.

The rate at which the oscillators slow down, and their maximum frequencies, have been chosen to provide an acceptable display, while at the same time ensuring that the number of oscillations is suitably random.

The 555 outputs are used to clock 74C90 CMOS decade counters. The counter outputs are converted into seven segment format using 74C48 decoders, and used to drive 0.3" high common-cathode displays.

After the displays stop cycling, the number displayed is essentially random because the total number of oscillations depends on the total length of time the play switch is depressed, and this will vary from player to player and from play to play by the same person. Extensive tests with the prototype failed to show any bias whatever.

The payout detection circuitry consists mainly of combinations of gates. The gate inputs are connected to the BCD outputs of the decade counters, and the logic is arranged so that only one of the six outputs can go high at once. If no prize combination occurs, all outputs stay low.

Each output turns on a LED indicator, using a BC548 transistor. The positive supply line for the LEDs is controlled by another BC558 transistor. This transistor is controlled by gate 1c, which also drives the green "play in progress" LED. The input of gate 1c is connected to the debounced output of the play switch, via a time delay network.

This ensures that the payout LEDs are disabled while the 555s are still oscillating, so that false payout indications are not given. The diode ensures that there is no delay when the play switch is first operated, so that the "play in progress" LED is illuminated immediately. After the play switch is released, the 10uF capacitor is charged via the 680k resistor, and holds the gate output high for about 6 seconds.

Note that a buffered gate must be used in this position, as otherwise the

Zener Diodes

.5 Watt	volts	1 Watt	volts
BZX83C-3V0	3	IS3006A	6.1
BZX83C-3V3	3.3	IS3007A	6.8
BZX83C-3V9	3.9	IS3008A	8.2
BZX83C-4V7	4.7	IS3009A	9.1
BZX83C-5V1	5.1	IS3010A	10
BZX83C-5V6	5.6	IS3012A	12
BZX83C-6V2	6.2	IS3015A	15
BZX83C-6V8	6.8	IS3016A	16
BZX83C-7V5	7.5	IS3020A	20
BZX83C-8V2	8.2	IS3024A	24
BZX83C-9V1	9.1	IS3027A	27
BZX83C-10	10	IS3030A	30
BZX83C-12	12	IS3033A	33
BZX83C-13	13	IS3036A	36
BZX83C-15	15	IS3039A	39
BZX83C-16	16	IS3047A	47
BZX83C-18	18	IS3051A	51
BZX83C-20	20	IS3056A	56
BZX83C-22	22	IS3062A	62
BZX83C-24	24	IS3068A	68
BZX83C-27	27	IS3075A	75
BZX83C-30	30	IS3100A	100
BZX83C-33	33	IS3150A	150
BZX83C-47	47	IS3180A	180
		IS3200A	200

All .5W only **30c ea.**
All 1W only **65c ea.**

SPECIAL SAVINGS

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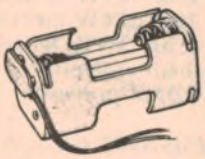
BH4 30c



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10 mfd 16 volt	11c	9c
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47 mfd 16 volt	15c	12c
100 mfd 16 volt	15c	12c
220 mfd 16 volt	20c	18c
470 mfd 16 volt	40c	35c
1000 mfd 16 volt	55c	50c
2.2 mfd 25 volt	12c	10c
4.7 mfd 25 volt	12c	10c
10 mfd 25 volt	12c	10c
22 mfd 25 volt	12c	10c
33 mfd 25 volt	15c	12c
47 mfd 25 volt	15c	12c
100 mfd 25 volt	16c	14c
220 mfd 25 volt	35c	30c
470 mfd 25 volt	35c	30c
1000 mfd 25 volt	55c	47c
1 mfd 50 volt	18c	13c
3.3 mfd 50 volt	18c	13c
4.7 mfd 50 volt	20c	18c
10 mfd 50 volt	20c	18c
22 mfd 50 volt	20c	18c
33 mfd 50 volt	20c	18c
47 mfd 50 volt	20c	18c

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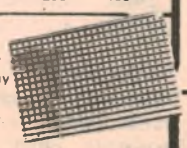

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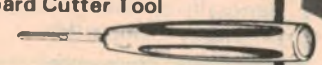

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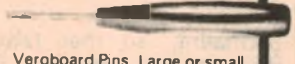

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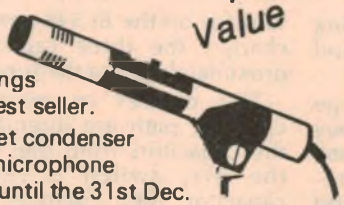

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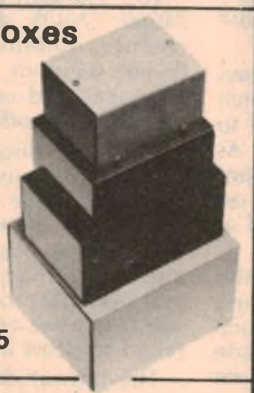

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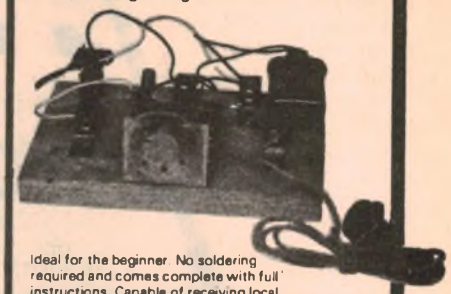

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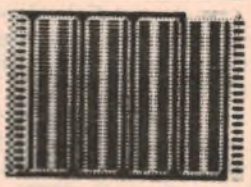

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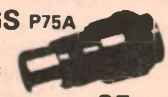

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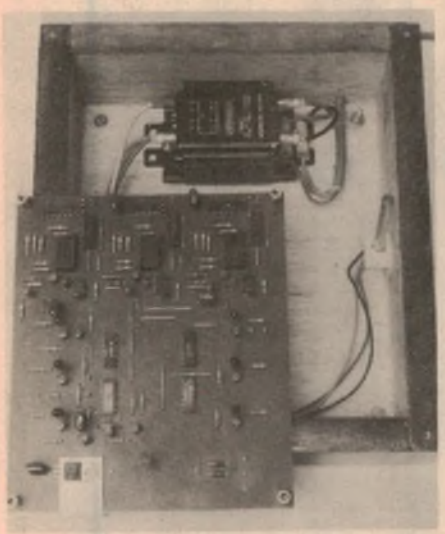
output of gate 1c changes too slowly. Suitable gates are coded CD4011BC (National), SCL4011AE (Solid State Scientific), HEF4011P (Philips) or CD4011BE (RCA).

The power supply consists simply of a three terminal regulator, a filter capacitor and two diodes, fed from one of the commonly available power transformers.

Construction of the unit should be quite easy, as all components except the power transformer mount on a single printed circuit board (PCB), coded 77pm12. Commence construction by fitting the links. There are 16 of these, none of which need to be insulated. Do not omit the links under the 74C90 devices.

Next fit PCB pins at points where external connections to the PCB are required. We recommend that PCB pins be used at the mounting holes for the 2500uF electrolytic capacitor, as this component must be mounted under the board, and this will reduce the possibility of strain on the copper tracks.

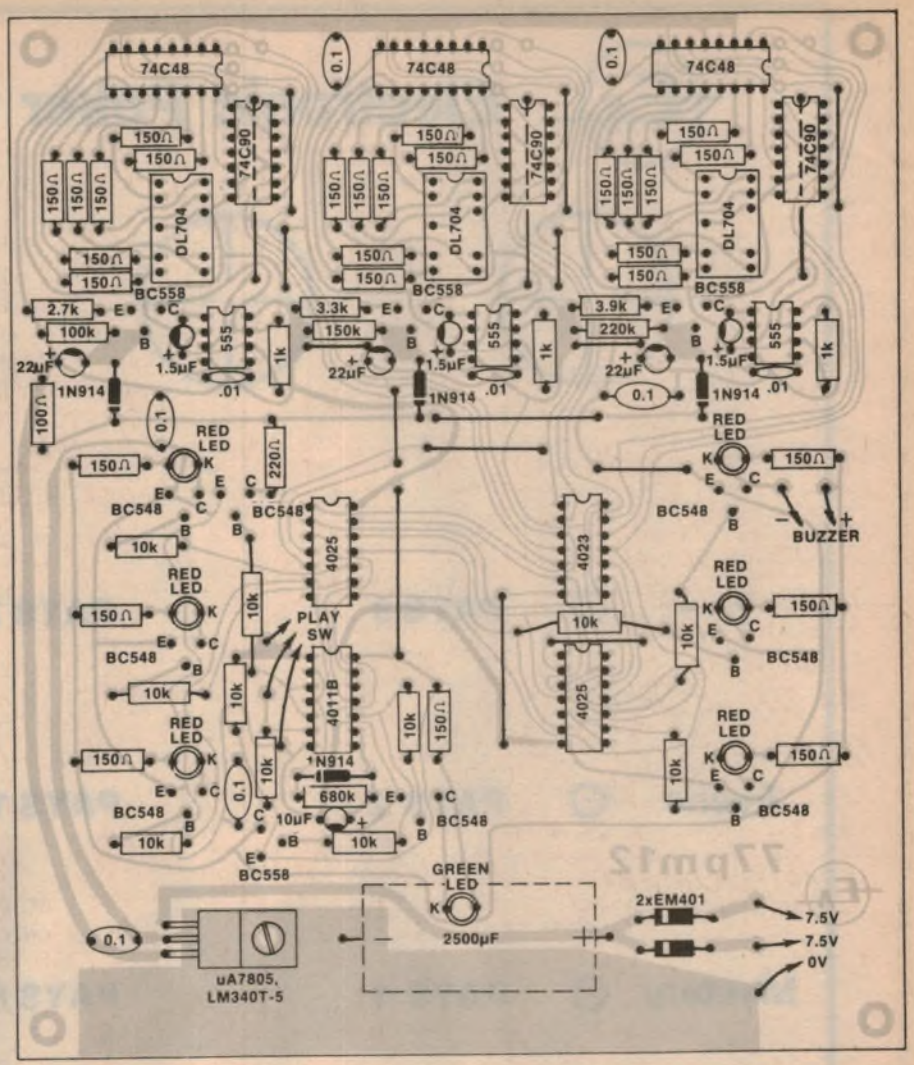
Then fit the passive components, keeping them as close to the board as possible, and observing any polarity requirements. The bipolar components



ABOVE: This photograph shows how the PCB and other components are arranged in the box. Note how the toggle on the play switch has been extended.

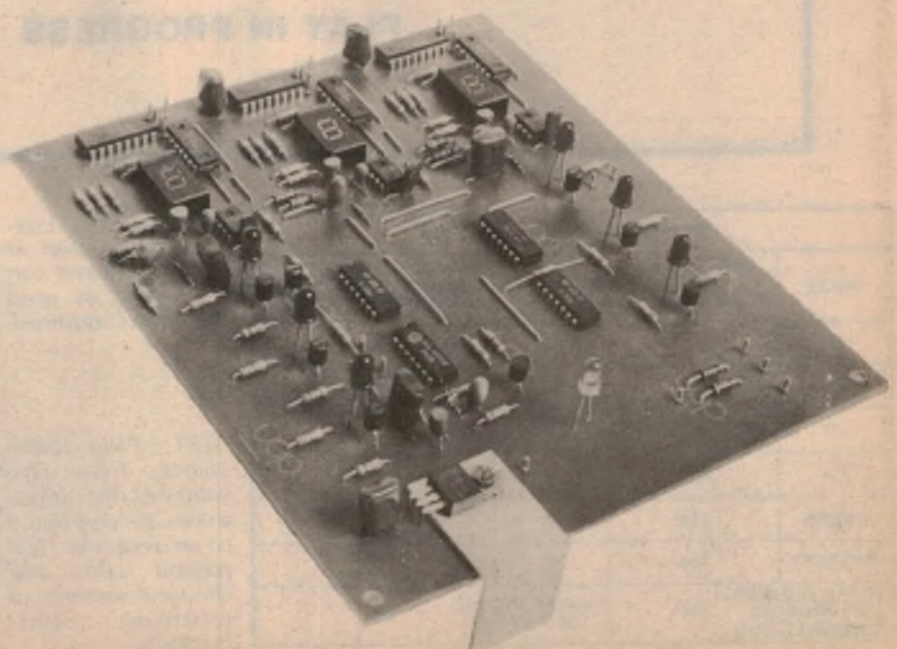
should be fitted next, but do not at this stage mount the LEDs. The three terminal regulator bolts directly to the board, with an L shaped piece of aluminium used as a heatsink. Mount the display ICs as far from the board as their lead lengths will allow, remembering to allow for the front panel clearance.

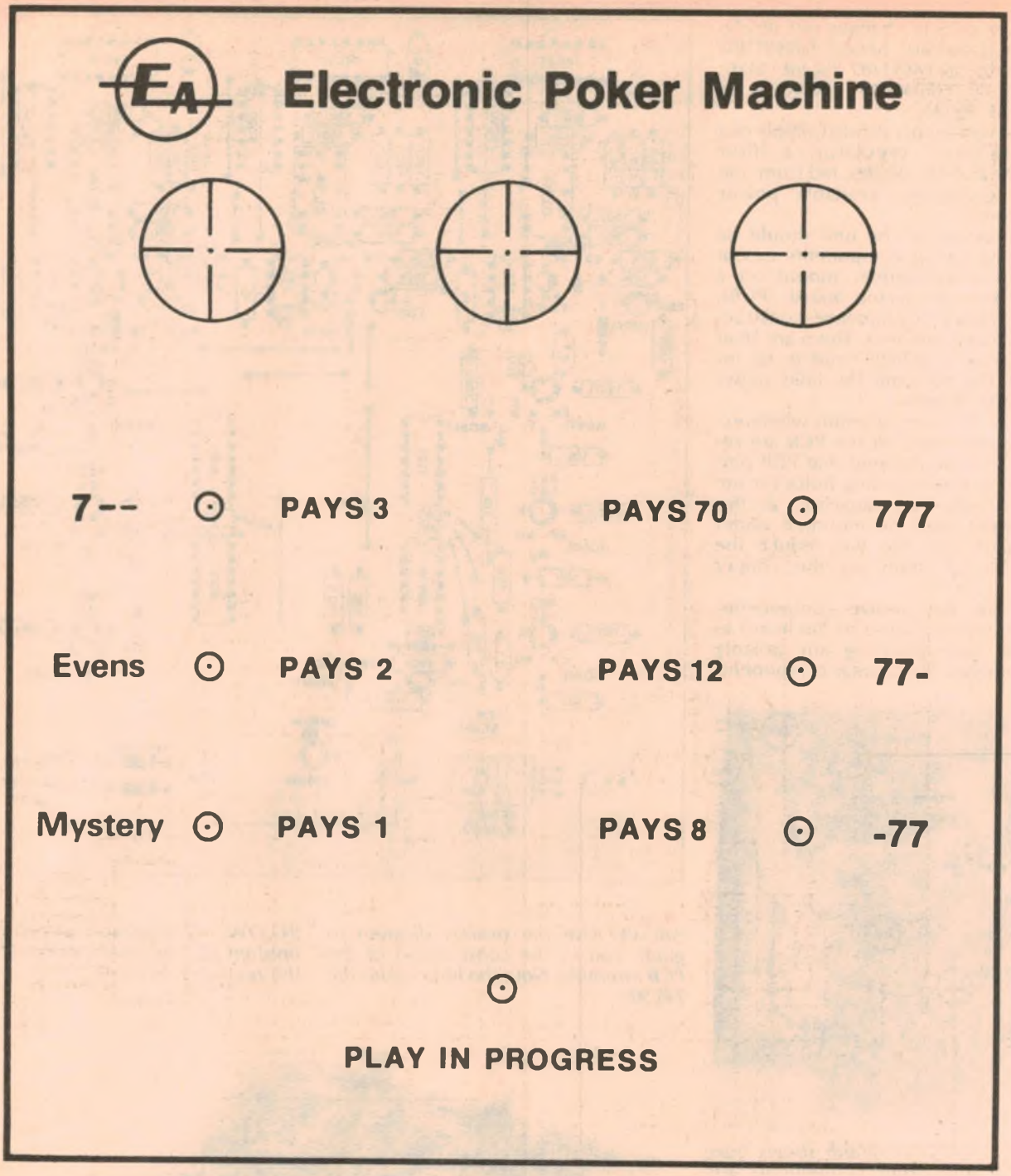
The next step is to insert and solder the CMOS ICs. Earth the barrel of your soldering iron to the earth track of the board, and insert and solder the ICs one at a time. Solder the two supply pins first. These are 5 and 10 for the 74C90s, 8 and 16 for the 74C48s, and 7



ABOVE: Use the overlay diagram to guide you in the construction of the PCB assembly. Note the links under the 74C90s.

BELOW: Photograph showing the finished PCB assembly, complete with the regulator heatsink.





PAYOUT CALCULATION TABLE			
PRIZE	NUMBER OF WINNING COMBINATIONS	VALUE OF PAYOUT	NUMBER OF WINNING COMBINATIONS x VALUE OF PAYOUT
777	1	70	70
77-	9	12	108
-77	9	8	72
7- -	90	3	270
EVENS	125	2	250
MYSTERY	180	1	180
TOTAL NUMBER OF WINNING COMBINATIONS	414	TOTAL VALUE OF PAYOUT	950

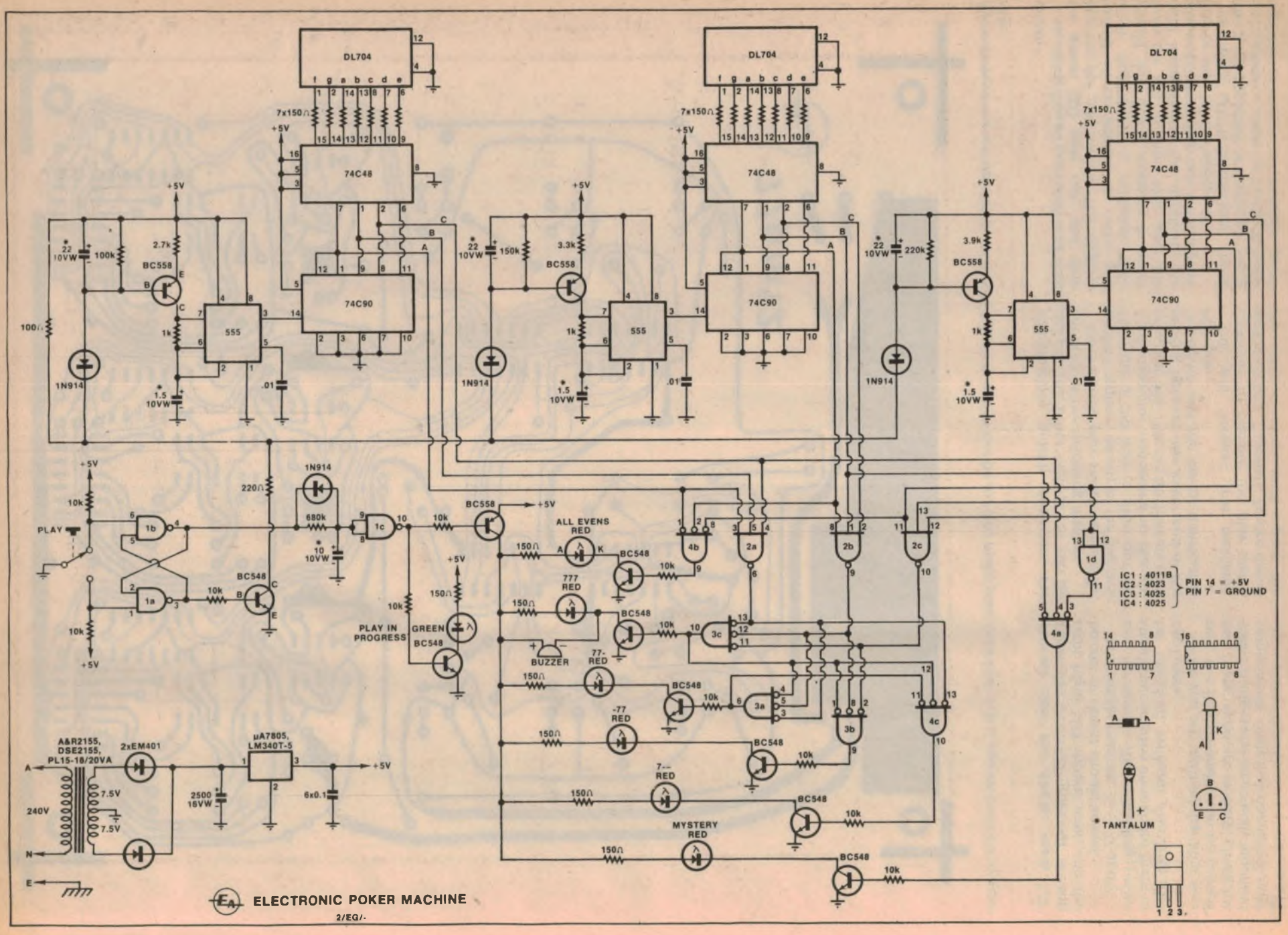
ABOVE: The full sized reproduction of the front panel can be copied or used directly as required.

LEFT: This table shows how the values of the various prizes are combined to arrive at the total payout value and the total number of winning combinations.

and 14 for the gates.

The only components remaining to be fitted should be the LEDs. Mount the front panel to the PCB using 13mm spacers, in the position that it will occupy when fitted to the case. Insert the LEDs in position, and solder them only when they are correctly mounted to the front panel, remembering to check their polarity.

Connect up the transformer and the play switch, and while monitoring the output voltage of the regulator, switch on. The voltage should rise to 5V, the green LED should emit, and the three displays should come on. If the displays cycle without stopping, switch off and recheck the connections to the play


DL704
74C48
74C90
555
BC558
BC548
1N914
+5V
PLAY
PLAY IN PROGRESS
ALL EVENS RED
777 RED
-77 RED
7-- RED
MYSTERY RED
GREEN
BUZZER
A&R2155, DSE2155, PL15-18/20VA
2xEM401
µA7805, LM340T-5
240V
7.5V
7.5V
2500 16VW
6x0.1
IC1 : 4011B
IC2 : 4023
IC3 : 4025
IC4 : 4025
PIN 14 = +5V
PIN 7 = GROUND
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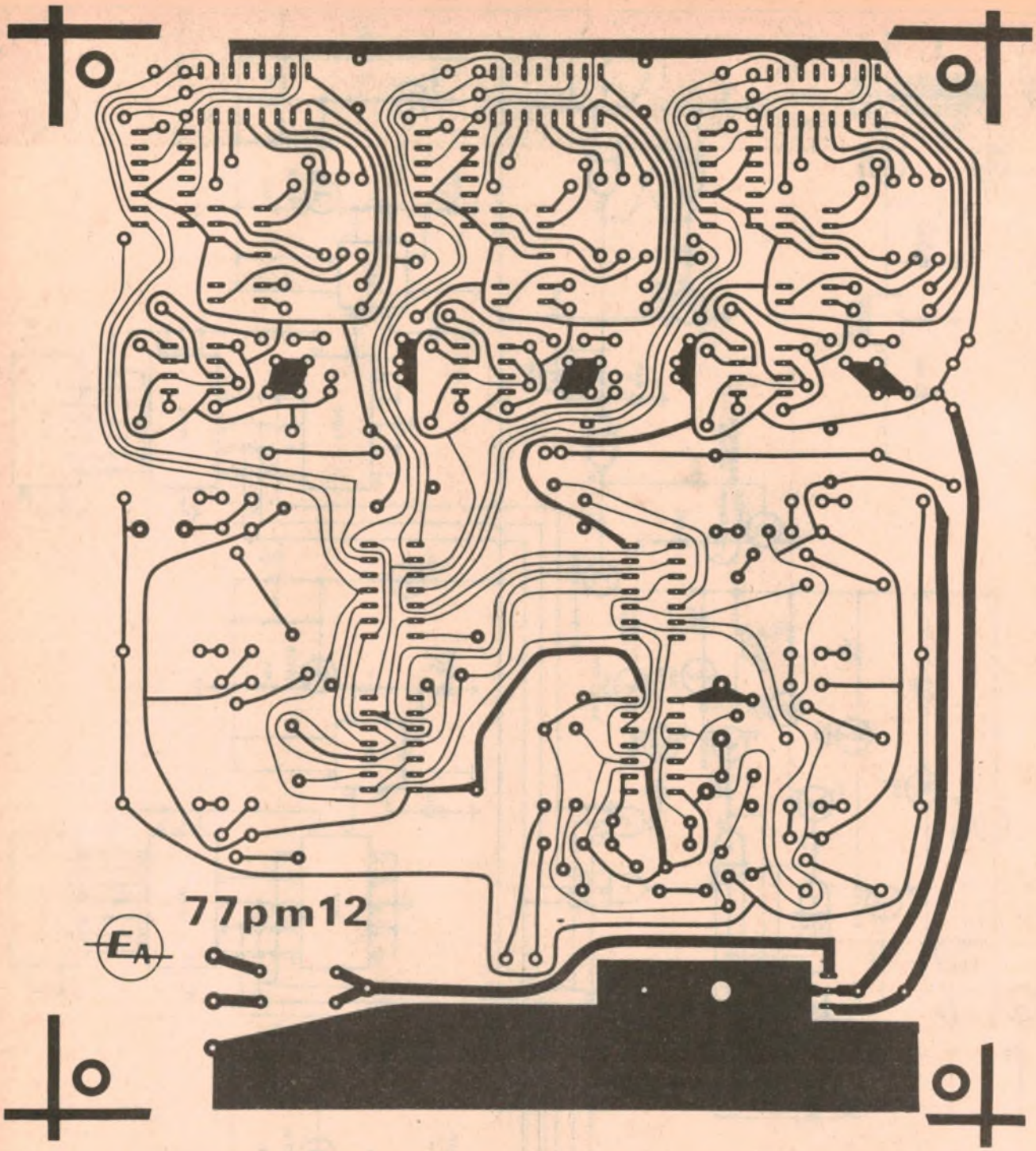

Shown above is a full sized copy of the PCB pattern which can be used to make your own board. It is shown from the copper side.

switch.

Assuming that all goes well, wait until the green LED goes out, and then depress the play switch. The displays should all commence to cycle, and when the switch is released, they should slow down, stopping in order from the left. A short time after the right hand display has stabilised, the green LED should go out, while a prize may or may not be displayed.

If a prize LED is illuminated, check that a valid number is displayed. Since the counters cannot be preset, it is impossible to check all possible prize combinations quickly. However, the jackpot and other high prizes can be checked in the following manner.

Operate the play switch repeatedly, until a 7 appears on any of the displays. Then use a clip lead to short out the 1.5uF capacitor connected to the appropriate 555. This can be done by connecting between the lower end of the 1k resistor and the lowest transformer PCB pin.

This will "freeze" that oscillator. Continue to operate the play switch until a second 7 appears. Freeze this in the same manner, and repeat the process until the display reads 777. When the green LED goes out, the top right hand LED should emit, and the buzzer (if fitted) should sound.

In a similar manner, 77-, -77 and 7- - can be tested. The remaining prizes should occur often enough for them to be checked without freezing the oscillators.

Once you are satisfied that all is correct, the final assembly can be carried out. If any faults are evident, check for solder bridges and incorrectly mounted components. Only if all else fails should you suspect the ICs.

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WF 5/6/77

Making your own printed circuit boards

Producing printed circuit boards for your own circuit designs or for projects described in this and other magazines can be very satisfying. This article shows that doing so is not as daunting as you may have thought.

by ROBERT FLYNN

There are a number of methods available to the constructor who wishes to make his own printed circuit boards (PCBs), and in this article three of them will be described. Method one entails drawing the required wiring pattern directly on the copper laminate using a suitable resist "ink" as the drawing medium, followed by the chemical etching of the board.

Method two again requires the pattern to be prepared directly on the copper laminate, but this time rub-on transfers are used as the resist medium. Etching of the board is the same as method 1.

Method three calls for the production of the board pattern (or artwork) on a transparent plastic film, coating of the board with a photo resist, exposure of the board to light through the transparency and subsequent development of the pattern on the board. The board is then ready for etching.

For fairly simple circuits method one is a cheap and quick way of producing a board. But for complex circuits or circuits that have to be produced on a board with high component density or many closely spaced conductors, it is very difficult to achieve sufficient accuracy to produce a satisfactory board. Because of this we will only deal briefly with the direct ink-resist method.

To produce a PCB using this method, the blank material should be cleaned on the copper side using a scouring pad, water, and some proprietary cleaning powder such as Bon Ami or Ajax. Once the copper is bright it should be dried with a paper towel and from then on handled on the copper side as little as possible.

Assuming that the layout of the circuit has been drawn on a piece of paper or is to be copied from a PCB layout reproduced in a magazine, the next step is to place the board copper side up on the workbench and cover this with a piece of carbon paper.

Next place the circuit layout diagram over the carbon paper and once you are certain that it is in position over the board, trace the pattern outlines using a hard pencil or a ball point pen. The centres for holes can be transferred to the copper using a small hammer and centre punch to make a light pop mark through the paper into the copper.

The paper layout and carbon paper can now be removed from the laminate and the outline on the copper can be filled in with resist. The type of resist most often used is bituminous paint. This paint is very thick and it is a good idea to stand it in a dish of hot water while using it, in order to make it flow more freely. Use an artist's paint brush or a sign writing pen to apply the paint, taking care not to run adjacent lines into each other. After the paint has been applied satisfactorily and it has been allowed to dry the board is ready for etching.

The Dalo printed circuit board pen referred to in the article.

An alternative to using paint as a resist for this method is a "Dalo" pen. This is a felt tipped pen with a resist solution as its ink. It can be used alone or in conjunction with bituminous paint to produce the board pattern.

The author has not tried method two, but the procedure is similar to method one except that instead of painting-in the traced image on the PCB blank, dry rub-on transfers are used for the resist. These transfers can be bought in various shapes such as termination pads, lines, corners, groups of pads etc. They are applied to the copper by placing the carrier film with the transfers on over the copper.

When the transfer is in the required position it is transferred to the copper by rubbing the carrier film with a smooth pointed instrument such as a ball point pen or knitting needle. Because the transfers are machine made, it should be possible to produce a more complex board using them than using the paint method.

Both methods described so far are very near "total loss" systems as far as board artwork is concerned, for, even though the paper pattern remains after the board is etched, the tedious business of re-tracing the pattern and painting-in the outline has to be repeated if any further copies of the board are required.

The photo-etch method of producing PCBs, using artwork prepared with stick-on pads and tapes on a transparent plastic film, enables anyone to produce boards of a high quality while retaining the artwork for repeated use. These pads and tapes are manufactured by Bishop Graphics Inc. of the USA and are available from Circuit Components Pty Ltd, P.O. Box 70, Bexley, 2207. This same company also supplies the photo resist and developer used in the system to be described.

The resist used (CCPR12) is a positive one, which means that when it is exposed to ultra-violet light through the artwork and then developed, the areas of the artwork that are clear will wash away in the developer while the areas that are opaque will remain on the copper as the board pattern resistant to the etchant.

The following materials are required to make photo-etched printed wiring boards:

Bishop stick on pads and tapes;

Model makers knife (X-Acto, etc)
Clear plastic film;
Printing frame (this may be improvised using a piece of glass and a piece of particle board clamped together with bulldog clips);
Twin twenty-watt fluorescent batten with 20W blue actinic tubes, such as Philips TLA20W, GE F20R12.BL, etc;
One or two plastic dishes;
CCPR12 Photo resist;
CCPD16 Developing powder;
Ferric chloride etchant;
Kitchen oven (gas or electric).

Starting with a circuit layout drawn on paper or taken from a magazine, the next step is to produce a transparency from this. Cover the diagram with a suitable size piece of plastic film and stick it to the drawing beneath with adhesive tape. Using a model-makers' knife, lift the pads from their backing paper and stick them down on the film at component termination points. After all the pads are positioned, make the necessary interconnections between them with suitable width tapes. Start by pressing the tape onto a pad and then pressing it along the required conductor path to the next pad. To cut the tape place the knife blade onto the tape, above the pad, and pull the surplus tape upwards against the blade. This will produce a neat cut without damaging the pad below.

When all of the pattern has been completed it should be checked to make sure all is correct and then turned over and rubbed firmly all over with a small roller, such as the squeegee type used by photographers. The transparency is now complete.

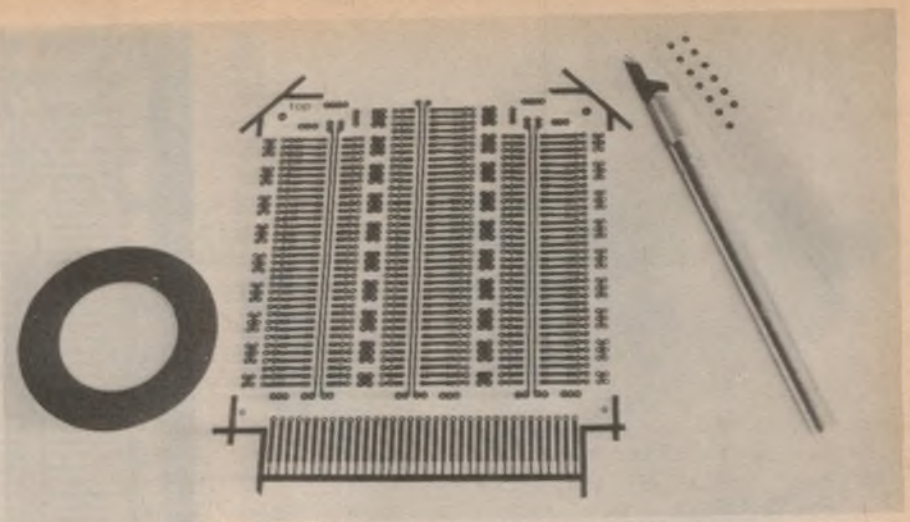
Before proceeding to preparation of the board material, now is a good time to mix the developer. The developer is sold in powder form and 30 grams is mixed with each litre of water. This mixture can be stored in a bottle until required.

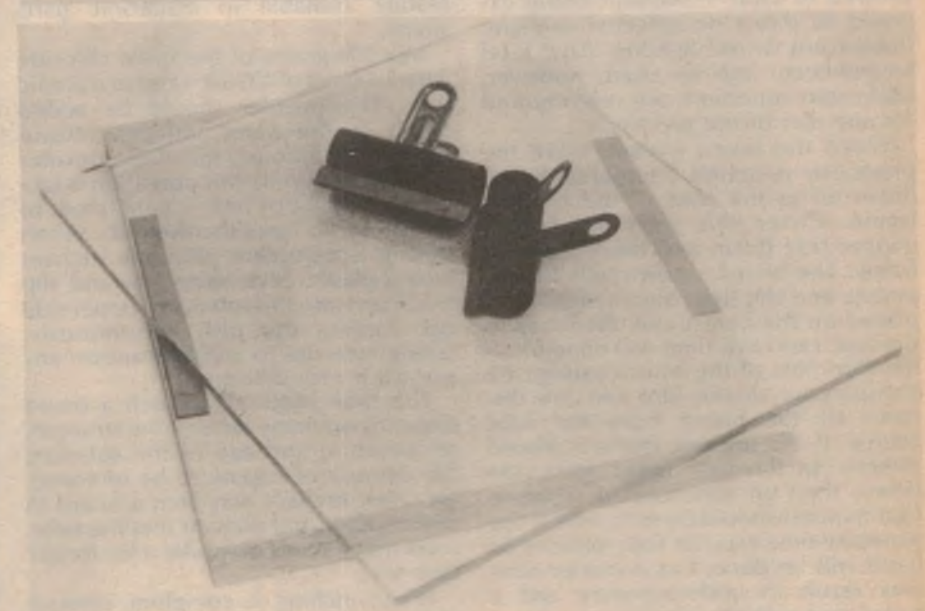
Cut a piece of blank PCB about 5mm larger all round than the pattern, and clean it as described earlier using a clean scouring pad, such as "Scotchbrite", and either "Ajax" or "Bon Ami" powder cleaner. The degree of cleanliness required is far higher than that for the painted-on pattern methods, and the board should be scrubbed until when rinsed clean and held under a running tap, the surface becomes completely wetted without the water contracting into streams across the copper.

When the board passes this test dry both sides with a paper towel, taking particular care that the copper surface is not touched with the fingers. Place it copper side up on the work bench and dust off with a CLEAN paint brush to remove any lint, dust, etc.

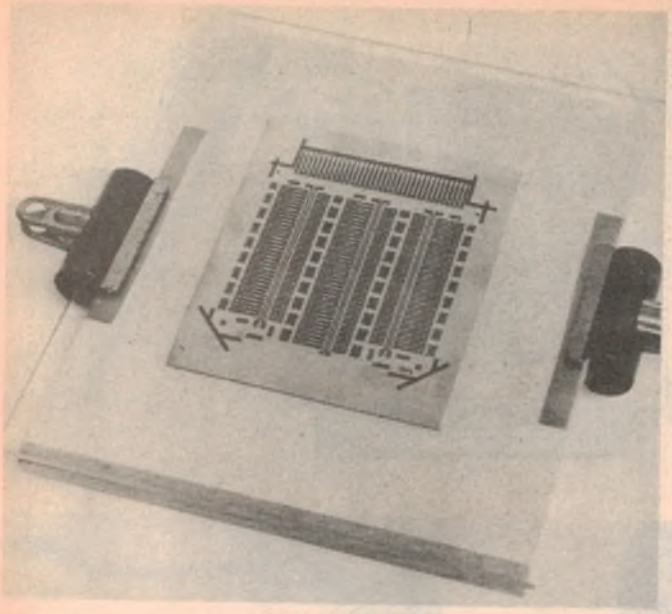
Before coating the cleaned board with resist, the oven should be preheated to 80°-90°C (176°-194°F) and turned off when this temperature is reached.

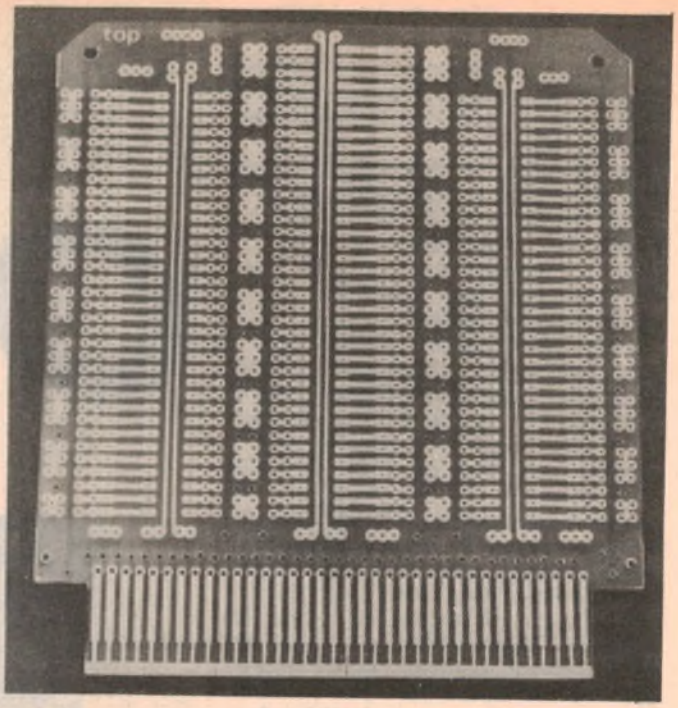
Returning to the cleaned piece of





The top picture shows a completed piece of artwork and some of the materials used to produce it. Centre, the photo-resist being spread over the copper laminate. Bottom, the materials required to improvise a printing frame.





Above, printing frame assembled with board and transparency, ready for exposure. Right, the etched board, stripped of resist and partially drilled.

board, pour a small pool of the resist onto the centre of the copper and spread it smoothly over the board with a CLEAN 12mm paint brush. If the resist looks streaky when wet, don't worry as this usually evens out during the drying process. The paint brush used should be later cleaned with methylated spirits and then soap and water, and kept for future use in board making only.

Place the board resist side up on an asbestos mat or biscuit tray and put it into the upperhalf of the preheated oven for about 15 or 20 minutes. The resist should now be dry and the board should be removed from the oven and allowed to cool — without being exposed to direct or reflected sunlight, fluorescent or red lighting. (Low level incandescent can be used, however. Darkroom conditions are not required for any part of the process.)

When the board is cool, place the previously prepared transparency face down on to the glass of the printing frame. Cover this with the board, copper side down and then close the frame. The board is now ready for exposure and the light batten should be placed on the bench with the tubes to the top. Exposure time will depend on the thickness of the resist coating, the transparency of the film and the distance of the board from the light source. If the printing frame is placed directly on the light tubes, glass side down, then an exposure of three to four minutes should be sufficient. If the exposure time exceeds four minutes no harm will be done, but a shorter time may result in underexposure and a board that will not develop.

The pre-mixed developer should now be poured into a plastic or glass developing tray and the board removed from the printing frame and put into the developer copper side up. The liquid should be agitated gently by tilting the tray from side to side and after about half a minute the board pattern should begin to appear. Within about two minutes all the exposed area of the resist should be dissolved and the board should be removed from the developer. Rinse it well under the tap and dry with a soft cloth. After this the board should be put aside in free air to stabilise for about half an hour.

The etchant can now be mixed and, though there are many to choose from, anhydrous ferric chloride is about the safest to use as well as being the most readily available in electronic parts stores.

Mix 500 grams of the ferric chloride with 1.5 litres of COLD water in a plastic dish. The powder should be added slowly to the water and the mixture stirred continuously till all the powder is dissolved. While this operation is taking place a lot of heat is generated, so be careful in handling the dish. When mixing is complete pour the etchant into a plastic developing tray and slip the board into the solution, copper side up. Agitate the dish continuously, taking care not to spill etchant on any surface it may damage.

The time required to etch a board depends on many factors: the strength, temperature and age of the solution, the amount of copper to be removed, etc. New etchant may etch a board in five minutes, but etchant that has been used many times may take a lot longer than this.

When etching is complete, remove the board from the etchant and wash well in water. Apart from drilling the necessary holes the board is finished. Although the resist is not a flux, it can be left on the board as a protective finish through which it is possible to solder. As an alternative, the resist can be removed from the board with methylated spirits and a coat of flux made up from 15 grams of powdered resin dissolved in 115 millilitres of methylated spirits applied to the full surface of the copper side of the board.

The above etchant and etching procedure is also used for making boards by methods one and two. Both bituminous paint and the resist from "Dalo" pens can be removed with kerosene or mineral turpentine. The PCB transfers can be removed with household powder cleaner. After cleaning a coating of the flux previously described should be given to the boards.

Remember that the chemicals used in the board making methods described in this article are injurious if swallowed. Decant them into clearly marked bottles after use and store them out of the reach of children. Clean up any spillage of solutions immediately. Cleanliness not only aids safety, but also helps achieve good results in board making.

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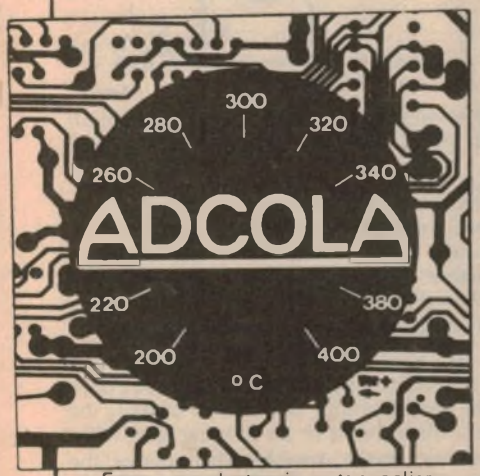

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Low-cost Battery Condition Indicator

by B. J. SIMPSON*

Monitoring the condition of dry batteries in battery-operated equipment can be inconvenient if no meter is fitted, as in the case of compact or inexpensive devices. This article describes a simple, low-cost battery indicator which is small enough to fit to most appliances and which gives a clear "good/bad" indication.

A problem with battery-operated apparatus is that the performance tends to fall off as the supply drops below the nominal battery voltage, with an increase of the battery impedance. Thus, it is necessary to check the battery voltage regularly to ensure good performance, and this check should be done on load.

Therefore a need often arises for a cheap built-in battery checker, suitable for retrofitting to existing apparatus. These two requirements usually rule out a meter.

Furthermore, if the load imposed on the battery varies with operating conditions, it is desirable that the battery checker impose a predetermined, fixed load, selected as being representative.

A precise measurement of battery voltage is unnecessary if one can ensure that the voltage, under test, lies between the nominal voltage and a predetermined lower voltage at which performance starts to deteriorate. In other words, one can use a simple good/bad indicator.

The circuit of the battery checker is given in Fig. 1(a). It contains two transistors which form a bistable switch, which triggers into one of its two states in response to an input voltage applied between the slider of R2 and negative rail. When the input voltage is high enough to produce slightly greater than unity gain in the Q1, Q2, R5, R6 loop, the switch snaps on and current flows through the light-emitting diode D1 and the series resistor R4.

When the input voltage falls below the threshold voltage, the switch snaps back to the off condition.

In all trigger circuits of this kind, the circuit triggers off at a slightly lower voltage than that at which it triggers on. This will vary with the nominal battery voltage employed but, in this application, it is only the on-threshold that is of interest.

The important thing about this circuit is that the on-threshold voltage is remarkably constant over a wide range of battery voltages. It varies typically only from 0.94 volt with a 3V battery supply to 0.955 volt at 18 volts.

The fact that the on-threshold voltage for this circuit is constant over a range of a few volts renders the circuit very suitable for use in a good/bad indicator. In practice R2 is so adjusted that the off-threshold condition is just realised at a predetermined battery voltage selected as the lowest at which the apparatus will operate satisfactorily.

The LED will then light when the circuit is connected, via the push button, to a supply having a higher voltage than the predetermined minimum. When the LED does not light the battery needs to be replaced. A green LED is therefore a good choice.

The minimum battery voltage at which this circuit will operate is set by the sum of the voltages across the LED, Q2 and R6, with the circuit in the on condition. This amounts to about 3 volts, which means that the circuit is limited to nominal battery voltages of 4.5 and above.

Resistor R4 determines the current through the LED, and also the load on the battery whilst being tested. In the original design, a load of 20mA was selected; a value which provides good LED illumination and a reasonable battery load for many applications.

The value of R4 is selected for the specific application, depending on the nominal voltage of the battery to be tested. The value of R4 can be calculated from the expression R4 = (E-3)52 ohms, where E is the nominal battery voltage. The result may be rounded off to the nearest preferred value.

It seems unlikely that a battery load lower than 20mA would be required, and below 10mA the illumination of the LED becomes rather poor. It is more likely that a higher load current may be required and it is possible to connect a further load resistor in parallel with the LED/R4 combination to draw extra current. The maximum recommended current for the transistors used is 100mA, and then only for a brief test.

The value of the extra load resistor is easily found by experiment, however, an approximate value is given by (E-0.75)/A, where E is again the nominal battery voltage, and A is the additional current (over the 20mA) in amperes.

The values of R1 and R2 in the circuit are suitable for batteries up to 18 volts or so, and therefore cover most applications. They draw a negligible current of 0.4mA at 18 volts and less at lower voltages.

Resistor R1 could be omitted if desired, and R2 made, say, 10K ohms, but this would reduce the sensitivity of setting R2 for the minimum acceptable battery voltage. Conversely, juggling the values of R1, R2 and possibly adding a further fixed resistor between R2 and ground could provide greater sensitivity of adjustment for a specific application.

To install this circuit, only the LED and a miniature push button are required on the panel; items which can usually be accommodated in an existing unit without too much trouble. The rest of the checker circuit can be located as convenient.

To set-up it is necessary to decide the minimum acceptable battery voltage. For most dry cells, this is often taken as 1.25 volts per cell. This is a margin of a little over 15%, but specific cases may suggest

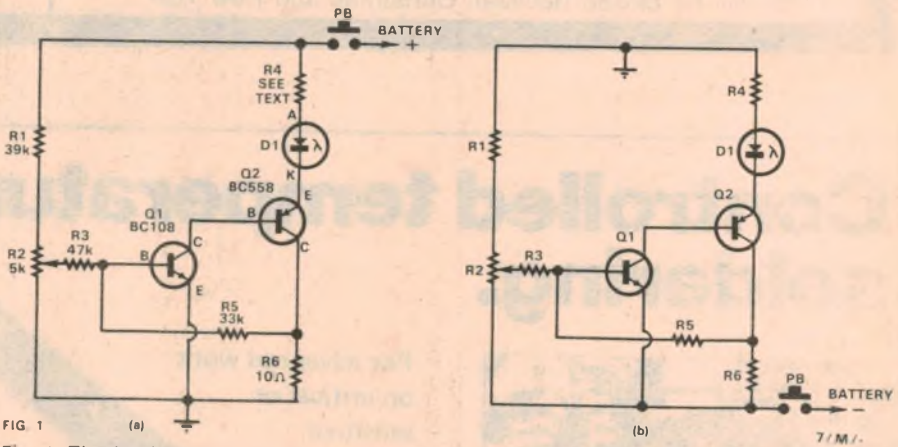


Fig. 1. The basic circuit (a) is quite simple and is intended for a positive active circuit. The negative active arrangement is shown at (b). It can also be used where both sides of the circuit are active, see text.

*6 Eden Avenue, Turramurra, NSW 2074

a closer or a wider margin.

Apply to the checker circuit a voltage at the minimum value which has been selected. This is conveniently done by using an external variable supply; positive to the junction of R1 and R4, negative to ground. Then adjust R2 so that the LED just comes on. Check the on voltage (not the off voltage) by varying the variable supply voltage, readjusting R2 until, with a rising voltage, the LED comes on at the selected minimum.

The physical assembly of such a simple circuit hardly needs comment. Nothing is critical. For those who may wish to use a printed board layout, Fig. 2 gives a pattern and component layout. An alternative circuit for negative active systems is shown in Fig. 1 (b).

Where two batteries are used to give positive and negative voltages about ground, Fig. 1 (a) can be used to check both batteries in series. Connect the push button to the positive active pole and the R2, R6 junction to the negative active pole.

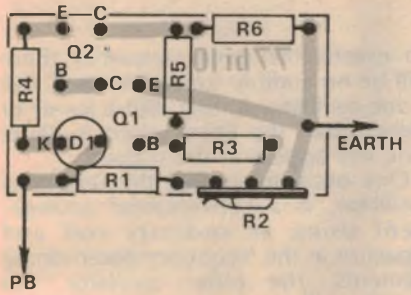


Fig. 2. While simple enough to construct without a printed board, a suitable pattern may be useful where the indicator is to be included in a new board design. The pattern is shown from the component side, full size.

Readers may envisage other applications for this circuit. For example, it will provide a simple monitor of an automotive system during operation. The monitoring can be permanent if the push button is omitted, the low current drain permitting this. In this application it would be necessary to remember the effect of the switching hysteresis, and it may be necessary to set up the circuit for the off-threshold instead of the on-threshold.

There is also the possibility of providing a universal battery checker, which could cater for batteries with voltages ranging from 4.5V to 30V or so. Provision could be made for two or more values of load current to be drawn from the battery under test.

The cost of components for this circuit at present retail prices works out at less than $2.00; nearer $1.50 if the transistors are bought at bargain prices. The transistors are not critical, and almost any equivalent or near-equivalent types will work well. The cost and convenience of this circuit compares favourably with any alternative that is available, and is certainly cheaper and easier to install than a meter.

Metal locators are fun—try one!

One electronic device to capture the imagination in recent years is the metal detector or, as it is sometimes called, treasure detector. While we have not heard of anyone finding any vast quantities of treasure with these devices, they do have their serious uses and learning how they work can be an interesting exercise.

by WALTER NEVILLE

Metal detectors in one form or another have been around for many years — since well before World War II in fact. Their main role initially was a military one — to detect mines in the path of advancing troops. We have all seen pictures of an army sapper wearing a pair of headphones and holding a search coil ahead of him on a long handle. Hopefully, his metal detector will find the mine before the mine finds him!

More peaceful uses for metal detectors are to locate buried water pipes, electric cables in walls, nails in timber which is to be sawn and, at a more imaginative level, to find coins, jewellery, watches etc buried in the sand on the beach.

Unfortunately, these devices are often portrayed in somewhat exaggerated style, implying that they can detect quite small pieces of metal at great depths. In fact, the sensitivity of most of them is quite limited, usually to a few inches unless a very large mass of metal is involved. And even if it's as large as a pirate's treasure chest (or a filing cabinet) it is unlikely that a typical metal detector will find it if it's more than a couple of feet under the surface.

In short, any pirate treasure that is buried more than a few feet below the surface is pretty safe as far as metal detectors are concerned. If your pirate treasure map tells you to walk 40 paces east, 30 paces west, then dig, we are afraid the only way to confirm the authenticity of the map is to do just that — dig!

But, pirate treasure jokes aside, what of the other suggested uses? Just how good are these devices at locating such objects? Not as good as we would like, might be a fair answer, but the performance of one of the units we are about to describe would seem to be fairly typical. It will detect an Australian 20c coin at about 125mm (5in) in air, on the basis of a minimum discernible indication after a little practice.

Any performance below this is hardly worth serious consideration. Anything above it would be most welcome, but may be difficult to achieve within the normal constraints of reasonable size and cost.

How do these devices work?

There are at least two broad approaches to metal detection. What appears to be the original concept, developed as the army mine detector, is the beat frequency system. This is the system used in the units we are about to describe.

It uses two RF oscillators, both designed to operate at the same nominal frequency, usually somewhere between 100kHz and 300kHz. The output of the two oscillators is fed to a common detector, followed by an audio amplifier driving an earphone or speaker.

The system is designed to detect the difference in frequency between the two oscillators, which appears as an audio tone equal to the difference frequency. Thus, if both oscillators are on exactly the same frequency there will be no audible tone generated. But if one oscillator is, say, 200Hz lower or higher than the other, then a 200Hz tone will appear at the output.

One oscillator, called the reference oscillator, is a conventional arrangement using an ordinary coil and capacitor as the frequency determining elements. The other oscillator, the search oscillator, uses a similar or identical circuit, but with a different form of coil.

This is the search coil. It is relatively large — 10 to 15cm across — and consists of only a few turns. It is normally mounted on the end of a long handle to enable it to be moved over the surface of the ground.

In the presence of metal this coil will change its inductance (not its "conductance" as stated in one explanation) and this will change the oscillator frequency.

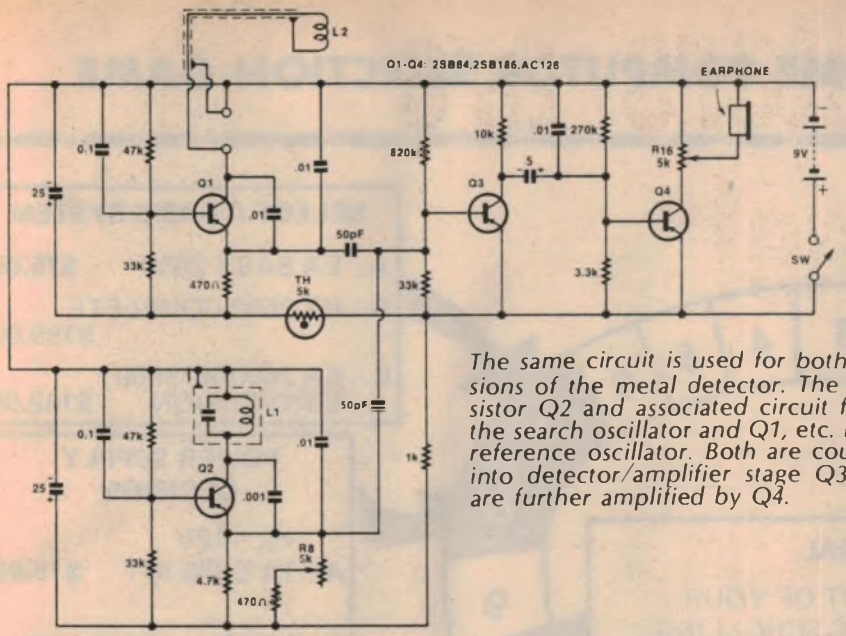
Suppose that the search oscillator was running 200Hz higher in frequency than the reference oscillator, producing a 200Hz tone in the earphone. If we now bring the search coil close to a mass of metal this will (normally) reduce the inductance and cause the search oscillator to increase in frequency to, say, 250Hz higher than the reference oscillator. Thus the audio tone will shift from 200Hz to 250Hz.

This is what the operator looks for when searching; a change of note, no matter how slight, as he moves the search coil back and forth. With practice, quite small changes are readily discernible, particularly if the coil is moved rapidly over a suspect area.

The other main system uses two coils in the search head, mounted at right angles to each other. The electronics consist of a high gain audio amplifier, feeding an earphone or speaker, and with the input connected to one coil

SENSITIVITY TABLE

	28-134	28-181
Copper water pipe (½in)	90mm	180mm
Side cutters	50mm	100mm
Razor blade	65mm	90mm
Aust. 5c coin	50mm	90mm
Aust. 2c coin	65mm	100mm
Aust. 20c coin	75mm	125mm
370ml drink can (aluminium)	125mm	225mm
Scissors	75mm	110mm
Filing cabinet	375mm	600mm
Man's watch with metal band	50mm	100mm



The same circuit is used for both versions of the metal detector. The transistor Q2 and associated circuit forms the search oscillator and Q1, etc. is the reference oscillator. Both are coupled into detector/amplifier stage Q3 and are further amplified by Q4.

and the output to the other.

With the two coils at right angles there is minimum coupling between them, thus preventing the amplifier from going into oscillation. In operation the gain would be advanced until the amplifier was on the verge of oscillation.

If, in these circumstances, the search head is brought near a mass of metal, the critical minimum coupling between the coils is upset and the amplifier, already on the verge of oscillation, spills over and gives out an audible note.

(Editorial note: A metal detector employing this principle was described in E.A. for January 1970. File No. 3/MS/20.)

So much for some of the background to metal detectors. Is it practical for the home constructor, even a beginner, to construct one?

The answer is yes, particularly as there are now a couple of kits on the market which not only use proven circuitry, but eliminate the hassles normally associated with getting together all the bits and pieces. In particular, a kit of this kind can solve many of the hardware problems which might otherwise be beyond the mechanical resources of the home constructor.

But just because we have written this story around these kits, it does not mean that this is the only way they can be built. Virtually all the electronic components are routine devices which should be available from almost any parts supplier. We will have more to say about some of these later on. As far as the mechanical side is concerned, the individual reader can make up his own mind as to what he can construct himself and how elaborate he can make it. There is even scope for experiment in improving the original performance.

Both kits are Science Fair products, distributed through the Tandy stores. One is the Science Fair kit No. 28-134 and the other is kit No. 28-181. Both use the same circuit, and similar components, but there is considerable difference in the finished product.

The 28-134 kit is the cheaper of the two ($9.95) and should not really be considered as anything more than an instructional device to demonstrate, in a practical way, how this kind of metal detector works.

A study of the accompanying circuit will help explain how the theory discussed earlier is put into practice. The transistor Q2, along with the coil in its collector circuit and associated components, forms the reference oscillator. The output of this oscillator is fed via a 50pF capacitor to the base of Q3, which functions as a detector and amplifier.

Transistor Q1, with the search coil in its collector circuit and a similar circuit configuration, forms the search oscillator. Output from it is also fed to the base of Q3 via a 50pF capacitor, where it is mixed with the output from the reference oscillator. Output from Q3 is the audible difference frequency which is fed to Q4 for further amplification and then to the earphone via a volume control.

The simpler version of the detector, built on a plastic chassis. Note how the search coil is wound on the clear plastic portion of the original box. Sticky tape holds the coil in place and the two halves of the box together.

The 28-134 kit is packed in a small plastic box, the bottom of which, when inverted, becomes the chassis on which the device is built. The box is perforated and each row of vertical holes is identified by letters, and each horizontal row by numbers. This enables the instruction sheet to identify any group of holes in which a particular component is to be mounted.

In most of these kits only the bottom of the box is used but, in this case, the top is also used. Note how these two fit together before the package is opened, so that they can be fitted back together. The top of the box (clear plastic) is used as a former for the search coil, making a single compact unit.

Since the kit comes complete with a comprehensive set of building instructions, there is little point in duplicating these in this article. We will content ourselves with commenting on one or two points which we feel can be emphasised or enlarged upon with advantage.

The first thing to do with a kit of this kind is to check off the components against the list in the instruction folder. Quite apart from the obvious reason for doing this, it provides an opportunity for the beginner to acquaint himself with, and identify, components with which he may not be familiar. Resistors, in particular, need to be identified by their colour code (supplied) and the experience gained from this exercise will prove invaluable.

Other components, capacitors, transistors, diodes etc are also portrayed pictorially as an aid to their recognition and lead identification. One of these which is not quite up to date is that for the electrolytic capacitor. The current trend is to identify the negative lead with a black band running the length of the capacitor body, sometimes accompanied by a negative sign (—) in a small circle.

Other capacitor markings can also be confusing. For example, the figures "104" on a plastic capacitor can easily throw the beginner who is looking for the 0.1uF quoted in the parts list. In fact, they mean the same thing. The

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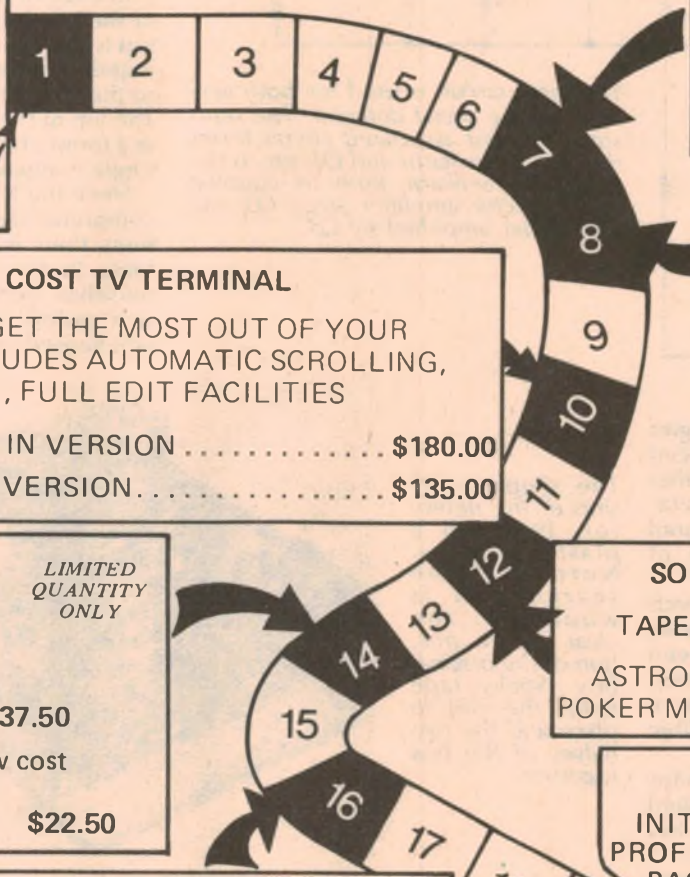

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combination "10 4" stands for 10 followed by four zeros, or 100,000 (pF). And 100,000pF equals 0.1uF.

A small magnifying glass is a handy addition to your tool kit, since many modern components are so small that the information printed on them is almost impossible to read unaided. It will also help to identify some of the more subtle colours used to code small resistors.

There were some changes in our kit (transistor type numbers was one) but all were covered by appropriate notes. Check these before pressing the panic button in the event that there appears to be an error. If there really is a mistake, take the kit back to your nearest Tandy store and explain what is wrong.

Assembly is best performed by simply following the step-by-step instructions, ticking off each step as it is completed. This approach may prove frustrating to those who can read a circuit and we admit that, half way through the exercise, we had doubts that the thing would ever work. But it did — immediately it was switched on. We imagine you will be similarly successful.

In a simple project of this kind there is not much incentive to make a neat job of the underside wiring, particularly as one may wish to ultimately salvage the components for other experiments. For this reason we trimmed the leads by only minimal amounts, leaving most of the components sitting well above the chassis. In a few cases, however, the full length of the pigtail is needed to reach the appropriate junction point.

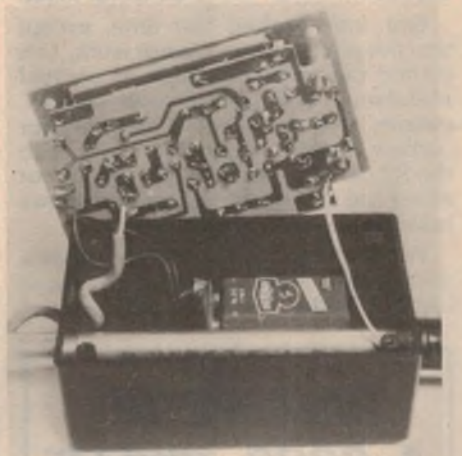
One part of the job which is a little tricky is soldering to the coil pins. These are barely long enough to come through the plastic, and some damage to the plastic around this area is almost inevitable. Also, the pins are quite close together and some care may be needed to prevent bridging them with solder.

Winding the coil calls for a little care, although ours turned out very neatly. The first thing to do is to unwind the hank of wire supplied, and wind it onto some kind of holder. (We used the cardboard box in which the kit was packed.) It is almost inevitable that it will tangle while being unwound, and the middle of a coil-winding operation is no time to untangle six or seven metres of fine wire! Wound onto a holder it will be much easier to use.

The coil is wound on the lid of the box and, for obvious reasons, should be as close to the top of this as possible. On the other hand, the box is slightly tapered, creating a tendency for the winding to slip off. Plenty of sticky tape is the answer, particularly for the first turn. Once that is held firmly in place it will support the remaining turns. (Secure the tape dispenser so that lengths of tape may be withdrawn with one hand.)

To secure each end of the coil we pulled an old trick from the days of home wound radio coils. Where the winding is to start drill two small holes (1/16in or smaller) about 5mm apart, parallel with the top of the box. Drill two similar holes where the coil is to finish, allowing that the coil will be about 4mm wide. (Leave, say, 6mm.)

The beginning of the coil is anchored by passing the wire back and forth through the two holes several times, leaving enough free wire for ultimate



The 28-181 kit, showing how the board is mounted on the front panel. Note how the battery is wedged in the case.

connection to the chassis. Wind on 13 turns which, in our case, left insufficient for another turn, but plenty for connection to the chassis. Again, secure the wire by passing it back and forth through the two holes. Finally, tape the winding in several places to protect it.

The ends of the coil should be trimmed, cleaned, and soldered into the circuit. The two halves of the box are then mated and secured with sticky tape. The battery is a miniature 9V type, such as the 216, or similar. Current drain is modest, between about 4mA and 10mA, depending on the level of note being generated.

The circuit is set up by setting the pitch control (R8) to its mid position and the volume control (R16) fully clockwise. Adjust the slug in the coil of the reference oscillator until a whistle is heard in the earphone. It should be possible to adjust this for decreasing frequency down to zero (zero beat), then increasing frequency as the slug is turned further in the same direction. Leave it set for zero beat.

In use, R8 is adjusted to give the lowest audible frequency and on that side of zero beat where the presence of metal causes an increase in frequency. Under these conditions the ear is most sensitive to small changes in frequency.

As we said earlier, the 28-181 kit is designed around the same circuit, but is a much more serious approach as regards hardware and the final form of the instrument. The price of this kit is $26.95.

A good idea of its general appearance can be obtained from the accompanying photographs. The electronic circuitry, battery, controls etc are housed in a small plastic box mounted on a telescopic shaft, and fitted with a convenient handle. The search coil is mounted on the other end of the shaft, connected by a coiled cable. The angle of the search coil can be adjusted relative to the shaft.

The circuit is built on a printed board, which makes wiring a good deal easier, and this board is secured to a metal panel which mounts in the plastic box. An attractive decal is supplied which, attached to the front panel, identifies the controls and gives a professional appearance.

The search coil is ready-made and equipped with an electrostatic shield on the underside. This latter feature appears to be very effective.

As with the simpler kit, it is supplied with extensive constructional details, such that almost anyone should be able to construct the device and have it work first time. And, as before, we will confine our remarks to those points which may stand elaboration.

The printed board, as supplied, needed a little trimming in the corner cut-outs before it would fit easily between the panel support pillars. This needs only a few moments' work with a small file.

The search coil supplied with the 28-181 kit. It is fitted with an electrostatic shield on the underside.

The larger section of the telescopic shaft passes right through the box and extends out the other side by sufficient (about 90mm) to support the plastic handle. In our case the holes in the box needed to be enlarged slightly to admit the shaft but, as it is intended to be a push fit, do not be heavy handed.

The black plastic handle proved to be quite a tight fit on the shaft and we finished up hammering it on with a piece of wood. Make sure that the thread on the other end of the shaft is protected by the ferrule before doing this. Note that the end of the box with the larger hole (to take the coiled cable) goes towards the search coil. This cable hole also needed enlarging slightly in our case.

The decal is a self adhesive type, and a little care is needed to line up the holes in it with those in panel. However, it appears strong enough to stand pulling off and repositioning if necessary.

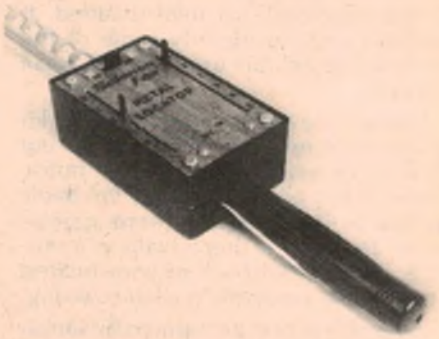
The other main points to watch are careful identification of component values, particularly the resistors, the polarity of electrolytic capacitors, and the identification of the transistor leads.

Our unit worked first time, except that the pitch control did not work. This turned out to be our fault, as we had mistaken a 4700 ohm resistor (yellow, purple, red) for the 470 ohm resistor (yellow, purple, brown) in series with the R8 moving arm. The mix-up did not effect the rest of the circuit, but shows how careful one needs to be.

Watch the height of the components above the board, particularly those located under the slide pots, but all must clear the front panel. Regarding the slide pots we suggest that surplus lead be cut off, rather than bent over, where it comes through the board. Once bent and soldered it would be almost impossible to remove a pot without wrecking the board.

How do the performances of these two units compare? Rather interestingly, the more elaborate model is significantly more sensitive than the cheaper version, in spite of the fact that they both employ the same circuit. We can only conclude that the difference is due to design of the search coil in each case. Suffice it to say that the 28-181 model will detect some objects at up to twice the distance possible with the simpler version.

For those who feel competent to work from the circuit and who are prepared to do their own collecting of bits and pieces there should not be too many problems. Alternative transistor type numbers are given on the circuit and most of the other components are quite straightforward.



The 28-181 kit fully assembled. The decal on the front panel gives a professional finish.

About the only ones requiring special mention are the reference oscillator coil and the search coil. The reference oscillator coil is a 455kHz IF transformer, with the secondary widing and any primary tap ignored, but with the internal capacitor retained.

To make a search coil we suggest starting with the design used in the 28-134 kit. This used 13 turns of enamelled wire, approximately 0.28mm, 29B&S, or 32SWG, around a plastic box measuring 120mm x 95mm. Both oscillators are designed to work at about 300kHz.

Finally, the accompanying table will give some idea of the performance to be expected from these two units. All the measurements were made in air, and may need to be modified for buried objects.

It will be noticed that the difference in sensitivity varies from about 1.5 to 1 to 2 to 1. This inconsistency appears to be due to the shape or area of the object (rather than its mass) relative to the size of the coil. It would seem that a large coil may be less sensitive to a small object than would a smaller coil.

It was also noted that both units are less sensitive to ferrous metals (iron and steel) than to non-ferrous metals. It would seem that losses in the search coil tend to be somewhat offset by the magnetic characteristics of ferrous metals, whereas non-ferrous metals cause losses only.

But, these finer points aside, one thing is obvious. If you take it out on the beach these days, there is a far better chance that you will find drink cans than 20c pieces! But it's still fun trying.

RINGING UP A GOOD 'SWEEP'

YOUNG honeymoon bride Mrs Sharrin Langlands was extremely upset when she lost her wedding and engagement rings in the surf near Mackay late last week.

After hours of searching with her husband, Dern, they had virtually given up hope of finding them until Dern thought of asking the Army for help.

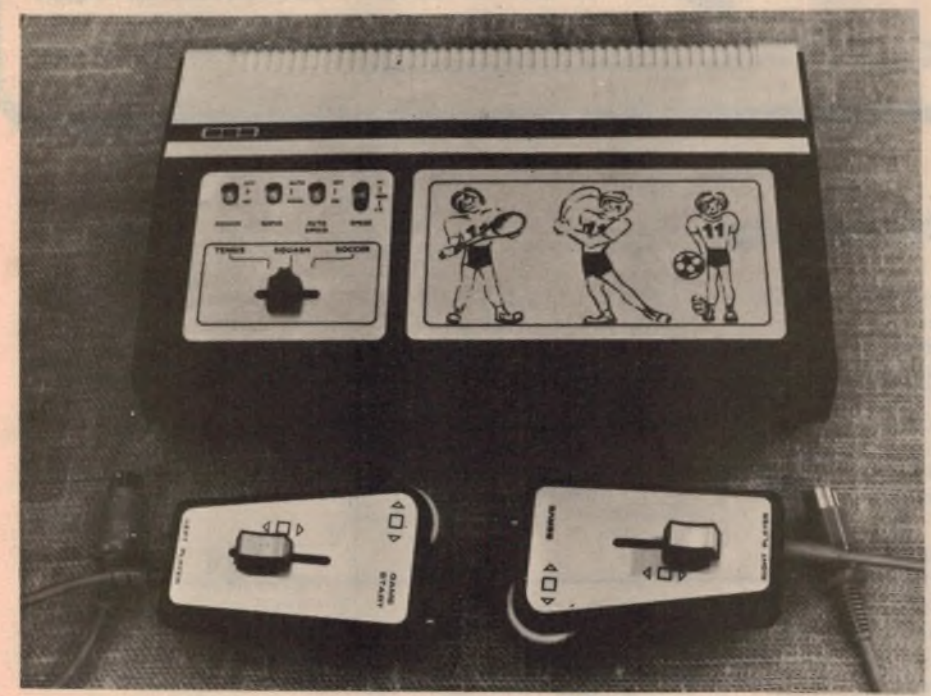
Help arrived at the weekend in the form of two soldiers from Townsville's Lavarack barracks and two mine detectors.

Sgt Barry de Bomford and Pte Michael Jones spent six hours "sweeping" the beach with the mine detectors before success.

The rings were found under 15cm of sand about two metres apart.

This news item appeared in the Sydney "Sun" for October 24, 1977. It gives some idea of what can be done with the best equipment and training.

YOU HAVE SPOTTED A WINNER



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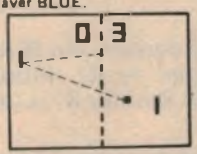
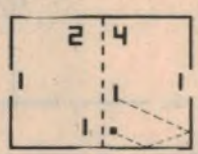
GAME DESCRIPTION

TENNIS:
The game is designed to simulate playing methods and rules of table tennis as closely as possible. The display consists of a rectangular court with dotted centreline in white on a green background. The left player is RED and the right player BLUE.



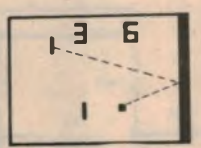
Each player has vertical and horizontal movement within the confines of his own half of the court. The bat is blanked out on entering the opponents half of the court. The game is started by resetting the score which sets initial conditions and gives the first serve to the left hand player. The serve will then alternate every 5 points. Points are won by deflecting the ball past an opponent and contacting either left or right baselines to score. To win the game 21 points must be reached with a clear margin of 2 points. If 20-20 is reached then the deuce circuitry operates and the winner is the first player to gain a 2 point advantage. The game also contains a double hit protection in that if a player does hit the ball a second time before his opponent hits, then he looses a point by default. A double hit is also registered when the ball is served (from the relevant baseline) and the player whose serve it is hits the ball before his opponent. This feature is included to prevent a player from staying near the baseline for serves. It means he must move away and get back quickly for the serve return which at fast speed makes the game more interesting and skilful.

SOCCER:
This game is designed to simulate English football but could equally be called hockey. The display consists of a rectangular court as in tennis but the left and right baselines are broken to create "GOAL AREAS". The court outline and centreline are again white. To provide a more realistic simulation of the game, "STATIC DEFENDERS" are positioned in front of the goal areas, to act as goal keepers. Both players can move over the whole court area. The background is green and the static defender colours are RED and BLUE to match the normal players colours.



To score points the ball must pass through the goal area. The ball will then serve from the loosing players side but from the centre line (ie. if left wins, the ball will serve from right to left and will appear from the centre line to simulate a kick off). Since no point target is set in football or hockey the game is won by the number of goals scored in a given time. When score reset is pressed at the start of the game the first kick off is given to the left player and an internal timer is reset, which times out after 3 minutes. This then operates the end of game signal, The player with the highest score being the winner. Double hit circuitry does not operate in football. This enables players to "DRIBBLE" and hit the ball as many times as required. This of course will operate the speed incrementer and a player can quickly loose control by too many hits.

SQUASH:
This game follows the rules and scoring methods of squash but could be equally called handball. The display again consists of a white court outline with the right hand side totally white to simulate a "WALL". The background is again green and players are RED and BLUE. The ball is white.



Both players can move over the whole court area. The ball is served from the "WALL" and left (RED) has the first serve after depressing the game start button. To win a point, a player must win on his own service by deflecting the ball past his opponent and contacting the left hand baseline. If a player wins a point on his opponents serve then he only gains a service and not a point. This simulates the normal scoring procedure of squash. Double hit feature in squash as follows:
When the ball comes off the wall either from a serve or in normal play, then only one player is eligible to play the ball, (ie. if RED last hit the ball, then BLUE is due to play). If RED hits again then BLUE is automatically awarded a point and the next serve. Similary, when a player has played the ball and hits again before the ball has contacted the WALL, he looses a point and the serve. The first player reaching 9 points is the winner if a margin of 2 points exist. If 8-8 is reached, then the deuce circuitry operates and the winner is the first player to gain a 2 point advantage.

BALL SPEED:
The ball has three pre-settable speeds: slow, medium and fast. When the AUTO-SPEED switch placed in the "ON" position, the ball speed will increase to the next higher speed to that previously set by the user after four player hits have occured. At the end of each point the ball speed reverts to the original set speed and the "SPEED INCREMENTER" will operate again. These speed-up features can be inhibited to enable any particular speed to remain constant by setting the Auto-Speed Switch in off position.

SCORING:
The score is displayed only during the time that the ball is out of play and leading zeros are always blanked. At the end of a point the new score is displayed and at the end of a game the score is displayed flashing on and off as an indication that the game is over. Operation of the game start button (located on the left player control box) will reset the score to zero and initialize the conditions to start a new game.

SERVE:
When the serve switch is placed in "AUTO" position the game is started automatically after each score. When the switch is placed in "MANUAL" position, the game can only be started after depressing the serve button located on the right player control box.

SOUND:
Sound is provided to indicate various events as follows:- 1) When the ball is served into play - short bursts of high frequency. 2) When the ball hits a bat - medium burst of medium frequency. 3) When a point is won - long burst of low frequency. 4) When the game ends - medium and low frequencies alternating.

INSTALLATION:
Simple connection to the aerial socket of your TV set.

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Circuit & Design Ideas

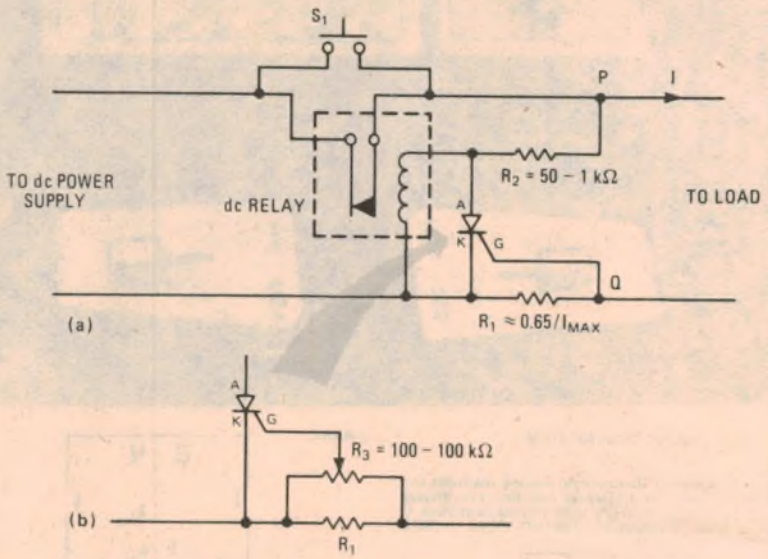
Conducted by Ian Pogson

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. Your contributions are welcome, and will be paid for if used.

Resettable fuse with SCR and relay

Most direct current power supplies rely on a circuit breaker, current sensing circuit, or fuse for current overload protection, but this simple resettable fuse circuit has advantages over all three. Built around a silicon controlled rectifier and line relay, it is faster than a circuit breaker, less complex than most current sensing circuits, and never in need of replacement.

How the circuit operates is evident from (a). Momentarily depressing S1 closes the relay so that current flows from the supply to the load. In normal operation, the voltage across points PQ will be equal to the nominal supply voltage, and the normal operating voltage will appear across the relay winding. The relay and resistor R2 are selected according to the DC supply voltage used and the relay's rated coil voltage, respectively.



Excessive current to the load causes a voltage drop across R1 greater than 0.65V and switches on the SCR. The anode-to-cathode voltage of the SCR in the conducting region is approximately 2V. This voltage, also across the relay coil, is far below the relay's holding voltage. Consequently, the relay opens, disconnecting the load from the supply. The relay may be reset by depressing S1 again.

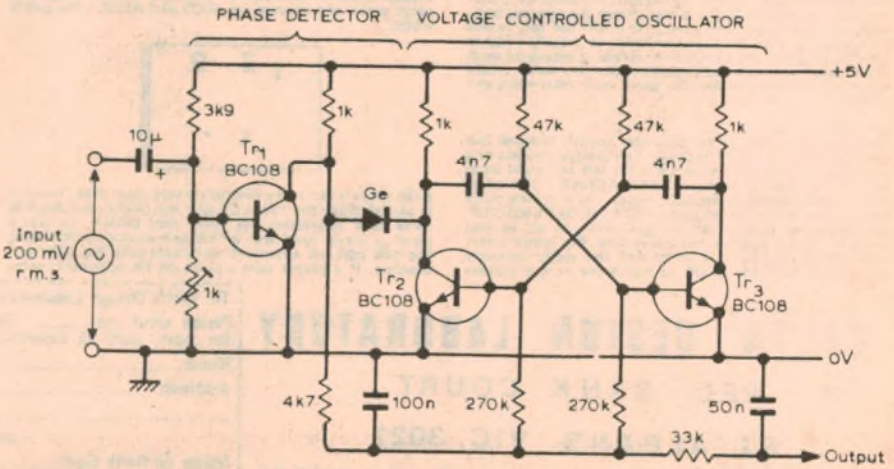
If a variable threshold point for SCR switching is desired, the SCR's gate can be connected to R1 through potentiometer R3. Resistor R1 is calculated as before.

(By Russell Quong, in "Electronics".)

Simple phase-locked loop

The conventional t -transistor multivibrator can be converted into a simple audio frequency phase-locked loop by the addition of a few components. Transistor Tr1 and the diode are connected as a logic gate and conduct during alternate half cycles of the input and VCO waveforms respectively.

The output of this phase-detector, when filtered, is most negative when the waveforms are in phase, and most positive when they are in antiphase. Because the diode conducts only when Tr2 is saturated, the action of the multivibrator remains unaffected. Once phase-lock has been established the VCO settles to an equilibrium phase, lagging the phase of the input by an angle which depends on the difference between the frequency of the input and the free-running frequency of the VCO.



With the component values shown, phase-lock is maintained from 100Hz to around 3kHz. Within this range, the output changes linearly at about 14mV/Hz. The response to a sinusoidal frequency modulation is 3dB down at about 50Hz.

(By J. B. Cole, in "Wireless World".)

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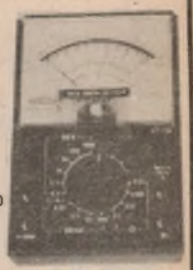

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Audio Output:	To 8 volts
Internal Modulation:	Approx. 400c/s
Tube Complement:	12BH7A, 6AR5, Silicon Diode and Germanium Diode
Power Source:	105/125, 220/240 volts, AC, 50/60 Hz
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Cat. Q-1300 ..... $67.50

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This unit has both sine & square wave output at less than 2% distortion. Frequency goes down to 20 Hz and up to 200kHz (sine) and 30kHz (sq). Output voltage is 7V rms for sine & 7V p-p for square.

$95.00

SPECIFICATIONS:

Frequency Range:	Sine Wave – 20 to 200 kHz in 4 bands Square Wave -20Hz- 30 kHz
Frequency Response:	±1½ dB
Output Impedance:	1 Kohm
Frequency Accuracy:	±5%
Distortion:	Less than 2%
Tube Complement:	6BM8, 12AT7, 6x4
Power Supply:	AC 50/60 Hz 220/240 volts
Dimensions:	215 x 170 x 140 Weight: 3 kgs

Cat. Q-1310 ..... $95.00

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Voltage Range:	Decibel Range:
200μV to 10mV	−52 dB to +38 dB
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2mV to 100mV	−32 dB to +28 dB
10mV to 300mV	−22 dB to + 8 dB
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100mV to 3V	− 2 dB to 12 dB
200mV to 10V	8 dB to 22 dB
1V to 30V	18 dB to 32 dB
Accuracy:	±3% Full Scale
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Dimensions:	142H x 90W x 42D mm Weight: 300 gr

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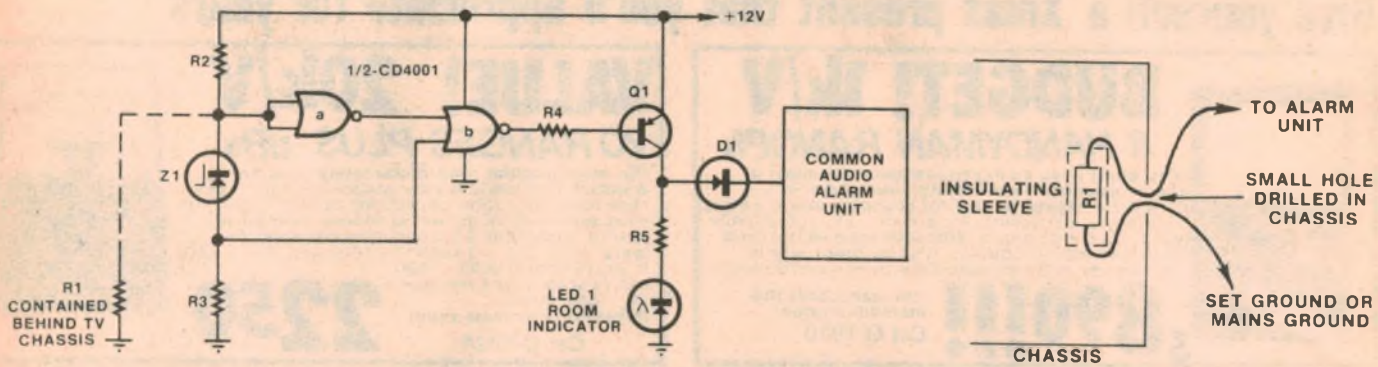
Another colour TV thief trap



In Circuit & Design Ideas for October 1977, a colour TV thief trap was described. It was suggested that this device may be useful for such places as motels. My experience is that many motel installations have the coax cable connected to earth at the "delivery" and thus all the sets on the same run will be connected to the shield. This means that the simple system as described would be ineffective.

The circuit which I have developed and installed in some motels is at least one answer to the thief problem. It is based on the CMOS quad NOR gate 4001 and requires only half of a chip per room.

Resistor R1 must be contained within the TV receiver chassis. The resistor is soldered onto its wires after they have first been passed through a hole in the chassis. Operation is basic logic except the values of R1, R2 and the zener diode may need some brief explanation.

As I have made use of the voltage threshold (45% Vcc) that the gate switches on, R1, R2 and the zener diode are chosen to keep gate (a) on and gate (b) off during normal conditions. Should the wire to R1 be opened the zener diode conducts causing gate (b) o/p to go low and switching on Q1. Should the wires be shorted gate (a) switches off causing gate (b) o/p to go low, switching on Q1.

Typical circuit values — R1, 3.9k; R2, 2.2k; R3, 220k; R4, 47k; R5, 470 ohms; zener diode, 5.1V; Q1, BC557; D1, 1N914.

(By Mr G. J. Brand, 15 Gwinganna Crescent, Holden Hill, SA 5088.)

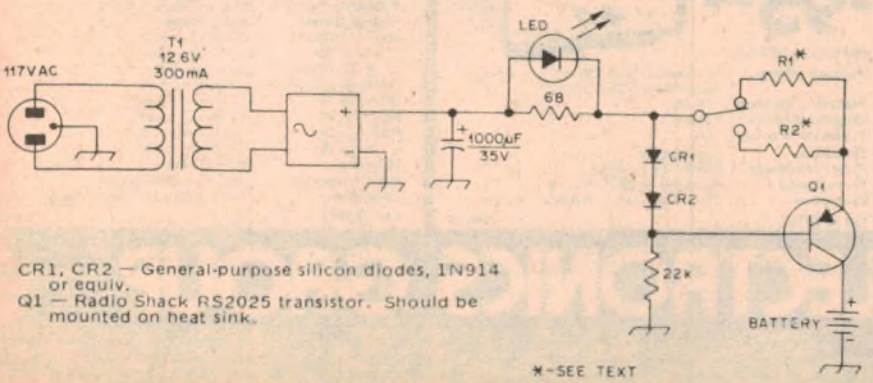
Charger for nicad batteries

This battery charger has two charging rates, selected by S1. The circuit is a simple one and based on the fact that a forward biased silicon diode has about 0.6V drop across it. CR1 and CR2 have a combined voltage drop of 1.2V and the emitter-base junction of Q1 has a 0.6V drop, causing the net voltage drop across R1 or R2 to be 0.6V.

The charging rate is equal to the emitter current of Q1 and since the base current is small, may be considered to be the same as the Q1 collector current. This current is determined by dividing 0.6 by the value of the selected resistor. R1 and R2 should be 5% tolerance resistors of wattage rating chosen to dissipate the calculated amount. The values of R1 and R2 may be found by dividing the desired charging rate in amperes by 0.6.

One definite advantage of this charger is that any battery rated up to 12.5V may be charged. The author selected charging rates of 60mA and 3mA, yielding resistance values of 10 ohms and 200 ohms, respectively. The transistor should be capable of handling the current and power involved. A type MJ2955 mounted on a heat sink should be suitable for most applications.

(By Michael Alterman, WA3KXT, in "QST.)



CR1, CR2 — General-purpose silicon diodes, 1N914 or equiv.
Q1 — Radio Shack RS2025 transistor. Should be mounted on heat sink.

*-SEE TEXT

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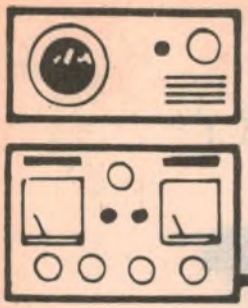

The Serviceman

On aerials, feeders, and exorcising ghosts

"When in doubt, blame the aerial". This would seem to be the slogan of some TV technicians when faced with a degraded TV picture for which they have no immediately obvious solution. It is an unfortunate situation because enough people have been caught to spread the word, making it difficult to convince a customer when the aerial really is at fault.

It is also unfortunate that a lot of advertising has been aimed at convincing the public (without actually saying so) that a colour TV set requires nothing less than a special aerial — coloured for preference — and coaxial cable.

There are, of course, situations where a better aerial installation can be justified. Not because the customer happens to have bought a colour set, but for the simple reason that the existing aerial system has either deteriorated since it was first installed, perhaps 20 years ago, or because it really never was adequate.

The best advice I can offer a customer when they raise these points is quite simple: If the present aerial is giving good results on a monochrome set then it should give equally good results on a colour set. Mind you, much depends on the viewer's interpretation of "good". For some people it only has to move; for others every tiny blemish on the picture is a cause for concern.

Much the same reasoning applies to the feeder. If an existing ribbon feeder is giving good monochrome pictures it will give good colour pictures. On the other hand, coaxial cable can be useful where localised electrical interference is a problem. But the point is that it can be just as desirable for a monochrome installation as for a colour one.

As for coloured aerials — well their value is debatable. The colour is normally aluminium anodising and, on the credit side, there is little doubt that this provides good protection against corrosion in seaside or industrial areas. Otherwise it has little to offer; the fact that it is coloured makes no difference to its ability to receive colour signals! And on the debit side is the fact that such an aerial is a clear indication that there is a brand new colour set in the house; a point which the light fingered gentry are not likely to overlook.

All of which, as you probably guessed, has been prompted by some recent experiences with aerials. The main one was a situation which occurred outside normal business hours and which, because I was unprepared, called for a certain amount of ingenuity and improvisation.

Having closed the shop one Saturday lunchtime I returned home to find that Mrs Serviceman had arranged for us to visit some friends the following day; a family who had just moved into a new (for them) house on the other side of the city, and were anxious for us to see it. In fact, it turned out that they were well into the scrub on the other side of the city, close to a couple of hours' drive away, so it was to be an all-day visit.

And, oh yes, they were having some trouble with their colour TV set and they hoped I might be able to offer some advice. No one seemed to know exactly what the problem was, except that someone had told them they were in a poor reception area. All I knew about the situation was that they had had the set for some months and that it had apparently performed satisfactorily at the previous location.

With so little to go on there wasn't much I could do in the way of preparation. However, I gathered up a handful of tools, the soldering iron and a multimeter, and hoped that it was nothing serious.

When we finally arrived the following day, after what seemed like an eternity on lonely country roads, my first instinctive reaction was to look for the aerial. It turned out to be a 215 type, which should have been quite adequate. I didn't buy the "poor reception area" claim because the location looked to be quite reasonable and, in spite of the distance I had travelled, they were not all that far from the TV stations; well, not as the CRO flies! (Sorry about that.)

But then I noticed something else. There was a slight wind blowing and the low band dipole was see-sawing up and down with each gentle gust. I wasn't really surprised when I walked inside and found the picture flipping at regular intervals, together with bursts of snow and white horizontal streaks.

"It looks like we will need to do a major job on that aerial." I told my friend, "Do you think we can get it down?"

"Should be easy enough," he replied, "I've got plenty of ladders."

But before we tackled that I fetched the multimeter and tried the low ohms range across the socket on the skirting. Normally I should have been able to read a dead short across the folded dipole but in fact the needle didn't even flicker. It looked as though we had more than one problem.

At that point my friend filled me in on the history as he knew it. It seemed that the previous owner had originally owned a monochrome set, which operated from the aerial in question. More recently he had purchased a colour set and for this a brand new aerial had been installed, complete with coaxial feeder. When he left, he had taken the new aerial with him but had not bothered to take the coax.

It was this last fact that had confused my friend initially. Faced with a choice of two feeders, one of which was visible and obviously coax, he automatically chose the latter. (After all, everyone knows that a colour set should be fed with coax.)

Unfortunately, the results weren't very encouraging. Only two of the four local stations could be received, and even these were obviously weak. On the other hand, it wasn't really surprising. The other end of the coax was lying on the tiled roof with, at most, a couple of inches of bare wire exposed.

And it was apparently this performance, when described to a local serviceman, which had prompted the comment that it was a poor reception area.

To give my friend his due he didn't buy the idea either, but he didn't feel confident enough to argue about it. But it did prompt him to trace out the feeder cables and change over to the ribbon which was, nominally at least, connected to the aerial. This had improved matters to the point where all four channels were available, though a

couple were still a bit noisy, and all suffered from the flips and flashes when the wind blew.

I was a little puzzled over the open circuit I had read on the multimeter, and suggested to my friend that we should trace the feeder through to the aerial, just to be on the safe side, It was quite a long feeder, running nearly the full length of the house above the ceiling, then through the wall cavity to the outlet on the skirting board.

Up in the roof we started at the set end and headed for the aerial. My first surprise was a kind of junction; a crude assembly of finger twisted joints from which a length of ribbon ran off either side at right angles and disappeared into other cavities. "Oh yes," said my friend, "there are outlets in the first and second bedrooms, as well as the lounge room."

"Well," I replied, "they'll have to come out, at least for the present. We can put them back if you want them, but it will have to be done properly." As it turned out, however, he had no real need for them, so that solved that problem.

Having found a break in the cable I took the opportunity to check continuity. Looking towards the aerial it was still open circuit, so we moved on. We found another joint, just before the cable disappeared through the tiles and the meter told the same story, meaning that it was almost certainly a break right at the aerial.

We climbed down from inside the roof and prepared to tackle the aerial itself. My friend fetched a ladder and we lowered the mast until the aerial was within reach of the roof, then unfastened it and brought it down to the ground level. The first thing I did was examine the cable where it was terminated. It was intact mechanically, though corroded, but the meter insisted that there was no connection between it and the elements.

Closer examination revealed that conventional terminal lugs had not been used, the bare copper wire having been simply twisted around the bolts and secured against the aluminium elements by the wing nuts. This could well have contributed to the corrosion, since copper and aluminium are electrolytically incompatible.

My friend produced an aerosol of penetrating fluid and gave the terminals a good squirt, which we left to soak in while we had a cuppa. Then I gingerly tackled the diecast wing nuts with a pair of pliers, only to have my worst fears realised. They were frozen solid; I had no option but to wreck them to get them off.

Then I took a closer look at the aerial. Whoever had assembled it in the first place had done a very rough job. Apart from the bare copper wire terminations they had obviously neglected to tighten various bolts properly. The most obvious one was that holding the low

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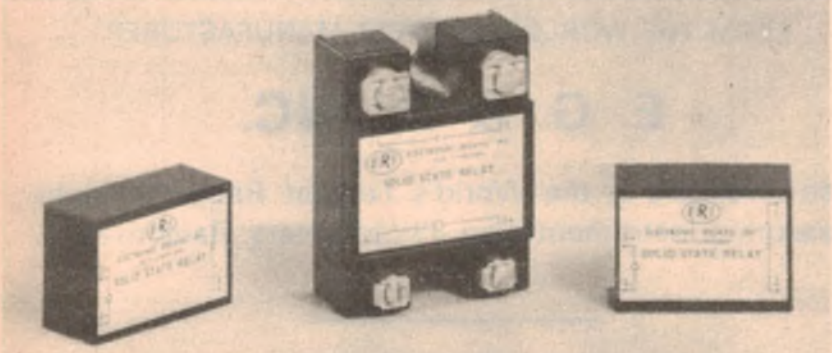

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band dipole. This had been loose for so long that the continual see-sawing of the dipole had elongated the mounting hole in the boom, laterally, further aggravating the situation.

Similarly, the nuts securing the connecting bars to the high band dipole had never been tightened properly, so that these rattled up and down the bolts as the low band dipole see-sawed. All in all, it was one horrible mess.

Fortunately, my friend has a pretty well stocked workshop and we managed to rustle up a goodly assortment of steel nuts, bolts, washers, lock washers etc, with which I was able to reassemble the faulty sections.

Then it was back up on the roof to replace the aerial on the mast, raise it, and tuck the length of feeder under one of the tiles. Back inside the roof I spliced the ribbon, soldered the joints, and wrapped it in tape. I did the same for the other break, and checked things over generally.

A check on the lounge room outlet with the multimeter told a different story this time — a virtual short circuit. I connected the set and all four channels came up clear and strong. I discreetly nudged back the colour control, which was running a little on the high side — though not as bad as many that I have seen — and touched up the brightness and contrast controls. The set was then delivering a perfect picture.

My friends were delighted and, I then realised, much relieved. It had come as a nasty shock to them to discover that, apparently, they had moved into an area where, at best, they might have to spend a lot of money to get reasonable reception or, at worst, they might not get a viewable picture at all.

Naturally, it was a bit of a busman's holiday for me, and also a bit of a challenge, since I had not the slightest inkling of what was in store when I set out that morning. The last thing I expected to do was to have to rebuild an aerial.

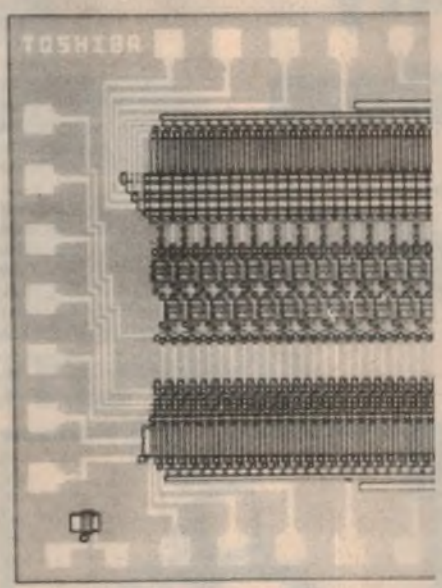
But my friends' gratitude was ample compensation, though we didn't knock back some fruit from their orchard, and I did snaffle the coax — with their permission. I'm sure I'll find a use for it.

One of the points to be learned from this exercise is that aerials can deteriorate, particularly where they have not been properly assembled in the first place. Maybe they don't need to be replaced as often as the aerial manufacturers would like, but it's not a bad idea to check them over every few years.

Another point is the readiness with which the local serviceman offered the glib explanation that it was ". . . a poor reception area". In fact, I proved that it was an excellent reception area; plenty of signal, no ghosts, and far enough away from industry to avoid electrical interference. It would be hard to find a better spot.

And finally there is the obvious fact that the previous owner had been talked into a brand new aerial and feeder system when he bought a colour set, whereas a few repairs to the existing system were all that were needed to bring in first class colour pictures — ribbon feeder notwithstanding!

Talking about aerials — or, at any rate, the ghosts which they can introduce — reminds me of yet another report from overseas regarding ghost suppression circuitry. Readers may remember that I touched on this subject in my January notes, based on a report in the Japanese magazine JEE. The more recent report comes from the American magazine "Electronics", but still concerns work being done in Japan. ("Electronics", August 4, 1977, p55.)



Portion of the large scale integrated circuit ghost canceller developed by Toshiba. Top row is the CCD delay lines, middle row weighting circuits, and bottom row analogue memory and demultiplexing circuits.

As before, the Japan Broadcasting Corporation (NHK) is well to the fore, this time in conjunction with the Tokyo Shibaura Electric Co (Toshiba). As nearly as I can gather, NHK have developed the basic idea, while Toshiba aim to package it all in a single chip.

One of the interesting comments in the report states, "Manually adjustable cancellation systems . . ." (the type referred to in my January notes) ". . . are unattractive because they must be readjusted for each channel, and . . . for the same channel over a period of time". (Nevertheless, I'd be prepared to bet that many people would gladly accept this limitation as a small price to pay for a good picture.)

But the current aim goes far beyond that. It is to produce a universal ghost suppressing circuit which will need no adjustment and will automatically suppress any ghosts (plural) by an order of 30dB — more than enough in almost any practical situation. The only restriction, at present, appears to be that the ghosts must be displaced not more than 27us from the main image, or half the active line period. (Half the width of the screen.)

As nearly as I can make out from the brief report the basis of the idea is to look for ghosts during the vertical blanking period and, more specifically, between the last pre-equalising pulse and the commencement of the vertical pulse block. (I had to fish out some of my old text books to work that one out, so don't be ashamed to do the same.)

Any reflected signal will cause a ghost of the pre-equalising pulse to appear somewhere in the period of 27us before the commencement of the vertical sync block. From this the position and amplitude of any ghost(s) can be readily determined, and this information is stored and used to create an anti-ghost signal which is applied during the following vertical scanning period.

(Presumably, if the reflecting surface were to move during this time, as would an aircraft, a new set of anti-ghost data would be created at the end of the vertical scan, to suit the next scan.)

The manner of creating the anti-ghost signal is more difficult to follow. The heart of this system is a delay line using CCD (charge coupled devices) with access to each stage in the CCD. The video signal is fed in parallel to each stage, via field effect transistors (one for each stage), which controls the amount of video signal, if any, fed to any particular stage.

The point at which the video is admitted to the delay line, and its amplitude, is determined by the first part of the system — that which observed the ghost in the vertical blanking period. This biases on the appropriate FET which controls entry to the CCD. If there is more than one ghost, more than one entry point will be opened, each by an amount appropriate to the ghost amplitude.

The video signal which emerges from the delay line will be delayed by an amount determined by its entry point. Suitably phased, it is then fed back into the video line so as to cancel the ghost.

I know that takes a lot of digesting, and leaves a lot of the details unanswered. But apparently it works, even though most of the work so far has used only a small delay line, about 6us. At a practical level most of the problems involve producing a suitable chip, of reasonable size and at reasonable cost. The present aim is for a chip no larger than that currently used for calculators, but it is expected to take up to two years to develop.

So, some time in the future, it should be possible to buy a TV set guaranteed free from ghosts.

Here's hoping!

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Letters to the editor

Laser critic

A brickbat at your laser. Surely relinquished responsibility is worse than irresponsibility or ignorance.

While a good device can be made foolproof, it can never be made idiot-proof. Yet freely available information may be construed to form a lethal weapon in the hand of individuals hell bent.

The price is no retardant. The power source is readily available from any automotive battery. Lack of restricted access has now placed yet another weapon in the arsenal of deliberate trouble-makers. Another arrow in their quiver.

Visualise it, if you will, in the hands of a highly imaginative youth, playing imaginary space war. Or unsupervised students in a school intended upon mischief. (Many a time I have been victim of some such prank, with scars to prove it.)

You cannot guarantee that only serious, intelligent, educated and responsible individuals will be the sole users of lasers.

John Vasar
Padstow, NSW

COMMENT: You appear to have greatly over-estimated the output from our laser. With an output of only 1.2 milliwatts, it is scarcely a lethal weapon. In any case your criticism would appear to apply to a multitude of everyday items — including your brickbat.

Advertisement

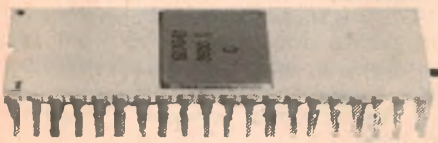
I refer to the September issue, 1977, of Electronics Australia regarding an advertisement placed therein in respect of a Playmaster loudspeakers system as advertised by Dick Smith Electronics Group. There are aspects of the above advertisement which are incorrect and therefore, in our opinion, misleading in advertising content. The advertisement compares the AD12K12 loudspeaker kit with the Playmaster, and we would hasten to point out that the AD12K12 ceased to be available as such on July 1 and has since been upgraded and replaced by a Mark II version, and there are, therefore, certain aspects of the table display which are incorrect.

We would like to take the opportunity of also thanking yourself and Dick Smith Electronics for reference to our loudspeaker systems and component loudspeakers in a previous article published in Electronics Australia, May 1977. It is quite obvious that both your magazine and Dick Smith hold our products in such high regard that they are a reference point by which the quality of other products should be judged.

I would also like to point out that whilst in the advertisement previously mentioned, the Dick Smith Group have gone to some pains to display a comparison between a speaker kit of their own creation, and our own superseded AD12K12, there is, of course, no indication of the specifications for certain of the components used, which could, therefore, be regarded as a comparison of quality. Quantity, you will appreciate, is no substitute for quality.

Kevin L. Gest,
Philips Electronic Components
and Materials.

Low-cost tester for microprocessors



by DAVID EDWARDS

This simple inexpensive test unit will enable you to troubleshoot your microprocessor system. At the same time it will enable you to gain an insight into how a microprocessor operates, and how it transfers information using its data and address busses.

Apart from the ubiquitous multimeter or electronic voltmeter used to measure DC voltages, traditional electronic servicing tends to rely fairly heavily on the cathode ray oscilloscope or "CRO" as a means of checking dynamic circuit operation. In most types of equipment the CRO has been very suitable for this purpose, as the signals are generally repetitive and with characteristic waveforms.

Unfortunately a CRO becomes rather limited when non-repetitive signals are involved, and where system operation depends upon the interaction of a relatively large number of signals. These are just the sort of situations that abound inside computers, including microprocessor-based hobby computer systems.

Things are further complicated, when it comes to troubleshooting in computer systems, by the interaction between hardware and software. When something goes wrong, it can often be the devil's own job to find out whether it is being caused by an electrical fault in the hardware, or an error in the software.

For example if your program fails to store some data in a particular memory location, it could be because you have made a mistake in the program; or alternatively it could be because there is a fault in the memory decoding or write strobe circuits, or even in the microprocessor itself. (Generally speaking, in 99 cases out of 100 you have made a mistake in your program, but in this article we are going to consider what to do in those rare cases where the trouble is due to a hardware fault.)

Attempting to analyse a fault in a computer system can be very frustrating and time-consuming. One tends to spend all one's time trying to catch pulses only 2us wide, which occur almost at random. Logic probes and similar devices can be quite useful, but have the disadvantage that generally you can't monitor all 40 pins of the microprocessor at once, nor is it easy to control the operation of the system while you watch the probe.

In order to try and cope with problems like this, commercial logic analysers have been developed, which enable the operator to trace and locate typical faults such as that proposed earlier. They are usually based on microprocessors themselves, and unfortunately tend to be rather expensive, placing them well out of reach of the average home experimenter or enthusiast.

We were discussing this problem recently with Ed Schoell and Chris Mason, who are both microprocessor applications engineers with NS Electronics Pty. Ltd. Our ears pricked up when they replied that they had worked out a simple but very effective way of getting around the problem.

Their basic idea was to have an array of 40 LED indicators, one for each pin of a typical microprocessor chip, forming in effect a 40-channel logic probe. But the LEDs are not connected continuously to the processor pins; instead they are connected to a set of 40 latches, with circuitry provided so that the latches can "strobe" or briefly sample the logic levels at the pins only at specific times.

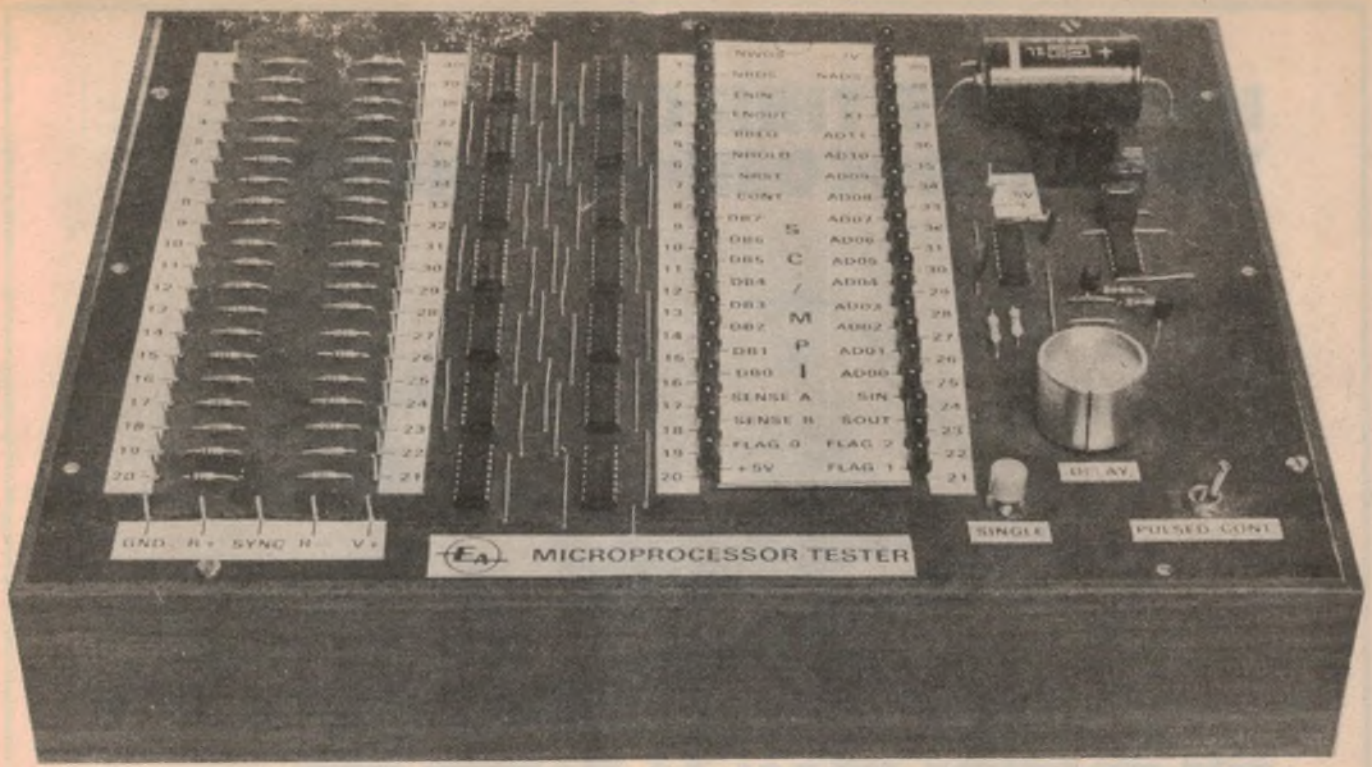
To avoid the problem of not having known conditions, their idea was to initially hold the system in the reset state, and then let it start running at a predetermined time. At the same time, a delay monostable with adjustable pulse width would be triggered, and the end transition of the monostable used to trigger the LED display latches.

By varying the delay pulse width, the LEDs could thus be arranged to sample the logic levels on the microprocessor pins at any desired time after starting up from reset. By having the resetting occur repetitively, say every 20 milliseconds or so, and providing the delay monostable with a vernier control, we thus end up with the digital equivalent to a 40-channel CRO, whose viewing "window" can be moved along in time to analyse system operation following start-up.

When we started to consider the logic required to implement such a system, we were surprised to find just how little was required, and how little expense would be required to achieve such a test unit. So without further ado, we started to develop the idea into the tester described in this article.

Before describing just what the unit can do, we will first give a brief physical description of it, as this will aid your understanding of how it works. Essentially, the tester consists of a single printed circuit board (PCB), measuring 282 x 226mm, mounted in a wooden case. The PCB forms the lid or front panel of the case, and has an array of components fitted to it.

As you can see in the photographs, the most conspicuous feature is the array of 40 LEDs, and a corresponding array of 40 PCB pins. The LEDs and pins are numbered from 1 to 40, while in the centre



of the LEDs is a replaceable card, which carries the pinout designations of the microprocessor chip being tested (in this case the SC/MP).

The LEDs and PCB pins are separated by two rows of seven integrated circuits (ICs), while to the right of the LEDs is a small control panel, containing a knob and two switches. A large "umbilical cord" emerges from the upper left hand corner of the case, and is terminated in a 40 pin DIL test clip.

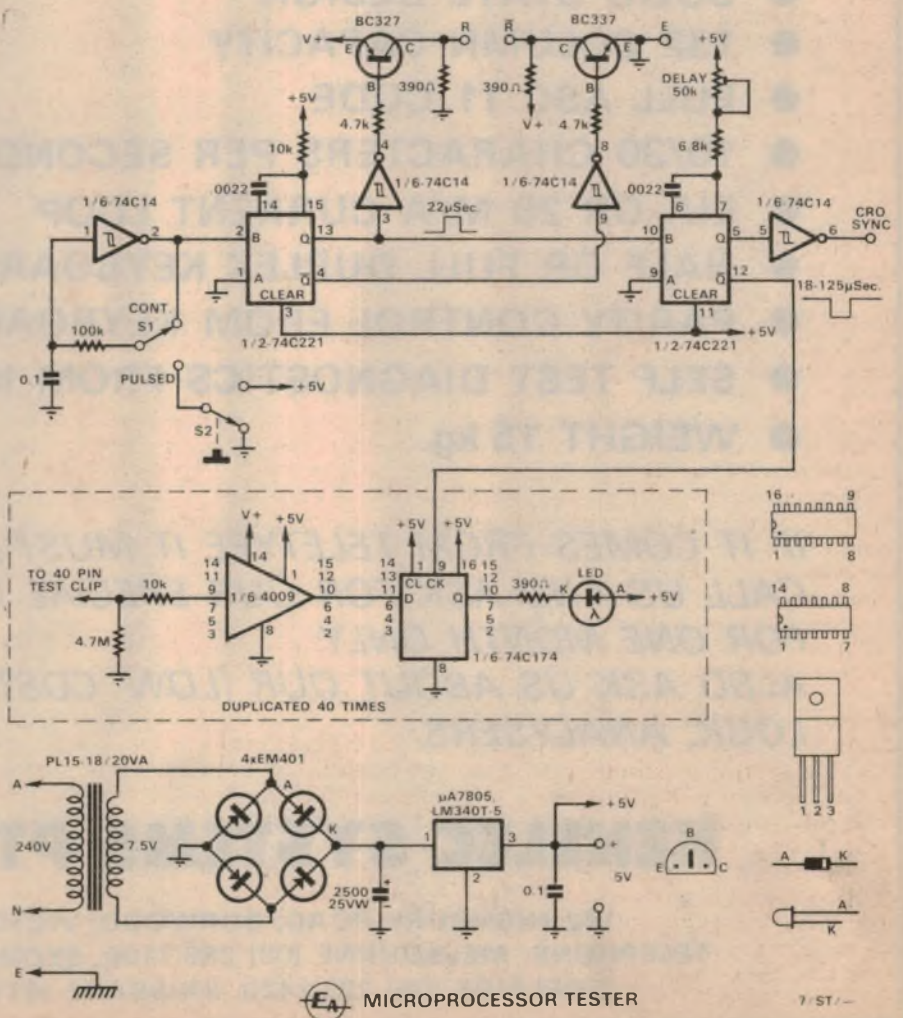
The 40 leads in the umbilical cord are connected in order to the underside of the 40 PCB pins, so that pin 1 of the microprocessor clip is connected to the PCB pin numbered 1, and so on.

A small number of additional PCB pins are provided below the main array. These are used to allow interconnections between the system under test and the tester—power supply lines, reset signal, and so on. There is also an output pin providing a trigger signal for a CRO, if you want to use one in conjunction with the tester.

Turning now to the circuit diagram, we can examine the operation of the circuit. One section of a 74C14 hex Schmitt trigger device is connected as the reset driver. Switches S1 and S2 allow it to be used either as an oscillator with a period of about 20ms, or as a manual "one-shot" pulse generator.

The output pulse (positive going) from the Schmitt trigger is used to trigger a monostable element, which has a pulse width of about 22us.

The Q and Q-bar outputs from this monostable are passed via further 74C14 inverters to complementary transistor



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Microprocessor tester

buffers, capable of driving TTL inputs. These buffered outputs are made available at the small row of PCB pins on the PCB, and the appropriate output is then connected to the reset pin of the microprocessor by a flying lead. Thus the microprocessor is reset, either periodically or on a "one-shot" basis, as required, for about 22 microseconds duration.

As well as driving the reset circuitry, the Q output of the first monostable is also used to drive a second monostable. This is the actual delay monostable, with its pulse width adjustable from about 15 to 125 microseconds. The Q-bar output of this monostable is connected to the clock inputs of the 40 LED latches, so that they are strobed at the end of the delay pulse. The delay is adjusted by means of a 50k ten-turn potentiometer, giving a resolution of less than 1us.

Each of the 40 device pins is buffered by a 4009 type inverting buffer. The V+ (VDD) supply pins of the seven ICs used are all connected together, and made available at one of the PCB pins in the small row. A flying lead is then used to connect this point to the positive logic supply pin of the microprocessor. This means that a logic level conversion can be made between the system under test and the tester.

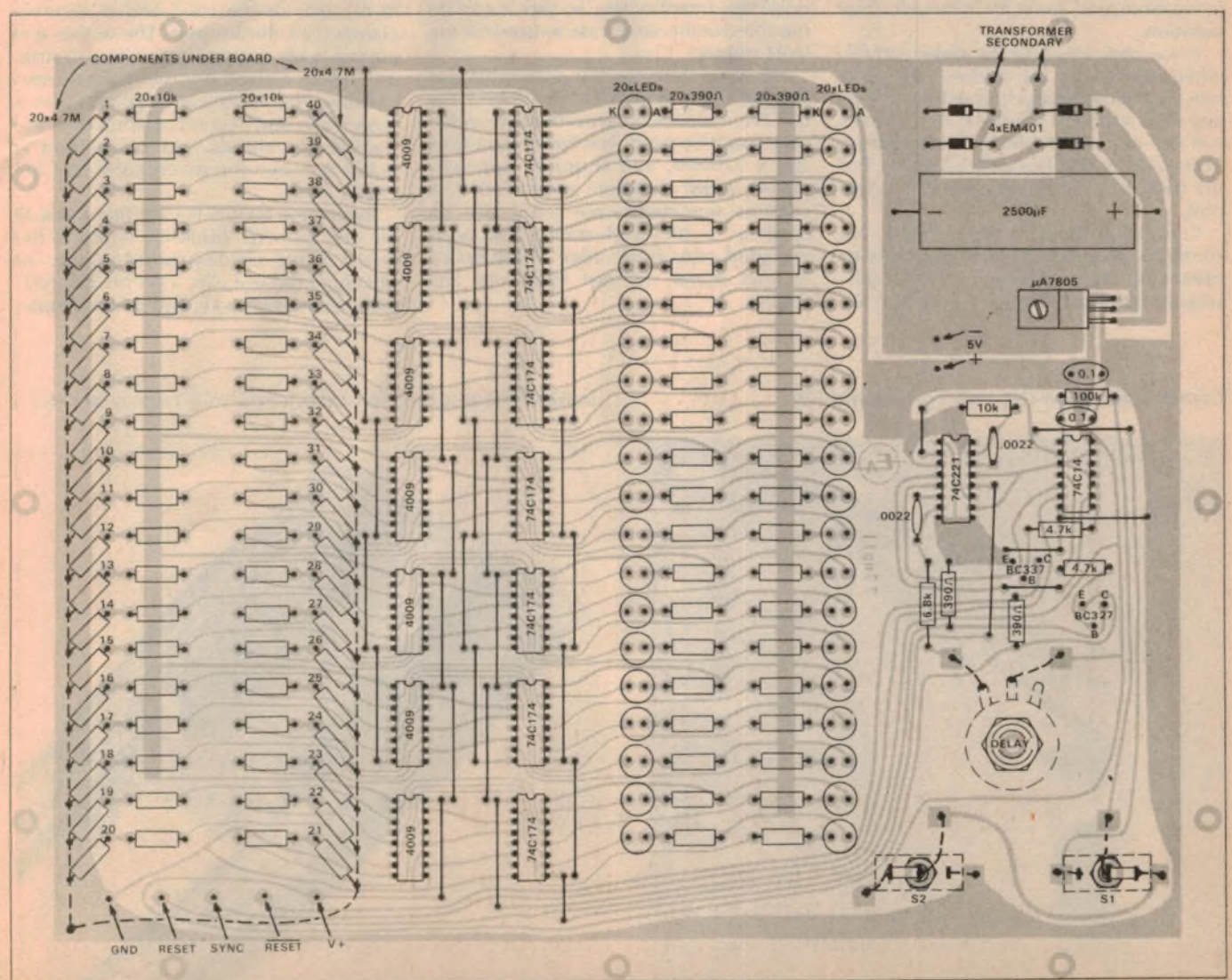
The transistor buffers used for the reset function are also connected to this V+ line, so that the reset pulses are automatically of the right amplitude.

10k resistors are fitted in series with the inputs to the buffers, so that if voltages above or below the supply rails of the buffers are present, the current through the static protection diodes is limited.

The 4.7M resistors shown on the circuit diagram are optional extras. They serve to pull the inputs down when the microprocessor pins go into a high impedance or "tri-state" mode. Without these resistors, the inputs to the buffers tend to respond to adjacent inputs (due to capacitive and leakage effects on the PC board), and also to the magnetic field of the transformer. The values of the resistors are not critical, any value between 1M and 4.7M will be satisfactory.

The Q outputs of the latches are used to drive the LEDs, via current limiting resistors. The pattern of the PCB has been arranged so that when pin 1 of the test system goes high, the LED labelled 1 is lit, and so on.

Now that you have an insight into how the tester is arranged, we can discuss what it is used for, and how it shows the workings of your microprocessor system. It is assumed that when the system is reset, it commences to run with a particular program. This can be either a monitor program, or one that you have written.



Microprocessor tester

Initially, S1 is set to the continuous position, and the delay control is set to minimum. Then the microprocessor is reset and commences to run the test program once every 20mS. With the delay control set to minimum, the latches are clocked just before the end of the reset pulse.

Let us suppose that our system has a positive reset pulse, and that this is being applied to pin 1 of the microprocessor chip. Then LED 1 will be lit, and the remaining LEDs will show the state of the other pins during the reset period. Typically, output flags will be cleared, and the data, address and control lines will be in a high impedance state.

If the delay control is now operated slowly, a point will be reached when the latches will be clocked just after the reset pulse has ended, so that the reset LED will be out. The remaining LEDs will now show the state of the microprocessor at this time. Let us now suppose that the first instruction of the program is stored in location zero, and is XY in hexadecimal notation.

If we now increase the delay slowly, while monitoring the address and data pins we should be able to see the address and data appear. Of course, the address will not be very obvious, as all address LEDs will be unlit (for address 0000), but the data (XY) should appear on the data pins.

Continuing on with this process, we should be able to see the microprocessor obtain and act on the second and subsequent program bytes. It will also be possible to see the system using its various control lines, such as read/write and operation request.

Thus we can use the tester to analyse the operation of a working microprocessor, and can also use it to trace through the operation of a faulty system, to see where it is going wrong. The delay control allows us to look at various parts of the machine cycles, and at all the various input and output pins.

The tester can also be used in the one-shot pulsed mode, to enable the effects of circuit or program changes to be evaluated. The total range of the delay control in terms of instruction cycles will depend on the clock rate of the system under test. Typically, however, it will be of the order of 50 or so.

Construction of the tester should be relatively simple. All components are mounted on a single PCB, coded 77up11. This is identical in size with the board used for the digital logic trainer described in the July 1977 issue. We have done this intentionally, so that it can be mounted in the same case as used for the logic trainer.

The case used for the prototype was supplied by Dick Smith Electronics Pty Ltd. Alternatively, a home-made wooden case could be used. The board measures 282 x 226mm, and requires approximately 50mm clearance underneath it. A steel or aluminium case could also be used, as a 10mm clearance has been provided around the edge of the board so that metal will not short out any tracks.

49 PCB pins are required, along with about 1.5m of tinned copper wire. This is used for the numerous links on the board, which are necessary because we did not use a double sided board. These should all be fitted before any other components.

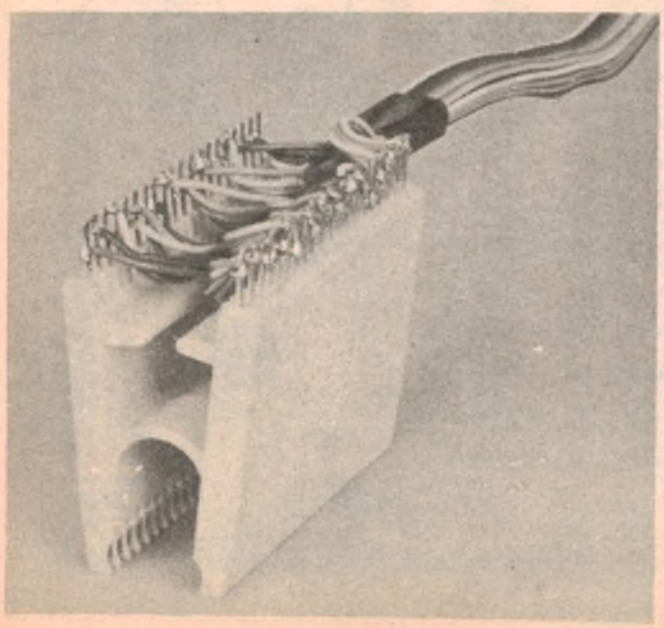
The passive components should next be fitted. The only polarity sensitive one is the 2500uF electrolytic capacitor. Next fit the bipolar components, such as the diodes and transistors. The three terminal regulator can also be fitted, along with its heatsink. The latter can be either a commercial unit, such as we used, or a small piece of scrap aluminium.

The input pulldown resistors are wired on the copper side of the board, as shown in the photograph. First solder all the resistors to the PCB pins, and then bend their free ends so as to form a bus line, which need only be connected to the earth track of the board in one place.

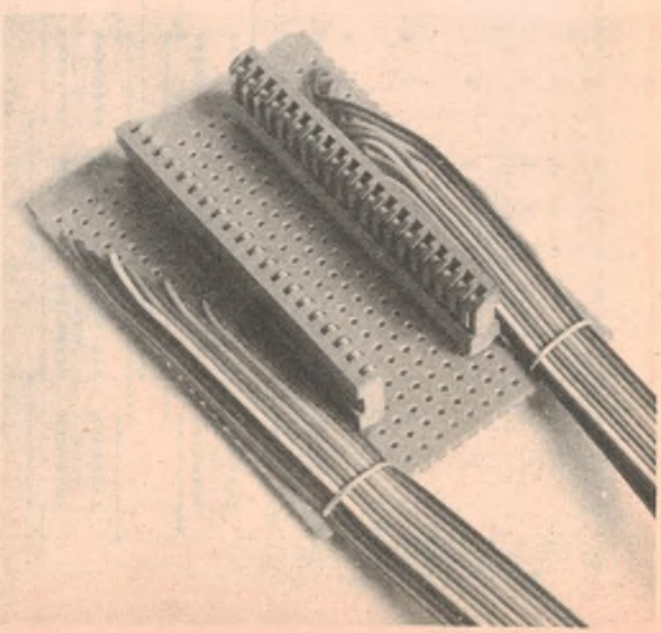
The mains cord enters through a hole in the rear of the case, and is securely clamped to the bottom. The active and neutral leads are terminated in a BB strip, and then routed to the transformer primary. The earth lead is soldered to a solder lug, and securely clamped to the transformer chassis. No connection is made between the mains earth and the circuit earth.

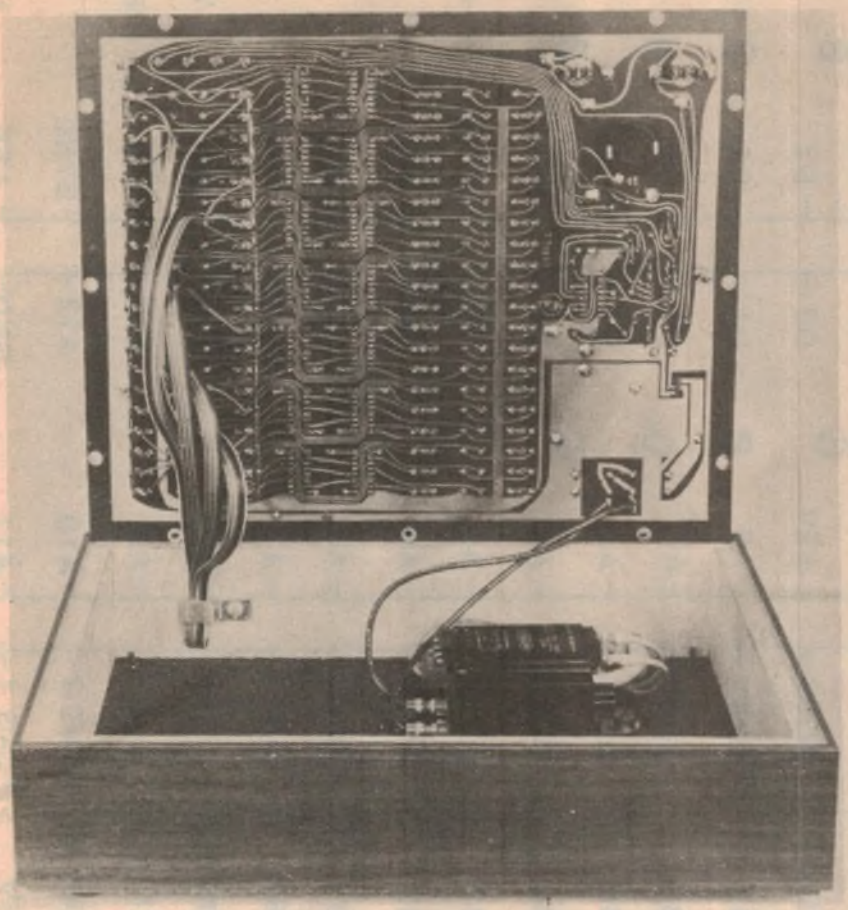
Before the CMOS ICs are fitted, the 40 pin DIL test clip should be wired to the board. There are two possible ways of obtaining the test clip, a simple but relatively expensive way, and a less simple,

Commercial 40-pin DIL test—cost around $20



Inexpensive test clip fabricated from a PCB edge connector.





Internal view showing transformer mounting and cable anchoring details.

less expensive way. The first method is to buy a ready made commercial 40 pin DIP clip, and simply solder the required wires to it. It will cost you around $20, but the result is a very neat and straightforward job.

The second method is to obtain a 40 pin, double sided PCB mounting 0.1" spacing PCB edge connector, and a small piece of Veroboard. The basic idea is to separate the edge connector lengthwise into halves, and solder them to the Veroboard at the appropriate distance apart.

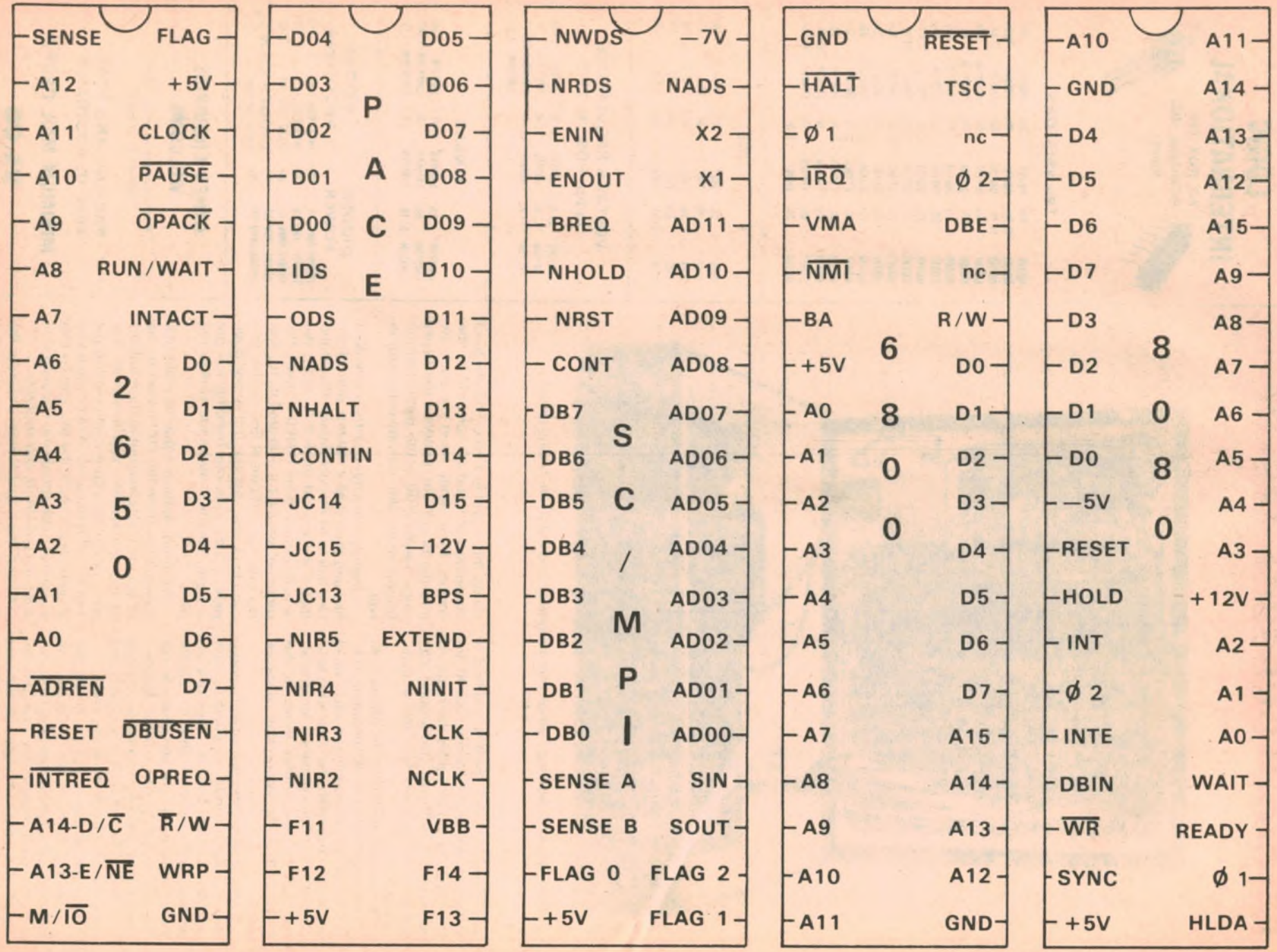
Radio Despatch Service, of 869 George Street, Sydney, kindly supplied us with samples from the U.E.C.L. range of connectors, and we were able to modify them satisfactorily. The first step is to cut the connector to the correct length—there should be 20 connectors on each side. Make the cut with a hacksaw, and then use a file to clean up the ends.

The next step is to cut the connector lengthways. This can also be done with a hacksaw, but care is required. First protect the edge connector contacts by taping two strips of paper in the slot where the board normally goes, and then clamp the socket in a vyce, with the jaws clamping each end of one side of the socket. Then gently insert the hacksaw into the board slot, between the paper strips. Keeping the blade parallel to the bottom of the slot, saw the connector in half.

Clean up the edges of the cut with a file, and then solder the rear pins of the two halves to the Veroboard. We found that if we spaced them 0.7" apart, the actual contacts were then 0.6" apart, the required spacing for a 40 pin DIL IC. Solder only the end pins at first, so that you can check the spacing. If it is not quite right, a little judicious bending will put it right. Finally, solder the remaining pins.

We used rainbow cable to make the connections from the DIL socket to the PCB. Care is required not to short out any of the terminations, and to ensure that pin 1 of the test clip is connected to pin 1 of the PCB pin array. At this stage you should clearly mark the test clip so that it will not inadvertently be connected to a device the wrong way round(!).

Clamp the cable where it enters the box, so that the flexing due to normal use


2650
SENSE
A12
A11
A10
A9
A8
A7
A6
A5
A4
A3
A2
A1
A0
ADREN
RESET
INTREQ
A14-D/C
A13-E/NE
M/IO
FLAG
+5V
CLOCK
PAUSE
OPACK
RUN/WAIT
INTACT
D0
D1
D2
D3
D4
D5
D6
D7
DBUSEN
OPREQ
R/W
WRP
GND
PACE
D04
D03
D02
D01
D00
IDS
ODS
NADS
NHALT
CONTIN
JC14
JC15
JC13
NIR5
NIR4
NIR3
NIR2
F11
F12
+5V
D05
D06
D07
D08
D09
D10
D11
D12
D13
D14
D15
−12V
BPS
EXTEND
NINIT
CLK
NCLK
VBB
F14
F13
SCMP
NWDS
NRDS
ENIN
ENOUT
BREQ
NHOLD
NRST
CONT
DB7
DB6
DB5
DB4
DB3
DB2
DB1
DB0
SENSE A
SENSE B
FLAG 0
+5V
−7V
NADS
X2
X1
AD11
AD10
AD09
AD08
AD07
AD06
AD05
AD04
AD03
AD02
AD01
AD00
SIN
SOUT
FLAG 2
FLAG 1
6800
GND
HALT
Ø 1
IRQ
VMA
NMI
BA
+5V
A0
A1
A2
A3
A4
A5
A6
A7
A8
A9
A10
A11
RESET
TSC
nc
Ø 2
DBE
nc
R/W
D0
D1
D2
D3
D4
D5
D6
D7
A15
A14
A13
A12
GND
8080
A10
GND
D4
D5
D6
D7
D3
D2
D1
D0
−5V
RESET
HOLD
INT
Ø 2
INTE
DBIN
WR
SYNC
+5V
A11
A14
A13
A12
A15
A9
A8
A6
A5
A4
A3
+12V
A2
A1
A0
WAIT
READY
Ø 1
HLDA

Microprocessor tester —

will not break the connections to the PCB. At this stage, only the CMOS devices should remain to be fitted. IC sockets should not be necessary. To commence, earth the barrel of your soldering iron to the earth pattern of the board.

Then remove the ICs, one at a time, from their protective wrapping, and insert them into the board. Solder the power supply pins first (7 & 14 or 8 & 16), and then the remaining pins. It is not necessary to solder those pins which are not connected to the circuit.

The final stage of construction is to label the various points on the board. We made up a suitable artwork, and used this to make labels from Scotchcal, which we then stuck to the board. Some of the PCB manufacturers may make silk screened boards available, making this unnecessary.

We also made up artwork for the removable cards used to identify the pin functions of the various microprocessors currently available. These have been printed full size with this article, and we suggest that you cut them out and paste them to cardboard. We have provided five cards, covering the Signetics 2650, the National PACE and SC/MP, the Motorola 6800 and the Intel 8080.

Before you cut the cards to their final size, check the width between the two rows of LEDs. The cards should fit between the LEDs, underneath the rim at the bottom.

The leads used to make the required interconnections on the unit are the same as those used in the new logic trainer. You will only require about 5 or 6, and these can most conveniently be made using the clips from a miniature valve socket. Extract the clips from the socket, and connect them together with short lengths of hookup wire.

To test the completed unit, connect a test lead between the V+ PCB pin and the +5V PCB pin, and then apply power. Monitor the output of the regulator while you do this, and switch off immediately if the output is other than 5V. Assuming that everything is OK, switch to the continuous mode, and set the delay to minimum.

Connect the reset pin to pin 1, and reset-bar to pin 2. LED 1 should emit, while LED 2 should not. Now increase the delay. After a small rotation, LED 1 should go out, and LED 2 should come on. Now connect reset-bar to each of the remaining 38 pins in turn, and check that all LEDs are operative.

If, on first turning on, you find that you cannot reduce the delay sufficiently so that LED 1 comes on, reduce the value of the 6.8k resistor in series with the delay control. The minimum allowable resistance is 470 ohms. On the other hand if you find the delay control has to be rotated more than about half a revolution to get LED 2 to come on, increase the value of the resistor.

Finally, switch to the pulse mode, and check that the display changes only when the pushbutton is operated.

Use of the completed tester is quite simple. Firstly, determine which pin of the system you are to test is the reset pin, and the polarity of the signal required, and connect the appropriate reset pin of the tester to that pin. Then determine which is the positive logic supply pin, and connect the V+ pin to it. Similarly determine the negative or ground pin, and connect the E pin to it.

Then fit the test clip to the microprocessor chip, observing the correct polarity, and switch on the microprocessor. After setting the delay control to minimum, switch on the tester.

Now set the mode switch to continuous, and slowly increase the delay. By comparing the patterns produced by the LEDs with the listing of the program running in the microprocessor, you should be able to see the system in operation. Do not operate the delay control rapidly, as otherwise you may skip right over some steps in the program.

If you have access to a cathode ray oscilloscope (CRO), this can be used to examine the waveforms at the various pins. A positive going sync signal is available at the PCB pin marked sync. This occurs at the same time as the latches are clocked, so that the CRO is automatically triggered at the same time the LED samples are taken, if you connect the signal to the external sync or trigger input.

When the delay is at a minimum (i.e., during the reset period), you may notice the LEDs corresponding to tri-state outputs flickering. This is normal, and is caused by the varying time taken by these pins to return from a high logic level to the low logic level as determined by the pull down resistors.

Finally, switch off the tester before you switch off the system under test, and do not remove the test clip till everything has been turned off.

The total current drain of the tester is about 400mA (when all the LEDs are on), so that about 600mA @ 5v is available for external use from the two pins near the heatsink. If you draw this much, however, a large heatsink will be required.

NOTE: When using the Microprocessor Tester with either of the current National Semiconductor microprocessors (SC/MP I or PACE), it will be necessary to connect the GND pin to the circuit ground directly.

This is because this connection cannot be made via the 40 pin connector and umbilical cord, as these devices do not have a ground connection at the chip itself. In all other respects, operation will be the same as for other systems.

PARTS LIST

1 74C14 hex Schmitt trigger
1 74C221 dual monostable
7 4009 hex inverting buffers
7 74C174 hex D flipflops
1 uA7805, LM340T-5.0 or similar three terminal regulator
40 red LEDs
1 BC327 PNP transistor
1 BC337 NPN transistor
4 EM401 silicon diodes

CAPACITORS
1 2500uF 25VW pigtail electrolytic
2 0.1uF polyester
2 0.0022uF polyester

RESISTORS (all ¼W)
40 4.7M, 1 100k, 41 10k, 1 6.8k, 2 4.7k, 42 390 ohm
1 50k ten-turn potentiometer

MISCELLANEOUS
1 printed circuit board, coded 77up11, 282 x 226mm
1 transformer, 240V to 7.5V, PL1.5-18/20VA or similar
1 SPDT miniature toggle switch
1 SPDT miniature momentary action pushbutton
1 knob
49 PCB pins
5 connecting leads (see text)
1 mains cord, mains plug, cord clamp and terminal block
1 case, wooden or metallic as required (see text)
1 40 pin DIL test clip (see text)
Hookup wire, rainbow cable, solder, tinned copper wire, machine screws and nuts, insulating tape, scrap aluminium

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

RIGHT: Pin identification cards for Signetics 2650, National PACE and SC/MP, Motorola 6800, and Intel 8080 microprocessors.

Announcing the winner of the Dick Smith-Electronics Australia

Mini Scamp Contest

The winner of the Dick Smith-Electronics Australia Mini Scamp microcomputer contest is Mr Kurt Deininger, of Melton, Victoria. Mr Deininger's entry, a microcomputer-controlled swimming pool alarm, was chosen by our judges Dr John Kennewell, Dick Smith and Jim Rowe from the many impressive entries received. It wins for Mr Deininger the microprocessor development system pictured below, valued at more than $2000.

Mr Deininger (second from left) is congratulated by Allan Greening of Dick Smith Electronics during the prize presentation. At left is EA's Victorian representative Keith Watts, while at far right is Mr Deininger's son, Hans. Mr Deininger is a computer programmer for TAA.

Mr Deininger's winning entry fulfilled the aims of our contest particularly well. It represents a practical, down-to-earth application for a microprocessor, although one which at the same time reflects a great deal of design ingenuity.

A swimming pool alarm, it uses the flexibility and "intelligence" of the microcomputer to overcome the drawbacks of conventional designs. A simple scanning-type sensor is used to allow Mini Scamp to continuously monitor the pool water level, but the software performs a number of tests on both average level and wave characteristics, to allow reliable detection of a child or adult having fallen in.

Although Mr Deininger based the alarm on Mini Scamp, to qualify for our competition, it could easily be produced as a very compact dedicated SC/MP system with the program resident in a ROM or PROM. We hope to give a full description of the winning entry in our next issue.

Although they were not rated by the judges quite as highly as the winner, two other entries were highly commended and deserve particular mention. One was an intermittent fault detector for electronic servicing, submitted by Mr John Barry, of Liverpool, NSW. The other was a microcomputer-controlled model train layout, submitted by Mr Stephen Dart of East St. Kilda, Victoria.

These and a number of the other entries were so good that we believe readers will find them of great interest and value. We therefore intend trying to publish as many of them as we can, in forthcoming issues. So stay with us!

And to all those who entered the contest, thanks for your interest and efforts.

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2 new revolutionary, portable electronic games!
No TV set needed!

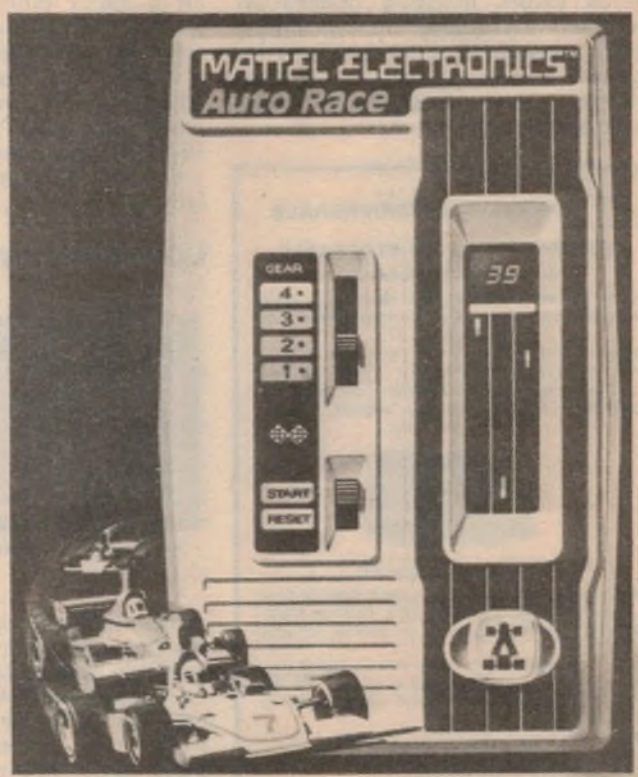
FUTURETRONICS HAVE DONE IT AGAIN. THE PEOPLE WHO BROUGHT TO YOU THE WORLD'S FIRST MICROPROCESSOR BASED CHESS GAME NOW BRING YOU THE ULTIMATE IN PERSONAL ENJOYMENT AND RELAXATION. TWO NEW PORTABLE HAND HELD ELECTRONIC GAMES FULLY ASSEMBLED, WITH L.E.D. DISPLAY, PRECISION LENS, SOLID STATE CIRCUITRY AND REALISTIC SOUND EFFECTS. USES STANDARD 9 VOLT BATTERY (NOT INCLUDED). IT'S YOU AGAINST THE COMPUTER FOR A WHOLE NEW KIND OF EXCITEMENT, FUN AND CHALLENGE.

MISSILE ATTACK

ICBM alert! Computer-controlled missiles attacking! You command anti-missile missiles! Push the fire button. Intercept. Save "Your City"! (Lose and you'll hear part of "Taps".)
Game features automatic digital scoring, launch and guidance controls, and realistic sounds.

AUTO RACE

The race is on! Computer-controlled cars coming straight at you. Steer! Shift! Avoid a collision and beat the clock! (Hear the sound of victory!)
Game features automatic digital timer, steering and gear shift controls, plus realistic race sounds.



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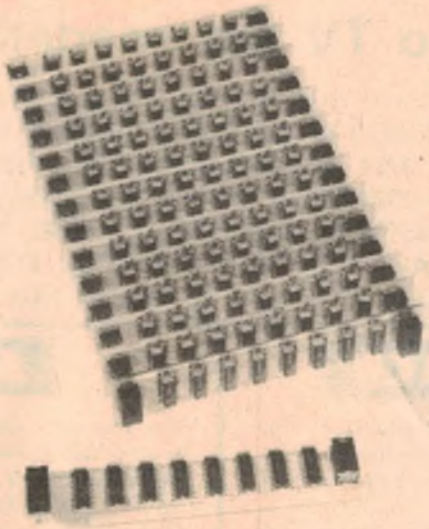
Microcomputer News & Products

RAM "sticks"

An innovative memory product designed for the home computer market has just been released by Applied Technology. It is a 1k x 8-bit RAM "stick" module, whose design allows ready stacking for memory system expansion.

Announcing the new product David Brown, Applied Technology's sales manager, said the RAM stick filled a real need for the microprocessor user who wanted to build up his system's memory in convenient, practical and easily affordable increments. "We chose low power 2102 chips for the design because these are one of the most cost effective RAMs on the market today — and being static they are by far the easiest to use."

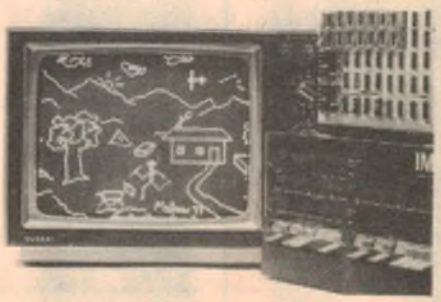
The RAM sticks are supplied fully assembled, 100% tested and burned-in for 24 hours using a processor-controlled test routine. The test routine checks continually for fundamental memory errors as well as complex "pattern errors" which plague some memory systems.



Applied Technology has also designed a 32k x 8-bit memory unit with power supply and standby rechargeable battery, which mounts in a standard instrument case or rack mounting. The memory can also be configured as 16k x 16 bits for use with 16-bit microprocessors.

Enquiries to Applied Technology Pty Ltd, 109 Hunter St, Hornsby, NSW 2077.

Low cost graphics



Modified CRT graphics controllers with external sync capability are now available from Matrox. The modified controllers are their MTX-256, ALT-256 and MDC-256. The external sync facility permits the use of multiple cards to build up a variety of high resolution graphic imaging systems, with either grey scale or colour capability.

The graphics system can also be synchronised to external sources such as the Matrox MTX2480 alphanumeric VRAM (video RAM), or a TV camera, where video mixing is desired. A light pen capability can now be implemented in hardware or software. Demanding graphics applications can thus be handled at a fraction of the cost of competing systems.

Enquiries to the Australian representatives for Matrox, Measuring and Control Equipment Co. Pty Ltd, PO Box 78, Epping, NSW 2121. Telephone (02) 86 4060.

"Interface Age" here

The US magazine "Interface Age", specialising in microcomputing for the home and small business, is now available in this country on subscription via Computerland/Electronic Concepts, at 55 Clarence St, Sydney. The cost is $21.60 for 12 issues, or $45 for earlier delivery via Jetspeed.

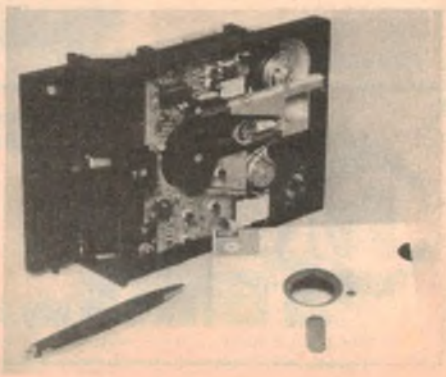
By courtesy of Computerland we were able to look at a sample copy of the magazine, that for September 1977 (V2, No. 10). The feature of that issue was an insert "floppy ROM" flexible disc recording, with a general ledger program for small business use. This is being fully documented in the magazine itself.

In all, we found Interface Age a very mature and down-to-earth magazine, and one which should be of value to most serious micro users.

Mini floppy from BASF

BASF, one of the largest magnetic media suppliers in the world, has announced a mini floppy disc drive compatible with the newly standardised 134mm flexible disc media. Called the model 6106, the new drive measures 191 x 146 x 76mm. It rotates the mini discs at 300rpm, recording at 2581 bits per inch on 35 tracks. The track density is 48 tracks per inch, and the tracks may have from 1 to 16 sectors.

Data transfer rate is up to 125 kilobits per second, with an average track-to-track access time of about 220 millseconds. The 6106 has been rated for MTBF at 5000 hours under heavy usage, but will perform more than 8000 hours with regular usage.



Beware a wolf in sheep's clothing.

Now only $129·50

Cat D-1620

Or is it a Wasp in sheep's clothing?

The simple, elegant lines of this deluxe new AM CB may fool you. It looks a million dollars, works as good as it looks—and should cost just as much, right?

Wrong. This high performance Wasp is surprisingly economic. Just think of how many AM sets you've seen with RF gain control. The Wasp has it. Or delta tune. Switchable noise limiter AND blanker. Transmit indicator. LED channel readout (of course!). It also has the mundane things like volume, squelch, PA, etc.

Remember the Wasp. Designed for Australia with phase-locked-loop frequency synthesis for ultra-stable performance.

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Look for the sheep's clothing.

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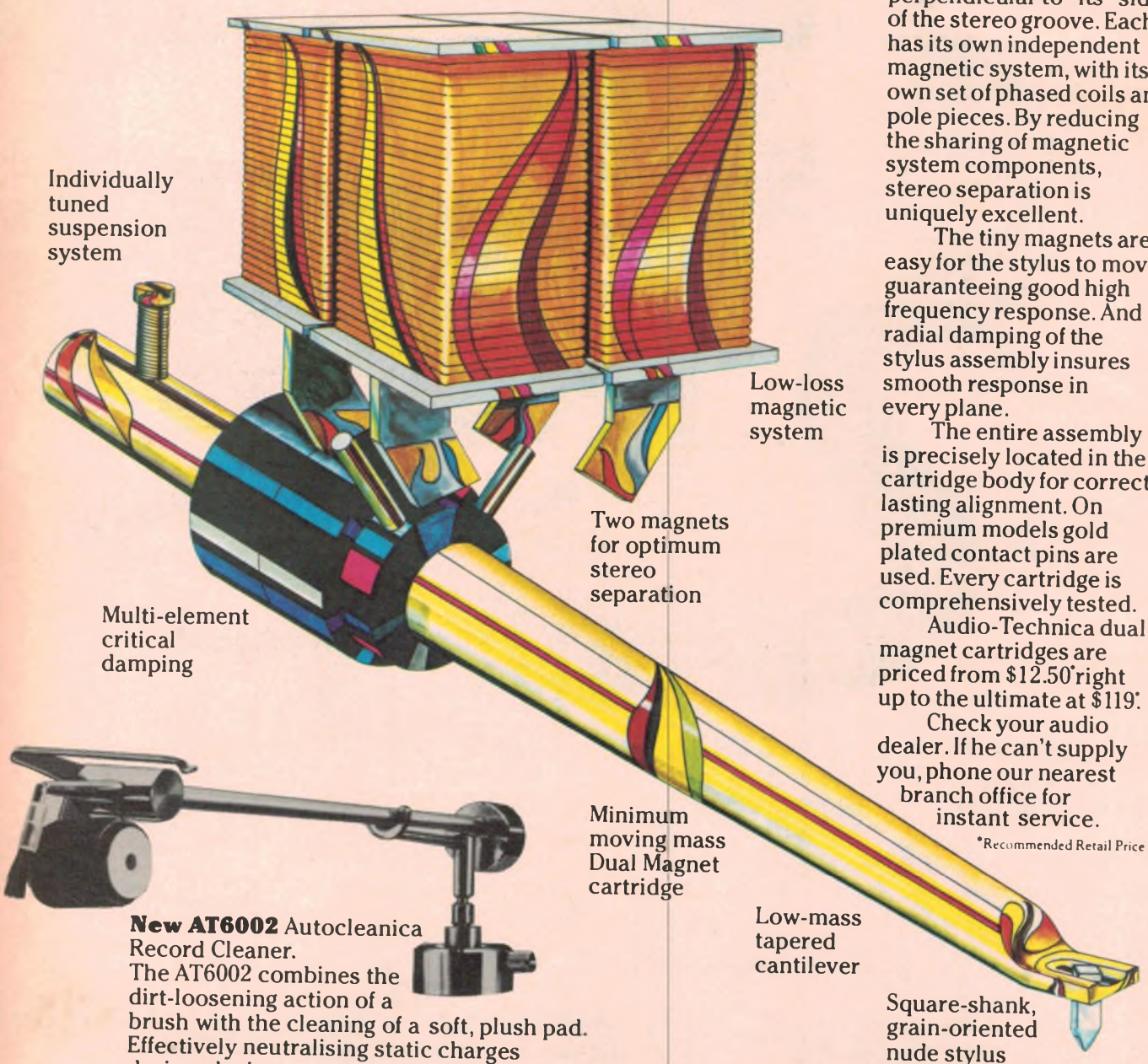
Why Audio-Technica Dual Magnet Cartridges are different.



Individually tuned suspension system

Low-loss magnetic system

Two magnets for optimum stereo separation

Multi-element critical damping

Minimum moving mass Dual Magnet cartridge

Low-mass tapered cantilever

Square-shank, grain-oriented nude stylus

They have two tiny high energy magnets mounted almost at the fulcrum of the stylus cantilever. Each is perpendicular to "its" side of the stereo groove. Each has its own independent magnetic system, with its own set of phased coils and pole pieces. By reducing the sharing of magnetic system components, stereo separation is uniquely excellent.

The tiny magnets are easy for the stylus to move, guaranteeing good high frequency response. And radial damping of the stylus assembly insures smooth response in every plane.

The entire assembly is precisely located in the cartridge body for correct, lasting alignment. On premium models gold plated contact pins are used. Every cartridge is comprehensively tested.

Audio-Technica dual magnet cartridges are priced from $12.50* right up to the ultimate at $119*.

Check your audio dealer. If he can't supply you, phone our nearest branch office for instant service.

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New AT6002 Autocleanica Record Cleaner.
The AT6002 combines the dirt-loosening action of a brush with the cleaning of a soft, plush pad. Effectively neutralising static charges during playing.

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Soundline Pty. Ltd., 883 Wellington Street, Perth. WA 6000 Phone: 22 5177

123 Abbotsford Road, Mayne. Qld. 4006 Phone: 52 2480

Wills & Co. Pty. Ltd., 7 The Quadrant, Launceston. Tas. 7250 Phone: 31 5688

PKB89201

The 6106 drive consists of read/write and control electronics on a single PCB, read/write head, track positioning mechanism, drive mechanism and the removable disc in its sleeve.

BASF says it has aimed the 6106 drive for OEM use in the calculator, desk-top computer, terminal and word processing markets. It regards the mini floppy as an excellent alternative to paper tape, magnetic cassettes and magnetic cards, offering higher power and reliability while being competitive in size and cost.

For further information regarding the BASF 6106, contact the EDP Media and Systems Division of BASF Australia, 11B Lachlan Street, Waterloo NSW 2017.

New SWTP terminal

Paris Radio Electronics, distributors of Southwest Technical Products systems and peripherals, has advised that it now has stocks of the new CT-64 terminal kit. An assembled CT-64 is shown above, complete with the matching SWTP 10MHz monitor.

The CT-64 stores and displays either one of two pages, each consisting of 16 lines of either 32 or 64 characters. The number of characters per line is jumper programmable, and a jumper may also be used to change the terminal from 50Hz to 60Hz operation. The full 7-bit upper and lower case ASCII character set is displayed, with either white-on-black or black-on-white operation.

An interesting feature of the CT-64 is that all 32 ASCII control characters are decoded, with some 21 decoder outputs available for user-defined control tasks.

Other features include optional control character printing, screen reversal on individual characters for highlighting, and selectable page mode/scrolling mode operation. The basic CT-64 is designed for parallel data input, but a serial interface option is available, as is an ASCII keyboard.

The matching CRT monitor shown above offers bright, well-focused character display. The 10MHz video bandwidth ensures optimum character resolution with 64-character lines.

For further information on the CT-64, including price, contact Paris Radio Electronics at PO Box 380, Darlinghurst, NSW 2010.

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Classical Recordings

Reviewed by Julian Russell

Previn: "elegantly presented" at a budget price

PREVIN — Recital of Seven Pieces; played by the London Symphony Orchestra; conducted by Andre Previn. RCA Stereo VICS-1751.

The Vaughan Williams overture "The Wasps" was not very enthusiastically reviewed by me in this column last month though I had nothing but very high praise for the other items on the disc played by Constantin Silvestri and the Bournemouth Symphony Orchestra. But I much prefer this reading by Andre Previn conducting "The Moths" with the London Symphony Orchestra.

RCA manage to get no fewer than seven pieces, most of them popular, onto this one disc. Its sales are plainly aimed at lovers of light classical music of the better type.

It is not beneath Previn's dignity to devote the same care — and sometimes brilliance — to these often hackneyed items. It might be called a jumble sale of short orchestral pieces where here and there you might well pick up a real bargain.

Nor has RCA spared any trouble over the excellence of the engineering. The London Symphony Orchestra always gives me the impression of enjoying playing for Previn — and vice versa. In fact the performance of Prokofiev's always fresh-sounding "Classical Symphony" is the best that I can recall. It is quite without condescension or false naivete.

Previn takes Satie's Gymnopedi No. 1 a little slower and more romantically than is usual — I think I prefer it a little faster. But despite its tempo Previn always preserves its classical, perhaps severe, outline, a fact due to the delicious playing of the oboe solo by John de Lancie.

Then comes a vigorous account of Mendelssohn's Ruy Blas Overture with Previn stressing the drama with contrasts of dynamics always in the very best possible taste. It is so long since I heard this work that I found myself enjoying it very much indeed.

You'll find The Wasps overture, mentioned above, on the first band of the reverse side. It makes a fine contrast to all that has gone before. The playing is as bright as a button with just the right amount of busyness. And the more expansive middle section is cream smooth and lyrical. The whole overture is treated with the greatest refinement.

While still in the insect world you have Rimsky-Korsakov's "Flight of the Bumblebee", a virtuoso piece and handled here in that fashion. I think it is too well known to need any further information.

Rimsky-Korsakov is also represented by the slow movement of his almost equally well known slow movement from his "Scheherazad Suite". This is lusciously played without anything being overdone. The string legatos are very impressive as are the rapid ornaments in the woodwind.

The recital ends with a suite of irresistible waltzes from Strauss' "Rosenkavalier". In this the LSO gets very close to the right swing in the accompaniment, a difficult feat for any non-Viennese orchestra to bring off.

Every item on this disc is so elegantly presented that it could well be a good test of the sensitivity of your equipment. I wouldn't have spent all this space on it if it hadn't been to show my admiration for so much expertise — and at a budget price.

☆ ☆ ☆

HAYDN — Piano Trios Nos. 13, 16 and 17. Beaux Arts Trio. Philips Stereo 9500 035.

Haydn wrote 45 trios and in most of them the piano has the dominant role. Present indications are that from time to time Philips will add more discs to this one until the whole 45 have been recorded. In most of these the cellist is the junior member, the violinist a busy executive, but the piano is, so to speak, the managing director. In fact his role is pretty well unceasing.

The fact that the three trios under review are played by the Beaux Arts group is a guarantee of their excellence — I mean the playing. It is in the nature of things that the pianist, Manahem Pressler, should stand out, but this he does so discreetly that he never seems to be hogging the score. The violinist, Isadore Cohen, usually echoes Pressler's statements, always admirably and cellist Bernard Greenhouse makes his usually modest contribution for the most part without being overwhelmed.

In all three trios both form and content are full of delightful surprises. But then which work of Haydn isn't?

I don't know where this present disc was recorded but, wherever it was, it was under the very best of conditions. The sound-balance, clarity and fidelity are all beyond praise. If the other 42 trios are of the same quality they will be well worthwhile waiting for.

☆ ☆ ☆

MOZART — Eine Kleine Nachtmusik KV525. Violin Concerto in A Major, KV219. Wolfgang Marschner (violin) and the Wolfgang Marschner Chamber Orchestra. Christophorus-Verlag. Stereo SCGLB75923.

This is a completely worthy performance of Mozart's most popular serenade. It has all you might expect from a good German chamber orchestra. All the right instructions are carried out and it is very well recorded although the surface of my pressing is far from immaculate.

The tempos are right and the sound is always musical. It is throughout a thoroughly scholarly performance not without its moments of real charm. I could not find a single note out of place, yet the general effect is never mechanical — an excellent classical reading.

As soloist in the 5th Violin Concerto, Marschner shows more warmth in the first movement, as does his orchestra which he himself conducts. It is only because of the abundance of chamber orchestras nowadays that we don't, I think, hear more of this combination.

There is nothing very inspiring in the slow movement except its technical perfection. Personally I don't like my Mozart over-expressed, but Marschner and his excellent players are, for much of the time, a trifle too deadpan for my liking.

☆ ☆ ☆

VIVALDI — Four Oboe Concertos. RV447, 450, 460 and 463. Heinz Holliger (oboe) with I Musici. Philips Stereo 9500 044.

When the Basle Chamber Orchestra visited Australia some three years ago many discerning musicians were struck by the tonal beauty, phrases of unusual length and the agility of fingers and lips

THE BEGINNING . . .

of the chain of audio reproduction is usually a disc. To our current range of audiophile recordings (HSF75, ARK by Fulton and Stereo Review) we are pleased to announce the first Australian release of the following:

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of the oboist Heinz Holliger. He was also a delightful and unassuming chap to talk to after the concert.

Well here you have him in four Vivaldi concertos and to describe his playing of all four as ravishing is no overstatement. Another spectacular feature of his playing is his ability to allow the sound to die away gradually at the end of some phrases. Now the way Holliger does this is a very difficult feat indeed and it is, perhaps, his knowledge of just how well he does it that encourages him to use the effect just a trifle too often.

But when you remember that on the concert platform he would probably play only one of these concertos and that here he plays four, goes far to make this, I feel, a somewhat churlish remark about this tiny mannerism. After all you don't have to listen to all four at one sitting.

The engineering is superb, with a real chamber music balance. And I repeat confidently that on this disc is some of the most elegant oboe playing you will ever be likely to hear. Moreover it all sounds so effortless that I could only marvel at its perfection.

The accompaniments supplied by I Musici are all of the same high standard. Again to avoid any more superlatives all I can recommend is that you buy it. It should provide endless enjoyment.

☆ ☆ ☆

RAVEL — Daphnis and Chloe. Complete Ballet. Boston Symphony Orchestra conducted by Charles Munch. RCA Gold Seal Stereo AGL1-1270.

The late Charles Munch could be a very uneven conductor, sometimes brilliant, sometimes dull. Indeed I remember hearing him in Paris conduct a French orchestra, in a concert celebrating the 50th anniversary of Debussy's death, in a manner that I found boringly clumsy.

This concert, as if to advertise the French love of La Gloire, was entitled "Homage of the City of Paris to Claude Debussy". It was held in the Theatre of the Champs-Elysees, decorated with 10,000 Gloire de Dijon roses, and with the Garde Republicaine in full dress uniform and with drawn sabres lining the staircases.

You would think this an occasion to inspire any group of players — but no. The concert was mediocre in the extreme, not only Munch's readings but the general coarseness of the playing, too.

During his visit to Sydney some years ago with the Boston Symphony Orchestra, at the end of an unremarkable performance of "Berlioz's Symphonie Fantastique" in the Town Hall, the tolling of the bell was quite deafening.

In this present recording of "Daphnis and Chloe", Munch sets out to really "sell" Ravel's wonderful score. His opening is quite convincingly mysterious until the chorus enters, when all mystery flees. And despite the skill with which the disc has been remastered the sound is later a bit congested in the ffs.

Throughout the recording the bringing forward of the chorus is too often at the expense of the orchestra which occasionally becomes almost inaudible. And I know this is difficult to believe, but there are sometimes some downright lifeless passages.

But here and there Munch gets the score to glitter quite excitingly. The 7/4 Dorcan's Dance, for instance, although it is beautifully and delicately attacked in the woodwind passages, coarsens in tone towards the end. All through the ballet Munch tends to pay too much attention to the confectionary department — harp glissandos and so on.

Ravel was essentially a miniaturist despite his two lovely and witty one-act operas. Daphnis is his greatest orchestral work. Indeed he nearly blew himself up writing it and, with the score finished, he took a very long holiday before resuming composition.

In some of the exquisite detail in the scoring the Boston players don't seem to be quite up to their top form and I begrudge every note I miss in this superb work by one of the greatest writers for orchestra of this century. Many passages I waited for could not be heard on this disc. And the chorus seldom sounds as remote and disembodied as it should. I still prefer Momteux's performance of the work.

There is also an irritating turnover. Altogether a bit disappointing though the sound improves if you use a bit more gain than usual. The surface on the second side of my pressing is a bit prickly.

☆ ☆ ☆

BRAHMS — Violin Concerto. Gideon Kramer (violin) with the Berlin Philharmonic Orchestra conducted by Herbert von Karajan. EMI Stereo-Quadraphonic OASD 3261.

Here is another name new to me — Gideon Kramer — a violinist with a luscious full tone just right for dominating the fine playing of the Berlin Philharmonic under Von Karajan. Kramer's reading, admirably mirrored by Karajan, is big enough to suit the massive work admirably.

Kramer may be a newcomer to recordings in this country but I am sure he will soon be a great one. The collaboration with Karajan comes off splendidly on stereo although my pressing is compatible stereo/quadraphonic.

Most record buyers of serious music are likely to already own one or perhaps more alternative versions of this, one of the last of the great symphonic violin concertos. But whichever you might already own, you'll find it difficult to better this one. If you want a sample listen to the perfection of the double stopping in the cadenza.

I am not surprised that (according to the sleevenotes) Karajan, not a man to throw praise around idly, stated after the recording session that . . . "Kramer is, in my opinion, the greatest violinist in the world". I am inclined to agree with him despite other contenders for that title. After all when you get up into this bracket just how do you decide who is best among equals — I'll spare you the Latin for this quotation.

The second movement is as beautifully expressive in both the solo and orchestral parts, and though I am no slavish admirer of Brahms it moved me deeply. And the formidable Finale also leaves nothing that I felt could be improved on. The sleevenotes also mention that this 30-year-old newcomer was a pupil of the late great David Oistrakh. I have often pointed out how difficult it is for a reviewer to convey his sense of perfection about a performance without resorting to a monotonous use of superlatives. I am facing the same difficulty again with this disc. I can only say that here is a performance that will probably be unrivalled in what is left of my lifetime. By the way, Kramer uses the Kreisler cadenzas and the balance between violinist and orchestra is perfect at all times.

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Lighter Side

Reviews of other recordings

Devotional and Christmas

THE SPIRIT OF CHRISTMAS BRASSED. The Annopolis Brass Quintet. Stereo, Richardson Records RRS-5. (From M. R. Acoustics, P.O. Box 110, Albion, Qld 4010).

A strange title, I must say, but behind it lurks a very impressive recording. It does not say so on the label but the distributors suggest — and I agree — that it carries the sonic stamp of the ARK-Fulton discs, reviewed recently and also distributed by M.R. Acoustics. The sound is very open, very clean and the pressing is beyond criticism. Top flight sound indeed.

But thirteen tracks of a brass quintet? Would it not be rather much for anyone but a band instrument enthusiast? In fact, no. The Annopolis Brass Quintet is a very capable group, who know their instruments, their audience and their music. You will find it no effort at all to listen, as they present a varied program of Christmas music from different lands and different periods:

Crisp English Carol Medley — Adeste Fideles — Joy To The World — El Cant Dels Ocells — Swiss Chansons — The Twelve Days Of Christmas — O Come, Emmanuel — A Spanish Medley — The First Nowell — Good King Wenceslas — O Holy Night — Von Himmel Hoch, Da Komm 'Ich Her — We Wish You A Merry Christmas.

If you plan to buy only one Christmas record, this would be well worth considering. (W.N.W.)

☆ ☆ ☆

MORE THAN WORDS. Parable. Maranatha, stereo HS 777/22. (From S. John Bacon Publishing Co, 13 Windsor Avenue, Mount Waverley, Vic. 3149.)

"Parable", featured on this album, is a typical Gospel Group presumably accessable for hiring through Maranatha Music, Irvine, California. Most of the music presented is by Chuck Butler and, while it is in modern format, with elements of soft rock, it is much nearer to middle-of-the-road than the sound from other recently featured Gospel groups.

In fact, with the lyrics printed in full on a sheet inside, anyone with reservations about these "new fangled" Gospel songs could reasonably invest in this musically fairly conservative example and form their own opinion.

The titles: More Than Words — All Alone — Sweet, Sweet Song — Maybe — Someone's Callin' — I Know What It's Like — Peter, James & John — On Your Own — Let The Old Man Die — Friends — Song For The Church — Goodbye — 16 Petersham Place.

Diction is average but, with the lyrics available, there is no problem anyway. The actual sound quality is excellent and the pressing surface is free from noise. Good family gospel listening. (W.N.W.)

☆ ☆ ☆

HAND TO THE PLOW. Paul Clark. Stereo, Seed Records PSR-005. (From Sacred Productions Australia, 181 Clarence St, Sydney, and other capitals.)

Paul Clark wrote all the songs on this album, played acoustic and classical guitar, piano, drums and synthesiser, took lead and back-up vocals and created special effects. A versatile young man indeed, but he is also backed by a group of other musicians and vocalists, who are appropriately credited in the jacket notes.

The words of the songs, given in full on the inner sleeve, are entirely devotional, expressing old-time Christian values in the modern idiom. The music, too, is in the modern idiom, ranging from straight rock in the opening tracks to a much quieter mood towards the end. But it's essentially music for today's youth, and that's where Paul Clark's appeal will lay.

The quality of the sound is very clean. (W.N.W.)

Instrumental, Vocal and Humour

THE JAZZ ALBUM. Rob McConnell and The Boss Brass Attic LAT 1015. Astor release.

The Attic label is a product of the Canadian Broadcasting Corporation, to showcase local talent; a job it does very well, judging by this record. There are five long tracks: It's Hard To Find One — Portrait Of Jenny — My Man Bill — Body and Soul — That's Right, all with a bright brassy big band sound about them that's easy to listen to. The record jacket has a group portrait of the 21 musicians involved and the instruments are listed for each track. The quality is good. (N.J.M.)

☆ ☆ ☆

THE GRAND WALDO DE LOS RIOS. Hispavox L-36251 Festival release.

Waldo De Los Rios does his usual thing with the popular classics with two tracks each from Beethoven, Mozart, Verdi and Tchaikovsky. The music usually starts in a fairly straight fashion; then the rhythm section makes its presence felt in no uncertain manner and the orchestra starts to swing.

Some purists might object but it makes for pleasant listening, with the technical quality the usual high I have come to expect from Hispavox. This record is one of a continuing series, with operas, concertos, overtures and symphonies all getting the same treatment. Some of the tracks are: The Marriage Of Figaro — Nabucco — Romeo and Juliet — La Traviata — Pastoral Symphony. (N.J.M.)

☆ ☆ ☆

"PORTS." Perry Botkin Jr. A&M L36280. Festival release.

I had not heard of Perry Botkin Jr. before listening to this record. More's the pity, as the group he leads produces

Reviews in this section are by Neville Williams (W.N.W.), Jamieson Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J. M.), David Edwards (D.W.E.) and Greg Swain (G.S.).

THE LIGHTER SIDE

some very pleasant music, mainly jazz oriented in nature, with such titles as: The Lovers — Lady Ice — Don't Believe The Laughter — Eternal Sunrise — Looking For Home — Nadia's Theme — Bless the Beasts and Children — Bridges — You've Gone Away — Ports — Gymnopedies I.

The team is made up of a number of well known West Coast recording artists, including Bud Shank on flute and alto sax and Tommy Morgan on harmonica. Apart from a surface crackle on the opening tracks of each side, the quality is excellent; in all a very enjoyable disc. (N.J.M.)

☆ ☆ ☆

FRANCIS LAI — THE MAN AND HIS MUSIC. Image Records Pty Ltd. Stereo ILP4945.

My expectations were rather high after reading the cover notes of this album. Francis Lai is the man who composed such well known movie themes as "Theme from Love Story" and "A Man and a Woman". These are featured here, in company with 10 other Francis Lai compositions.

However, I must confess to a growing feeling of indifference after a listening session, at least as far as the majority of tracks are concerned. The style is, perhaps, a little too avant-garde for my personal taste; maybe for yours also.

The track titles are: Theme from Love Story — Dance Of Love — Under Our Star — Solitude — Love in the Rain— The Legend of Frenchie King — A Man and a Woman — For a Shadow — For the Blood of Others — The Blue Rose — African Summer — Happy New Year.

Have a listen before deciding to buy. Record quality is good. (G.S.)

45rpm

PICTURES AT AN EXHIBITION (Moussorgsky/Ravel); TILL EULENSPIEGEL (Strauss); SLAVONIC DANCE NO. 8 IN G MINOR OP 46 (Dvorak). Orchestre Mondial de Jeunesses Musicales conducted by Pierre Hetu. 2-record set, stereo, 45rpm, Musicus MS2-45101. (From M.R. Acoustics, P.O. Box 110, Albion 4010 Qld.)

The immediate point of interest about this record is the fact that it is intended to spin at 45rpm — an unusual speed for a 12-inch album. While it imposes a proportional reduction in the playing time, it does open out the waveforms and holds the promise of a more transparent sound. And this is clearly where the production team placed the emphasis, using twin microphones in the concert hall feeding straight into the master tape recorder, without the intervention of compressors, equalisers, noise processers, etc, which "generally do more harm than good". For their French customers they explain "fait generalement plus de tort que de bien".

And the sound is good, very good. I'm not prepared to say that it excells the best 33s that I've heard but it's certainly well above average, with no suggestion of that stringy, messy build-

THE LIGHTER SIDE

up that can occur when a recording chain is being pushed towards its limit.

Recorded in Montreal, it features the Youth Orchestra that attended the 21st Olympiad in that city in 1976. Classical buffs may have stronger views than mine about relative performances but if, like me, your interest centres on the technology of the recording, and on its potential as a demonstration disc, you won't argue with their effort musically. Incidentally, side four concludes with a 1kHz reference track for system balance: 30 seconds of gauche (left), 30 seconds of droite (right) and 30 seconds of gauche + droite.

Another interesting record, thanks to the initiative of M.R. Acoustics. (W.N.W.)

☆ ☆ ☆

JOSEPH SEAL PLAYS. Wurlitzer pipe organ. Stereo, Astor PKL-5557.

Here's yet another album from veteran English theatre organist, Joseph Seal. Played on the three-manual pipe Wurlitzer at the Musical Museum in Brentford, it recaptures, without apparent effort, the atmosphere of similar instruments played in movie houses around the world.

As distinct from artists like Jesse Crawford, who tended to linger over melodies, Joseph Seal hurries some of these through in a demonstration of digital dexterity. But, as often as not, that was part of the show: Down The Mall — I Only Have Eyes For You — Over The Waves — Swedish Rhapsody — Bells Across The Meadow — Swing O' The Kilt — Warsaw Concerto — Temptation Rag — Melodies From Coppelia Ballet — A Nightingale Sang In Berkeley Square — Liebefreud — Forgotten Dreams — Hungarian Dances.

The sound is good and, if you haven't treated yourself to an old-fashioned Wurlitzer for a while, why not make it this one? (W.N.W.).

☆ ☆ ☆

PARIS WAS MADE FOR LOVERS, Michel Legrand and his Orchestra. Image ILP 4946, series 498. Astor release.

This mainly orchestral helping of pleasant music is from the soundtrack of a film of the same name, with two vocals from Michel Legrand and one each from Dusty Springfield and Matt Monro. With a distinctly French flavour, it all makes for enjoyable listening.

Some of the tracks: Paris Was Made For Lovers — Where Love Begins — A Place In Paris — Concert For Cabs — Pavanne For People — Sea and Sky — Where Love Ends — Fanfare.

The cover notes give a brief biography of Michel Legrand. The quality is good. (N.J.M.)

Bushwackers Band

MURRUMBIDGEE. The Bushwackers. Image stereo ILP-776. Astor release.

Having spent my boyhood in the bush, where it was no compliment to be referred to as a "bushwacker", I find it hard to identify with Australians who call themselves by that name, and who affect the songs, the accents and the style of what I suspect was a prettty rare breed of countryman. Most of the hayseed musicians and vocalists who crossed my boyhood path seemed far more involved with traditional Irish and Scottish tunes.

My problem aside, the Bushwackers, emerging in an unlikely fashion from a university background, have picked up and adopted a large repertoire of Australian bush tunes, and were chosen to provide the soundtrack of the TV bushranger series "Cash & Co", and later the theme for "Ben Hall". They've performed throughout Europe, the British Isles, and Hong Kong and, as I write, are currently on tour in Australia. They appear to have been very well received, with highly quotable reviews in the press.

Their album didn't turn me, personally, into an instant bush ballad enthusiast but this must be said: their feeling for bush music and their evident musicianship has produced a sound and an impact which is an effective compromise between what often sounds very corny and commercial Australiana like "Waltzing Matilda" and "Click Go The Shears".

The track titles: Augathella Station — Lachlan Tigers — Billy Of Tea — Cold Feet — Rain Tumbles Down — Streets Of Forbes — The Cameo — Tomahawkin' Fred (The Ladies' Man) — Murrumbidgee River — Flashjack. (W.N.W.)

☆ ☆ ☆

JOAN BAEZ. Golden Hour GH843. Astor Release.

Those who do not already own an album featuring the brilliant American folk singer Joan Baez should not miss this opportunity. Seventeen songs are featured in all, each sung with a conviction that shows a genuine sympathy for the human condition. Listen to the remarkable "There But For Fortune" (2nd track, side 1) if you need further convincing.

Tracks on this album are: We Shall Overcome — There But For Fortune — Plaisir d'Amour — Babe I'm Gonna Leave You — The Night They Drove Old Dixie Down — Don't Think Twice It's All Right — Long Black Veil — A Hard Rain's Gonna Fall — It Ain't Me Babe — Black Is The Colour — The Last Thing On My Mind — Help Me Make It Through The Night — Farewell Angelina — Bachianas Brasilias No. 5 Aria — Lady Come From Baltimore — It's All Over Now Baby Blue — Hush Little Baby.

Record quality is excellent. Recommended. (G.S.)

☆ ☆ ☆

FUNDAMENTAL ROLL. Walter Egan. United Artists L-36275. Festival release.

Walter Lindsay Egan has piercing blue eyes, and composes and sings very acceptable rock and roll music. Since this is his first record (to my knowledge), the pun in the title is excusable. Aided and abetted by Stevie Nicks and Lindsey Buckingham, he has produced a very listenable album.

Tracks featured are as follows: Only The Lucky — Won't You Say You Will — Waitin' — Feel So Good — Yes I Guess I Am — When I Get My Wheels — Where's The Party — She's So Tough — Tunnel O'Love — Surfin' & Drivin'.

Recording quality was excellent, except that the copy submitted for review had some foreign matter stuck to it which caused the stylus to jump from groove to groove on the last track. (D.W.E.)

New Products

BWD 539D 25MHz dual trace oscilloscope

BWD Electronics is a local manufacturer whose name is now well established both in Australia and overseas. Here we review the Model 539D dual trace oscilloscope recently released by BWD. It features a bandwidth from DC to 25MHz and a maximum sensitivity of 5mV/cm.

The BWD Model 539D dual trace oscilloscope is a new version of BWD's well proven 539 series. Improvements to this latest model include extended bandwidth and improved timebase facilities.

Overall dimensions of the Model 539D are 190 x 250 x 420mm (W x H x D), including handle knobs and feet. Mass is 6.3kg. A tilting bail is fitted to enable adjustment of the viewing position.

Vertical deflection sensitivity is variable in 12 ranges from 5mV/cm to 20V/m. In addition, the vertical amplifiers can be cascaded to give a sensitivity of 0.5mV/cm at a bandwidth of 12Hz to 100kHz (-3dB). By selecting TV trigger the minimum input signal required for triggering is less than 1mV p-p, enabling signals at this low level to be displayed with good stability.

Selection of chopped or alternate trace is by means of a separate pushbutton switch to the left of the CH-1 vertical sensitivity control. Alternatively, CH-2 can be turned off to give a single trace display for CH-1 only.

Twenty-one ranges (the manual says 19) in a 1-2-5 sequence are provided for the timebase, giving sweep rates from 0.5uS to 2sec/cm. A 5 to 1 vernier extends the sweep down to 10sec/cm. In addition, the horizontal trace position can be pulled out to provide five times magnification of the sweep signal.

Vertical inputs can be either AC or DC coupled, or grounded. Input impedance is 1M shunted by 35pF. AC bandwidth is 2Hz to 25MHz -3dB points) referred to 4cm deflection at 50kHz, with useful response to 30MHz or beyond. These figures make the 539D suitable for service work on CB transceivers and amateur equipment working up to 30MHz.

An attractive feature is that the timebase may be switched off to give X-Y operation, with the CH-2 signal becoming the horizontal component.

This makes Lissajous figure operation or similar comparison of two signals an easy matter. Back panel facilities include timebase out and "Z" modulation.

In common with most modern CROs, no provision is made for direct access to the plates. Observation of waveforms is thus limited by the response of the amplifiers.

An active sync separator is employed to enable TV waveform displays with line or frame lock. In addition, the sync separator can be used as an AM demodulator, enabling double or single sideband displays to be locked to the modulation envelope.

The calibrator waveform is referred to zero crossover of the mains voltage waveform. When this waveform is used to provide external trigger for the timebase, it enables accurate phase measurements on line operated equipment. For example, the firing angles of thyristors or triacs can be measured to within two or three degrees.

Front panel layout of the 539D is conventional and straightforward. All controls are legibly marked, and the unit is easy to drive. A well written manual accompanies the unit, and outlines a number of useful measurement techniques.

Also included in the instruction manual are a frequency response chart and a nomograph for estimating the true rise time of waveforms as observed on the 539D. Another useful nomograph is shown for measuring phase angle using a Lissajous display. The frequency response chart gives approximate calibration correction to beyond 40MHz, thus extending the useful measuring range of the instrument.

A range of accessories is available for the 539D. BWD list such items as probes, cameras, dust covers and a carrying case.

Overall impressions of the 539D are good. The 539 series is a well proven design that has been refined over the past few years, and is backed by good service facilities. A big feature of the unit is the comprehensive instruction manual.

Price of the BWD 539D is $465 plus sales tax where applicable. Further information can be obtained from BWD Electronics Pty Ltd, Miles St, Mulgrave, Victoria 3170.

Footnote: BWD Electronics has donated the unit pictured as the prize for a competition to be run in conjunction with "Electronics Australia". Details appear elsewhere in this issue.

Miniature relays for industry

A range of 12V and 24V "Mini Relays" is now available from Robert Bosch (Australia) for use in industrial and automotive applications.

Features of the Mini Relay include: long life (more than 250,000 cycles); 30A contact rating; compact size (26 x 26 x 19mm); and choice of contact configuration (single, double or changeover).

Enquiries to Robert Bosch (Australia) Pty Ltd, PO Box 66, Clayton 3168.

Digital Frequency Meter from JR Components

JR Components has released a "special features" kit for our 200MHz Digital Frequency Meter, described in the March 1977 issue. A high stability crystal is included, with a frequency tolerance of ±30 PPM.

The sample kit submitted for review was fully assembled, and appeared to comply with the March 1977 article in all respects. The special features of the unit include an aluminium chassis with a black "Maviplate" cover, a fibreglass PCB with screened component overlay, a choice of input sockets (BNC or UHF) at no extra charge, a silk screened "Polaroid" front panel, and the special crystal.

This latter component is one of the NC-18A types, with a frequency tolerance ±30 PPM at 25 degrees C, and a temperature characteristic of ±30 PPM over the range from -10 to +60 degrees C. The ageing characteristic is stated to be less than ±5 PPM per year.

All components appeared to be new and of high quality, giving the completed kit a very professional appearance. In operation, the unit was very satisfactory, and could not be faulted.

The 200MHz kit version has a recommended price of $89.50, while the 20MHz kit version has a recommended price of $82.50. Fully assembled versions will be available at an appropriately higher charge. Postage and packing is $2.00 for NSW customers, and $4.00 for interstate customers, with registration $2.00 extra. An air/road courier service is available to any Australian destination for $6.00.

The 95H90 prescaler is available separately for $9.50, and the special crystal for $8.00. Both of these items are sent post free. Further inquiries should be directed to JR Components, PO Box 128, Eastwood, NSW 2122. Tel. 85-3976. (D.W.E.)

30MHz digital frequency counter

A new hand held portable frequency counter is available from B & K Precision. It is intended for general service use and has a guaranteed frequency range of better than 30MHz.

The model 1827 Frequency Counter is housed in a yellow plastic case. A single slide switch functions as a power on switch, and also as a mode selector.

Input connections are made via a front panel mounted RCA phono connector, using a 550mm long test lead (supplied).

The third panel fitting is a momentary contact switch, used to enable the display. This is a six digit LED unit with individual overflow, kHz and MHz indicators.

The counter has two basic operating modes. In the auto position, the six most significant digits are displayed, with the kHz or MHz LED illuminated as required.

In the 1 Sec mode, the gating time is held fixed at 1 second, and maximum resolution is obtained. For frequencies greater than 1MHz, only the last six digits will be displayed, and the overrange LED will be flashing.

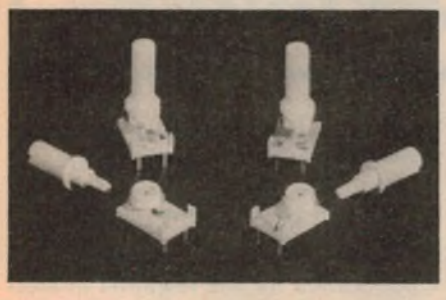
The unit has an input impedance of greater than 10k, and a sine wave sensitivity of better than 200mV from 100Hz to 200kHz, and 100mV from 200kHz to 30MHz.

A frequency range from 100Hz to 30MHz is guaranteed, with typical units operating to 50MHz. The internal time base is derived from a 4MHz crystal oscillator, with a temperature stability of ±10PPM from 0 to 50 degrees C.

The counter is powered from 6 AA size batteries. Optional accessories include an AC adaptor and charger, a NiCad battery pack, a 12V automotive power cord, a DC power supply cord, a signal tap with RCA plug-on tap cable, a 300mm (12") antenna rod, and a carrying case.

Further information is available from Parameters Pty Ltd, 68 Alexander Street, Crows Nest, NSW 2065. Recommended retail price is $228.85, including tax. (D.W.E.)

PCB rotary switch



Designated type MR, this simple single pole switch is specially designed for PCB mounting. It offers two or three positions with positive indexing, and is suitable where relatively infrequent operations are required reliably, but at low cost.

Switch body material is self extinguishing polyester thermoplastic. Maximum working voltage is 1000V AC, and current carrying capacity is 1A at 250V AC.

Further information from C & K Electronics (Aust.) Pty Ltd, PO Box 101, Merrylands 2160.

DC/DC converters

Scientific Electronics has announced details of a new DC/DC converter range.

The new converters are designed for applications requiring a well isolated supply derived from a DC source, and will operate over a wide input voltage range. There are two models: 96D rated at 50-100W, and 95D rated at 100-500W.

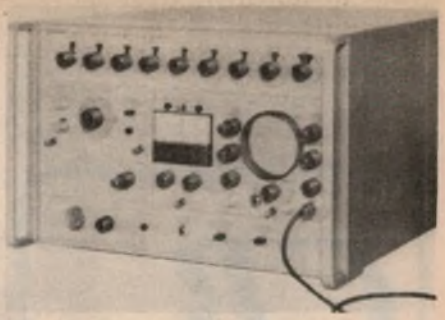
Conversion is by pulse width modulation, controlled by a feedback circuit to maintain constant output voltage. Other features include reverse input voltage protection, a constant voltage/current limit characteristic, and soft start up and recovery.

Enquiries to Scientific Electronics, 42 Barry St, Bayswater 3153.

Singer test set for 2-way radio

Designed to form a complete testing system for communications equipment, the Singer FM-10CS is basically a heterodyne frequency meter covering the range 50kHz to 1.3GHz. It uses a TXCO reference oscillator and synthesiser system to produce any frequency in this range to 1Hz resolution. Addition of sweep generator and CRT modules allow the system to be used for spectrum analysis, network analysis and many other testing functions.

Altogether there are a total of 10 plug-in modules, making the system very flexible and suitable for measurements on AM, FM, CW and SSB equipment. Accuracy of frequency measurement is 1ppm.



Further information on the Singer FM-10CS is available from Datatel Pty Ltd, Suite 4, 3 Raglan St, South Melbourne, Victoria 3205 (Tel. 03-699 7614).

Two-metre FM amateur transceiver

Recently released onto the Australian market, the Icom IC22S is a synthesised FM transceiver designed especially for the amateur 2-metre band.

The IC22S is PLL controlled and uses a diode matrix board to generate the required frequencies at 25kHz intervals. The transceiver is pre-programmed for all Australian amateur repeater frequencies, together with Channels 40, 50 and 51 simplex. Spare diodes are supplied for adding private channels.

Good intermodulation attenuation has been achieved by use of a low-noise, high gain MOSFET in the receiver front end, and a five-section helical resonator filter which determines the receiver bandpass. Power output is 10W nominal, and 1 W in the low power position.

The unit is supplied complete with microphone, operating manual, brackets and cables, and a 90-day warranty.

Further information is available from Vicom International Pty Ltd, 139 Auburn Rd, Auburn 3123.

The Icom IC22S is a PLL controlled FM transceiver for the amateur 2-metre band.

Books & Literature

Tape recording

MASTER CREATIVE TAPE RECORDING. By John Gardner. Published 1977 by Newnes Technical Books. Stiff paper covers, 136 pages, 215 x 133mm, illustrated. Price in Australia $5.50.

As the author points out in his preface, a great many tape recorders gather dust in homes, either because the owners never really needed one in the first place, or because their best efforts at live situation recording produced only discouraging results. It is to the latter group that this book is directed.

Chapters 1 to 4, occupying 60 of the 136 pages, seek to explain the nature of the technology and equipment involved: Recording and reproduction — Choosing a suitable machine — Choice and use of microphones — Mixers, monitoring and installation.

The next four chapters discuss in a practical way what is involved in using this equipment for creative recording — as might be involved in a music or drama group, for tape club circulation, for community broadcasts or for audio-visual presentations: Improvising a studio — Organisation and method — Drama and features — Music.

There is a final chapter on editing, an appendix and an index.

My impression of the book is that it is well written, well illustrated, thoroughly practical and well suited for study by those it is intended to help — non-professionals who aspire to produce something much better than the usual "amateur" recording.

Our review copy came from Butterworths, 586 Pacific Highway, Chatswood 2067. (W.N.W.)

Solid state design

SOLID STATE DESIGN FOR THE RADIO AMATEUR. By Wes Hayward, W7ZOI and Doug DeMaw, W1FB. Published 1977 by American Radio Relay League, Inc. Soft covers, 256 pages, 276mm x 208mm, illustrated by many circuits, diagrams and photographs. Australian recommended price $10.95.

This is the first edition of the latest addition to the ARRL's already long and useful list of books for the radio amateur and others in electronics. Author Wes Hayward is at Tektronix Corp. and the other member of the team, Doug DeMaw, is better known as the Technical Editor of QST. With such authors, one would expect a book of the highest quality and an examination of their work bears this out.

As the title would indicate, this is not a publication for the beginner in electronics. However, the use of mathematics is minimal. The first chapter deals with basic solid state devices and principles. This is in preparation for the application of design principles in RF circuits. These include AM, SSB, DSB and CW transmitters, mixers, detectors, RF amplifiers, networks, filters, etc. Receivers for amateur use are also well covered.

Perhaps the material on the design of solid state RF power amplifiers is as timely as any, as this is a field where I feel that readily available design guidelines have been somewhat lacking in the past.

In addition to the design and theory content, there are numerous well presented practical examples which could be built up by the average amateur. This is a book which I can confidently recommend to anyone interested in solid state circuitry — professionals as well as amateurs and enthusiasts.

In addition to the nine chapters, there is an appendix, together with quite a lengthy bibliography and an index.

Our copy for review came from Technical Book and Magazine Company Pty Ltd, 289-299 Swanston Street, Melbourne, Vic. 3000. Copies should also be available from other technical booksellers. (I.L.P.)

Loudspeaker survey

HIFI CHOICE LOUDSPEAKERS. By Angus McKenzie. Paper cover, 211 pages, plus advertisements, 199 x 147mm. Published 1976 by Aquarius Books Ltd, England. Price $2.95.

In line with the name and source, this book is a survey of currently available hifi loudspeaker systems, intended primarily for enthusiasts in the U.K. Some of the brand names would be familiar to their Australian counterparts but others would not and, among the familiar ones, not all the models would still be current.

While the usefulness of the book would therefore be limited on this account, as also would be the relevance

of the many advertisements front and back, it does contain 70-odd pages of general discussion about the methods and problems of evaluating loudspeakers for review purposes: Types of loudspeakers — Subjective listening tests — The anechoic chamber — Coloration — Distortion — Impedance and phase — Efficiency and power output — Polar response and omnidirectional loudspeakers — Crossover networks — Loudspeaker positioning — The program souce — Amplifier requirements — Presentation.

Our review copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne, 3000. (W.N.W.)

Integrated circuits

BEGINNER'S GUIDE TO INTEGRATED CIRCUITS. By I. R. Sinclair, Newnes-Butterworth, London, 1977. Soft covers, 120 x 186mm, 185pp, many diagrams. Price in Australia $6.00.

In his preface, the author of this book writes that it is intended for newcomers to electronics and those with an interest in, but no experience of, ICs. It is thus meant to be a basic introduction to ICs and their use.

Both linear and digital devices are covered, and a reasonable number of specific well-known devices are described — although not perhaps as many as one might hope or expect. Possibly this is due to the British-European background of the author. This certainly limits the usefulness of some of the practical circuits, like the audio oscillator using a device described as "the RS Components waveform generator".

There are a number of places in the book where I could not help raising a critical eyebrow. One is on page 16, where the body text refers to the diagram on the facing page, and describes the fabrication of a transistor in terms of three epitaxial growth processes! Happily the diagram itself and the caption at the bottom of page 16 describe a much more conventional double-diffused device.

Similarly on page 19 the text describes the fabrication of another unfamiliar element, an epitaxially grown resistor! Again the diagram and caption disagree with this, describing the much more conventional diffused resistor.

These and a couple of other items lead me to wonder whether two different people wrote the text and prepared the diagrams with their captions. If this was so, I hope for his sake that I. R. Sinclair wrote the captions and did the diagrams because, although these are a bit rough in places, they are at least factually correct.

In short, not in my view a very well produced book — particularly for people wanting an easy to follow and accurate introduction to ICs.

The review copy came from the Australian office of the publisher. (J.R.)

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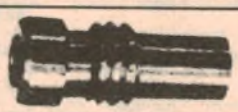

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The Amateur Bands

by Pierce Healy, VK2APQ

Amateur Radio is flourishing

The impression that amateur radio is flourishing was created partly by the very successful NSW South West Zone convention which the writer attended recently and also by the many personal and on-air contacts made during a subsequent tour of the south-east of the continent.

From the visit to the NSW South West Zone Convention at Griffith on October 1 and 2, 1977, and a subsequent trip through areas where amateur radio population is the highest in the country, it was possible to assess at first hand the direction in which amateur radio seems to be heading in Australia. It was pleasing to note that there appears to be a significant number of persons who have recently attained or are striving for amateur radio status.

Classes are being conducted by existing amateur clubs and new clubs are being formed to cater for an increasing number of persons whose appetite has been whetted through the introduction of CB radio. In fact, the view has been expressed that the cream of the CB operators, having experienced the bedlam and frustration of CB operation, will turn to amateur radio to satisfy their needs. The greatest critics of CB radio are appearing among those who have forsaken CB for amateur radio.

SOUTH WEST ZONE CONVENTION: The 25th such convention was conducted at Griffith, NSW, on 1st and 2nd October, 1977. It was an outstanding success thanks to members of the Griffith Radio Club assisted by Mrs Pam Cassidy as convention secretary.

Visitors from Sydney, Canberra, Goulburn, Young, South Coast area of NSW, Melbourne and parts of northern Victoria joined the South West Zone members in a weekend of field events and social activities.

The venue at the Griffith Ex-Servicemans Sports Ground and Pavilion was ideal for the field and social activities and allowed a very large range of commercial amateur equipment to be displayed. The total value was stated to be in excess of $70,000. There was considerable trading activity for both components and latest model HF and VHF transceivers.

Bail Electronic Services, Sideband Electronic Sales, VICOM, and Dick Smith Electronics (Griffith branch) displayed various types of equipment.

The official anniversary dinner was held on the Saturday evening at the Yoogali Catholic Club where 150 guests were welcomed by Warwick Marshallsea, VK2ADZ, president of the Griffith Radio Club.

During the evening the toast to the Wireless Institute of Australia was proposed by Pierce Healy, VK2APQ, who, in doing so, recalled some of the outstanding achievements of Australian amateurs as far back as the early 1900s and the formation of the WIA in 1911, it being the oldest national amateur radio society in the world. He also urged support for the continued growth of amateur radio.

The response to the toast was made by Dr David Wardlaw, VK3ADW, federal president of the WIA, and in doing so officially opened the convention.

Dr Wardlaw referred to the introduction of CB radio in Australia which has already created a growing interest in the amateur service and is a potential source of enthusiasts who will turn to amateur radio in order to increase their knowledge, plus their enjoyment which is available as qualified amateur radio operators.

He also gave a resume of the work undertaken by WIA federal executive in conjunction with the International Amateur Radio Union, in preparation for the World Administrative Radio Conference at Geneva in 1979, referring to some of the problems facing amateur radio through the attitude of some developing countries.

Officially opening the convention, David congratulated the organising committee and zone members on their activities and expressed his pleasure in attending and the opportunity to meet and discuss WIA affairs with them.

Other speakers were Tim Mills, VK2ZTM, president NSW Division WIA, who spoke on activities within the division and proposed the toast to the South West Zone. Harry Cuthbert, VK2AEC, responded to the toast and welcomed visitors to the convention, expressing thanks to the Griffith Radio Club for hosting the convention.

My visit to Griffith was the start of a most interesting tour with several meetings with fellow amateurs. At Griffith came the opportunity to meet many old friends and become acquainted with several who recently gained an amateur licence.

It was also an opportunity to observe the use of VHF FM repeaters in country areas by amateurs isolated from each other by direct VHF path or by a wholly reliable HF path, and as a means of operating mobile in otherwise impossible locations.

These aspects were discussed at length with an old ex-Sydney friend Sid Ward, VK2SW. Sid has been residing at Wagga for some years and played an active role in the establishment of the Wagga Radio Club and WICEN in that area.

In fact, because of Sid's insistence that I try out an ICOM 215 two metre FM transceiver while in Wagga, I was able to assess the value of the channel 3 repeater. From a motel room many enjoyable contacts were made via the repeater. Canberra, Snowy Mountains area, and mobiles passing within range were among the contacts made.

Time was spent with Sid reminiscing about the changes in the "state of the art". Especially from the days of home built equipment, using car batteries and genemotors, and my mountain top exploits of the early 1950s, to the size and efficiency of modern VHF equipment, coupled with unattended mountain top repeaters. Sensing its possible use during the remainder of my journey, it is probably understandable why I departed for Albury with the ICM 215 over my shoulder and an appropriately depleted bank balance. This move added a great deal of zest to my travels, culminating in another mountain top first.

From Albury, contacts were made through the Wodonga channel 8 repeater on Mount Big Ben about 40 kilometres south. In addition to the Albury Wodonga area, contacts were made with Wangaratta, Benalla, Tumbarumbi, Wagga and mobiles travelling through the area.

From a hill about a kilometre east of Albury railway station it was found possible to work through the Wagga channel 3 repeater on Mount Flackeney about 110 kilometres away and a number of contacts were made. The hand-held ICOM 215, with 3 watts output to a "Rubber Duck" 170 millimetre helical antenna, was exceeding expectations.

While in Albury an evening was spent with another old friend Don Haberecht, VK2RS and Murray Jardine, VK2BUJ. Murray's invitation to attend the Albury Radio Club meeting the following evening was readily accepted. Murray has a group of enthusiasts studying for the novice licence or to upgrade to the full licence status. The club meets every second Wednesday evening at 7.30 pm in the State Emergency Services rooms on the corner of Dean and Thrugoona Streets, Albury.

Further information may be obtained from Murray on telephone AH [060] 21 5460.

The next part of the journey was to Melbourne, where from a room on the third floor of a hotel in Little Collins Street, no trouble was experienced in working through the Melbourne channel 2 repeater on Mount Dandenong. Many interesting contacts were made which were instrumental in meeting a number of amateurs actively engaged in experimental projects or WIA activities.

Among them were Ron Harrison, VK3AHJ who specialises in amateur TV. An evening spent with Ron was most interesting. A highlight was a two-way ATV contact with Peter Cossins, VK3BFG, 35 kilometres away over a rather poor path. The pictures were first class.

Ron has a well set up station and each Sunday morning broadcasts an ATV segment during the WIA Victorian Division news broadcast. A conservative estimate is that there are 50 active TV amateurs spread around Melbourne. The group would like to hear from others interested in ATV. Contact Kevin Callaghan, VK3ZVJ, 34 Gordon Grove, Preston, Vic. 3072.

There is also a net each Sunday morning on 7085kHz about 10.45 am conducted by Ron Harrison, VK3AHJ. TV amateurs from all states are invited to join the net.

A contact with Graeme Scott, VK3ZR, WIA federal education officer, provided the opportunity to enquire about the classes and other activities in the education field.

Graeme proposes to conduct an intensive Morse code training class for limited licensees from the 23rd to 27th January, 1978. The classes will be held at the Box Hill Technical College from 6.00 pm to 8.00 pm each night. Contact Graeme at 11 Balmoral Crescent, Surrey Hills, Vic. 3127.

This course will be in preparation for the February 1978 AOCP examination.

Graeme also expects that YRS education officers may obtain the ARRL official novice instructor's guide, which includes Morse code cassettes and colour slides, from WIA Mag Pubs, 2/517 Toorak Road, Toorak, Vic. 3142.

A short but very interesting meeting and visit to Roy Hartkopf, VK3AOH enabled me to learn first hand the progress that the YRS is making in Victoria. It also was the opportunity to see and operate the keyboard Morse Code generator and first-in-first-out register, together with a video display unit. This unit, when fed from a normal Morse key, converts the code symbols to letters on the display unit. It was designed and constructed by Roy.

As editor of the YRS publication Zero-beat, Roy passes on a wealth of knowledge to YRS members.

Radio clubs and other organisations, as well as individual amateur operators, are cordially 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 2200.

He is also the author of several books, a well known one being, "Maths For Those Who Hate It" — which received praiseworthy reviews. His latest is, "Logic and Logic Circuits" produced for YRS use.

Next came an invitation from Les Jenkins, VK3ZBJ ex VK2ZBJ, to visit him and attend the Frankston & Mornington Peninsula Amateur Radio Club meeting. Les is well known in UHF-VHF circles and in his laboratory and workshop has designed and produced a wide range of amateur and commercial electronic equipment as well as type testing local and overseas manufactured equipment. From his amateur station ATV contact was again made with Peter Cossins, VK3BFG.

A QSL card on the wall of Les' home station caught the eye. It was for a yet unpublished or claimed world record for 432MHz. The contact was made on the 2nd February, 1975, between Les at Frankston, Victoria, and Wally Green, VK6WG in Albany, Western Australia. The distance was in excess of 1950 kilometres.

Signals were readability five and strength nine both ways. VK3ZBJ used SSB and VK6WG used CW.

There were over 50 present at the FAMPARC meeting, which featured a lecture on the design and construction of trap dipole antennas. A pleasant evening was spent meeting members and discussing matters of common interest. The club has decided to sponsor an Australian Mobileers Club for amateurs who operate from motor vehicles while touring. Further details are expected to come to hand shortly.

A quick call was made from Frankston across Port Phillip Bay into the Geelong channel 8 repeater using the ICOM 215 hand-held, and two contacts were made.

The WIA Victorian Division Station, VK3AOM at the Melbourne Science Museum, Swanson Street, was visited during the official news broadcast from VK3BWI at 10.30 am on Sunday morning. This well equipped station is on view to the general public. Amateur operators put the station on air during visiting hours.

The final personal contact in Melbourne was with John Kolm, VK3YJK, YRS examiner in Victoria. John gave me a copy of the trial novice examination papers results of which were reported in last month's notes. He also explained the programming of the computer used to analyse various facets of the examination results. Further trial exams are planned for 1978.

On returning to Albury I was invited by Murray Jardine, VK2BUJ, to go with him that evening to the Wodonga Channel 8 repeater site on Mount Big Ben. At an elevation of 950 metres the repeater is housed in a temperature controlled cabinet (inside a brick building) at around 18 degrees C. It was around 4 degrees C on the mountain top.

Six beautifully made coaxial cavities are used in the repeater which is an all solid state device. The whole installation was financed and built by a group of amateurs in Albury-Wodonga and surrounding areas. Running and maintenance costs are in general met by donations from those who use the installation.

During the week October 24 to 28, 1977 the VK2 Division of the WIA staged an amateur radio display in the OTC building in Sydney's Martin Plaza. The display included historic equipment, RTTY, ATV, equipment built by YRS students, and a working display of modern HF and VHF amateur equipment. The photograph shows this equipment being used as a WICEN station at the Sydney end of a National Disaster Organisation exercise. The exercise was a supposed earthquake in Adelaide and WICEN provided links between Adelaide and Canberra, Sydney, Melbourne, Brisbane and Perth. Shown (left) is Ray Gill, VK2BRF, and Mike Richter, VK2BMM. Ray and Mike, with Allan Nutley, VK2BNA, and Tim Mills, VK2ZTM, were among those who organised the display. It is estimated that at least 1500 people visited the exhibition, while many more viewed the window display from Martin Plaza.

Naturally the visit to the mountain top would not be complete without trying out the ICOM 215. The Wagga channel 3 repeater could be heard and my call VK2APQ/3 brought an immediate reply from Harry Cuthbert, VK2ACE at Coolamon with Sid Ward, VK2SW in Wagga joining the inquiry as to my location. This was the first contact either had had with a low power hand-held unit from Mount Big Ben. The distance to the Wagga repeater was around 150 kilometres.

I then told Sid that I would try the Canberra channel 7 repeater on Mount Ginini. My call was answered by Sid at Wagga and Ted Pearce, VK1AOP mobile in Narrabundah, Canberra. The distance from Mount Big Ben to Mount Ginini is in the vicinity of 200 kilometres and around a further 180 kilometres to Sid's home station in Wagga. Then just to complete the contracts, Sid suggested that we use channel 8 repeater. So, standing under the repeater antenna on Mount Big Ben, at a distance of about 10 metres, contact was again established with Sid at Wagga.

Thus within about 10 minutes we had, "with the help of some friends" (the amateurs who built and installed the repeaters), made contact through three widely separated repeaters and, probably, some DX firsts for a low power hand-held unit over some of the most mountainous area in the country. It certainly demonstrated the value of VHF repeaters to amateurs isolated as far as direct VHF is concerned, in sparsely populated areas.

Yes, amateur radio is flourishing; and my sincere appreciation is extended to all those who answered my calls through the repeaters and simplex channel 40, also to the hospitality of those met personally. Hope to meet up with you again further down the log.

IARU NEWS

Two papers by Tom Clarkson, ZL2AZ, which he presented to members of the NZART have been received and read with considerable interest. These papers deal with matters relating to 50 years of international control of amateur radio and WARC 79.

Tom is a past president of the NZART, at present their Overseas Liaison Officer and is an IARU Region 3 Association director. During his professional career he was Chairman Organising Committee, IXth Plenary Assembly, ITU International Radio Consultative Committee, Los Angeles, 1959, so he speaks with an intimate background knowledge of the operations of the ITU.

Unfortunately space does not permit a full reprint nor would a resume do justice. However, here is an extract worth consideration by all amateurs.

"Lessons to be drawn from past conferences.

"Here are some salient points on reviewing 50 years of international control of amateur radio:

"Amateur radio has maintained a position of im-

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With headphones, accessories etc

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15X $5.20 Post 60c

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2-16 M/cs $65.
Transmitter No. 11 suits 210 $35
24 volt Power supply to suit above $15
Or complete station with Headphones, Mic, Morse Key, Antenna $110.

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Plunger Type 24V 300MA. Suit electric camera control, miniature trains, radio, etc.

$2.50 P & P 20c
200 MA 24 volt, ⅛in push movement.
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1½" Diam 4½" F.L. 75c 2½" Diam 2" F.L. $1.50 each. Or $2.50 per pair P & P 40c

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No cranking—in vinyl case. Ranges: Meg Ohm 0-1000 Megs. Centre 20 meg. Rated voltage 500 volts. Low ohm 0-1000 ohm OH. 1 range 0-1 meg ohm on 1k range. AC voltage 0-250 volts. $85.00

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8ft in 6 tapered sections, copper platted steel no base $9.50

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Battery & Mirror Illuminated
900X Magnification $23.95
1200X Magnification $35.00

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Suits PRC 25 and dozens of other uses. 15 volts long life only $1.50 ea.

P & P A. $1.65 B. $2.75 C. $3.20 D. $3.20

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Directional Gyros
AN5735-1 Air Operated
Dimensions: 6inx5inx5in
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Sperry Artificial Horizon
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Diam. 4½in.
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Slip and Turn Indicators
Electric Type Mk. 12
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Dimensions: Length 6½in.
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Weight: 1kg.
$17.50
P&P. A $1.60. B $2.50. C $2.75. D $2.75.

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No C42 set 36 to 60 MHz with 24V power supply, headphone, mic, leads etc $65.00

No C45 set 23 to 38 MHz with headphones, mic. 24V power supply etc. $95.00

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1.2 WATTS OUTPUT
SUPERHET
PRC9 AND 9A 27 to 39 M/HZ
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WITH HANDSET ANTENNA $25 EA

Battery $3.50 extra. Harness $4.50 extra

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240 volts operated. Complete with Speaker and Amplifier.

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PMG Approved. Famous Pony Brand on 27 Meg.
7 transister model $55 per set of two (hand held).
11 transistor model 1watt (hand held) $72 ea.
5 watt 6 channel $99 ea.
Post A $1.65 B $2.75 C $3.20 D $3.20

"KAISE"

Trans-Match Ham Tester SWR, RF Power, Modulation Percentage, Relative Field Strength. $45.00 P&P A$1.65, B$2.75, C$3.20, D$3.20

"KAISE"

SK-100 Multimeter 100,000 ohms per volt 12 Amps AC or DC $52.
P&P A$1.65, B$2.75 C$3.20, D$3.20

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portance, but not sufficiently understood.

"It has needed a struggle to obtain reasonable spectrum provision.

"Supporters of the amateur service have relied heavily on the leadership of the United States. Only the United States has a continuous record of speaking out boldly in this direction, and using powerful influence consistently.

"Amateurs in America have better privileges than elsewhere. Up till Atlantic City 1947 decisions very largely followed the line taken by the leading nations.

"Now the leaders in technique do not always get support from other user nations.

"The Space Conference 1971 showed that world opinion, demonstrated by the majority of delegates there, had no great interest in the promotion of the amateur service. The failure of the Atlantic City conference in regard to adopting an allocation table shows that not enough was done to meet the special interests of the less developed users of radio services.

"Services like broadcasting are keenly appreciated in new and developing countries, the merits of other services may not be obvious.

"Here are two questions, worth regarding as significant in the electronic age:

"Why has the amateur service had to struggle so hard and so long to ensure the right to operate? Why cannot amateur radio rely upon having unanimous support of its welfare?

"The first one. It is because the policy makers in ITU circles have not been ready enough to see the national advantages for their own countries in having a healthy amateur movement.

"Secondly. Because new and developing nations have not been sufficiently impressed by what they see of amateur radio, to regard it as in their own national interest to promote it worldwide and in their countries."

Even the above extract does not present the full impact potential the paper has. Maybe the NZART and WIA or even the Region 3 Association will make copies available to amateurs for their enlightenment as to why WARC 79 is of such importance to the amateur service.

WIRELESS INSTITUTE NEWS

In 1978 the Queensland Division of the WIA, through its association with the Department of Technical and Further Education, and through its member clubs throughout Queensland, will be providing a record number of courses and classes for the amateur radio licence exams.

Throughout Queensland and in Brisbane the radio clubs will operate their own timetable and choice of courses. Direct queries to the WIA, Box 638, GPO, Brisbane 4001, (07) 224 6844.

Classes directly conducted by the WIA in Brisbane will be timed to finish for the appropriate examinations held by the Department of Post and Telegraph. These classes will consist of a crash novice, a normal novice, full AOCP theory and an eight-week duration Morse Code course. These classes will be conducted at McDowall (Chermside), South Brisbane Tech and Salisbury.

AMSAT NEWS

During Sunday, the 5th June, 1977, AMSAT-OSCAR 7 continuously transmitted a Jubilee message in Morse Code over the codestore message storage system. The text of the message read, "AMSAT sends greetings to the United Kingdom on the occasion of the Queen's Jubilee." This message, intended as a tribute from the amateur radio fraternity, was repeated more than 1000 times as the satellite passed over every country in the world and was received by thousands of the world's radio amateurs.

The text of a letter received by AMSAT-UK from Buckingham Palace read:

"Thank you for your letter of 14th July which was shown to the Queen.

"Her Majesty learned with interest of the Jubilee message transmitted by the amateur radio satellite, OSCAR 7, and greatly appreciated the greetings to the United Kingdom sent by AMSAT to mark her Silver Jubilee."

Also from the September 1977 issue of AMSAT Newsletter comes news of a planned amateur satellite network by the USSR. Summary of the information is —

Date of activation: 1977-1978.

Number of satellites: 3-4.

Orbital information: Inclination, 82 deg. Altitude 950km (circular orbit). Period, 102 minutes.

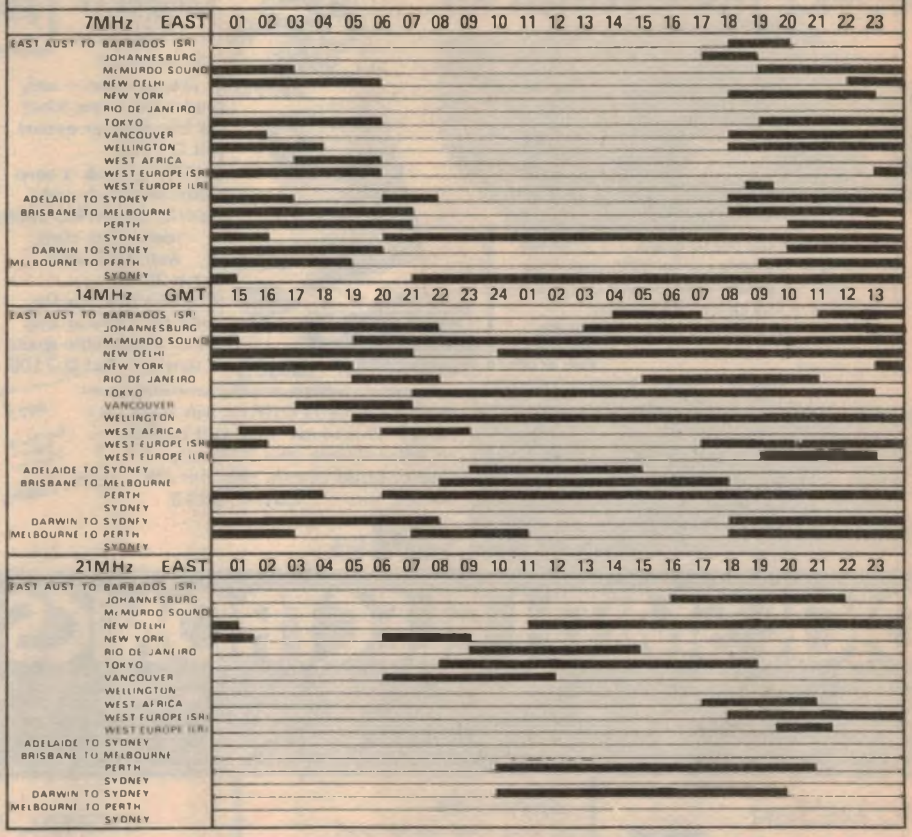
Uplink characteristics: 145.8-145.9MHz (100kHz bandwidth) quarter wave receiving antenna, circularly polarised. User uplink power, 10-15 watts to 10-12dB antenna. Transponder receiver noise temperature, 3000 deg. K.

Downlink characteristics: 29.3-29.4MHz (100kHz bandwidth) half-wave transmitting antenna, circularly polarised transponder power, 1.5 watt peak to 0dB gain antenna.

Maximum ground communication range: 6000km.

IONOSPHERIC PREDICTIONS FOR DECEMBER

Reproduced below are radio propagation graphs based on information supplied by the Ionospheric Prediction Service Division of the Department of Science. The graphs are based on the limits set by the MUF (Maximum Usable Frequency) and the ALF (Absorption Limiting Frequency). Black bands indicate periods when circuit is open. 12.77



RADIO CLUB NEWS

CENTRAL COAST AMATEUR RADIO CLUB: All amateur radio operators, their family, friends, and all interested in amateur radio are invited to attend the club's 21st annual field day on Sunday, 19th February, 1978, at the Showground, Showground Road, Gosford.

A full day's program of events has been arranged. Details in next month's notes.

MID SOUTH COAST AMATEUR RADIO CLUB: The annual meeting of the club has been tentatively set for the second Saturday of January 1978.

The weekly Lyrebird net is held each Wednesday through the club repeater VK2RMU at 2030 hours EST. The establishment of the repeater at Milton-Ulladulla (Ch. 2) has opened up two metre communications between Kiama and Narooma in a most satisfactory manner. It is one of the few repeaters in Australia using high power (100 watts ERP) and a receiver sensitivity of 0.3uV while transmitting and receiving on the same antenna. Additionally, one of the few repeaters with 100 per cent standby equipment.

Full details of the repeater are given in "The Lyrebird" the newsletter of the MSARC which also contains 12 pages of news of club members' activities and interesting technical articles.

President Frank Hill, VK2HQ, PO Box 113 Milton, NSW 2538, or secretary Doug Allen, VK2YDA, 1 Geoffrey Street, Ulladulla, NSW 2539, will be pleased to supply details of activities.

UNIVERSITY OF NSW AMATEUR RADIO CLUB: This club is to conduct a six weeks vacation course for prospective amateurs during the December-January holiday period. Classes will be held each Tuesday, Thursday, and Friday from 6pm to 9pm and each Saturday from 2pm to 9pm. The venue is the WIC, 14 Atchison St, Crows Nest.

Arrangements are being made with the P & T Department to conduct a special novice certificate exam at the completion of the course. For further information contact Sam Voron, VK2BVS, on (02) 407 1066.

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NOVICE TRANSVERTER KIT

Use your old CB rig to good advantage! Transvert it to 80M with this kit — easy to build, legal power output. Needs 0.3 — 3W drive. Ends up in novice section of band, too! Complete kit: Cat K-3134

$89.50

30W—80M AMPLIFIER

YOUR 80 metre QRP rig not quite up to it? This linear amp will take 0.3 to 3W drive and give 30W output. Easy-to-build circuit, ideal for the novice, too. Cat. K-3133

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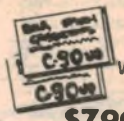


$7.90

We have three ways to help you!

1: Morse tapes — easy graduated steps, ideal for beginner or expert. Cat D-7106

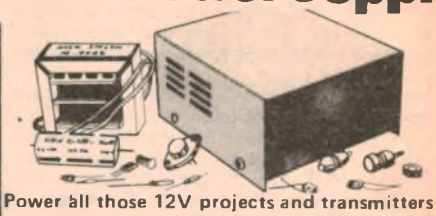
$2.50

2: ARRL book 'Learn Radiotelegraph code' As with all ARRL books really first class, well presented. Cat B-2216.

$1.80

3: Morse practise key, fantastic value at this price! Adjustable space & tension. Cat D-7105

Novice Power Supply



Power all those 12V projects and transmitters with this supply. In kit form, so you save money! With complete instructions, all components & case. Nothing more to buy. All you need is a couple of hours . . . Voltage internally adjustable, handles up to 4A surge (2A cont).. Cat. K-3448

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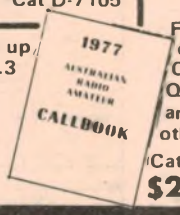

Find out who the other hams are! Calls, names & QTH of all Aust amateurs, plus other info

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EA LOG BOOK Ideal for all radio users — amateurs, SWL's & CBers. Has loads of useful data, too Cat. B-2258

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Open 'til 8PM Thursday	Open 'til 8PM Thursday	Now Open	Ample parking at store	Handy location!	NEW! Opp. Myer's	Open 8.30AM!	Due open shortly!

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VU METER

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DUE TO A HUGE PURCHASE AND LARGE SALES WE ARE ABLE TO OFFER THIS METER AT A FURTHER BETTER PRICE. METER IS FOUR CENTIMETRE SQUARE WITH A BLACK FACE AND WHITE AND RED LETTERING. BACK LIGHTING IS POSSIBLE. 200uA MOVEMENT.

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CHASER LIGHT DRIVER, AUTO OR MUSIC CONTROLLED FOUR 240 VOLT THREE PIN OUTLETS DRIVING UP TO 1000 WATT EACH. A VARIETY OF SPECIAL CHASING EFFECTS AVAILABLE. VERSATILE AND EYE-CATCHING DISPLAYS CAN BE ASSEMBLED USING THIS DRIVER.

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MUSICOLOR DRIVER, FOUR CHANNEL MUSIC TO LIGHT CONVERTER. FREQUENCY SELECTIVE, 1000 WATT PER CHANNEL. WATCH THE BEAT IN YOUR MUSIC. IDEAL FOR CHRISTMAS DECORATION.

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60 Hz TIME BASE

THIS IS UPSIDEDOWN BECAUSE THE BOTTOMS FALLEN OUT OF THE PRICE. 3.579 MHz. AMERICAN COLOUR 60 Hz. OUTPUT TO BE OBTAINED. LOW CURRENT IC CRYSTAL AND MM5369 DIVIDER IC WHICH ALLOWS A PROVIDES IDEAL SOURCE OF ACCURATE PULSES FOR CLOCKS AND COUNTERS. BOARD AND COMPONENTS FOR DIVIDER KIT ALSO AVAILABLE.

CRYSTAL	4.95
MM 5369	3.90
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400mW ZENERS IN THE FOLLOWING VALUES :

8.2V, 12V, 22V, 24V, 27V, 30V,
18c EACH OR 7 FOR $ 1.00

500mW ZENERS, MOTOROLA BRAND :

8.2V, 12V, 30V. 100 FOR $10.00

HARDWARE

PS1	ROCKER SWITCH SPST	30c	4	for $1.00
RN1	240V NEON PUSH FIT	30c	4	for $1.00
B21	6.3V BEZEL,RED & GREEN	30c	4	for $1.00
MS1	MICROSWITCH SPDT	50c	3	for $1.00
K10	ASSORTED PLASTIC KNOBS	25c	10	for $2.00
DS2	2PIN DIN SOCKETS	35c	10	for $2.00
DP2	2PIN DIN PLUGS	25c	10	for $2.00
RCA5	5 WAY RCA SOCKETS	60c	2	for $1.00
RCA6	6WAY RCA SOCKETS	60c	2	for $1.00
PN216	9V BATTERY SNAP	12c	10	for $1.00
FH1	3AC PANEL FUSEHOLDER	60c	10	for $5.00
ALS	240V,3A SPST AL.TOGGLE	35c	3	for $1.00
PPT	PMC TOGGLE 4PDT MOM.	30c	4	for $1.00
TC120	12-120PF TRIMMER	25c	5	for $1.00

PLASTIC BOXES

USEFULL PLASTIC BOXES WITH ALUMINIUM LID. FIVE SIZES. IDEAL FOR PROJECTS REQUIRING ATTRACTIVE PRESENTATION.

UB1.... 4" x 4" x 2"	$ 2.45
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UB4.... 4" x 2" x 1½"	$ 1.35
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DFC1 **89.50**

THIS UNIT HAS THREE RANGES, 1MHz., 10MHz., AND 100MHz., WITH SIX HALF INCH READOUTS AND THREE SCALE LEDS. MEASUREMENT IS MADE APPROXIMATELY EVERY 1.1 SECONDS. BUILT IN A GREY IMPACT RESISTANT PLASTIC CASE APPROXIMATELY FIVE BY FIVE BY THREE. POWER SUPPLY REQUIRED IS 12 VOLTS DC OR A 9 VOLT AC PLUGPACK ADAPTER. SUITABLE FOR TECHNICIANS, HOBBYISTS AND SCHOOLS. AT THIS PRICE EVERYONE SHOULD HAVE ONE- WHAT A CHRISTMAS GIFT.

DFC2 **119.50**

THIS UNIT IS SIMILIAR TO THE ABOVE BUT WITH AN EXTRA RANGE. INPUT ON THE TOP RANGE IS TYPICALLY 650MHz. WITH A SUITABLE INPUT LEVEL OPERATION CAN EXCEED THIS. IDEAL FOR THOSE WHO REQUIRE THE EXTENDED RESPONSE BUT STILL CANNOT AFFORD HIGH PRICES USUALLY ASKED.

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NAME.....
ADDRESS.....
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Shortwave Scene

by Arthur Cushen, MBE

The use of satellite transmissions to carry radio programs will be commonplace in the future. Already Radio Nederland is using this type of link between its studios in Hilversum, Holland, and its relay transmitters at Bonaire and Madagascar.

The announced reduction in the transmission time of Radio Nederland for each broadcast from 80 minutes to 50 minutes is now in operation. However, the program is now of better technical quality due to the use of satellites. There has been considerable reduction in some of the entertainment programs, and some have been deleted altogether.

News now takes 20 minutes instead of 16 minutes as formerly. Other popular programs such as His and Hers, which is broadcast on Tuesdays, and the Happy Station broadcast on Sundays, have been reduced in length. The schedule change means that there are now two transmissions in English to New Zealand and Australia. These are at 0730GMT on two frequencies: 9715 and 9770kHz, and repeated at 0830GMT on 9715kHz.

The Director of Programs of Radio Nederland is interested in the reaction of listeners concerning the changes. It would appear from early comment that most listeners would appreciate the return of the longer transmission period, less news, and more entertainment. The transmissions listed are for evening reception and are carried through the relay station at Bonaire in the Nederland Antilles. Reception throughout the Pacific area is excellent. The address for Radio Nederland is PO Box 222, Hilversum, Holland.

FEBA SEYCHELLES

A new verification policy for FEBA Seychelles has been notified in a letter from the station. FEBA has been receiving many reports world-wide and has decided to restrict the verification of reports to those in the primary area. From November, FEBA has been running dual transmissions, which increase the hours of transmission of their Gospel programs.

The station reports that the new verification policy has been forced on them by the huge mail being received from outside the primary area, although they do make exceptions for special reports and for those DXers who send a cassette of their reception, wherever they may live.

RADIO FREE CHILE

Since using the new slogan "The Voice of Free Chile" an additional transmitter has been heard carrying the External Service. The transmitter is noted on 15130kHz at 0100GMT with a broadcast in French, while the same program is carried on the old channel of 15150kHz. According to Bryan Clark of Wellington, an English news bulletin was heard at 2250GMT and the station gave the address as PO Box 244V, Santiago, Chile.

Another frequency providing fair reception is 11810kHz, heard at 1040GMT with news in English. At 1050GMT, the transmission continues in Spanish.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT; add nine hours for West Aust. summer time, 11 hours for East Aust. summer time and 13 hours for NZ daylight time.

NEW WYFR SITE

Phase one of the construction and transfer of WYFR's transmitter site from Scituate, Massachusetts to Okeechobee, Florida, has become a reality. The construction of the building which will house WYFR's transmitters is almost completed, and the first 100kW transmitter has been moved into place. The first transmission from this site was tentatively scheduled for November last.

WYFR has 660 acres of land for placement of its antennas and broadcasting facilities. The entire transfer will be accomplished in several phases and, during this first phase, both transmitter sites will be utilized.

The studios of WYFR are at 290 Hegenberger Road, Oakland, California, 94621. The present schedule, valid to March 5, 1978, of some of the English broadcasts is: 1900-2000GMT on 9680, 11775, 11805, and 17845kHz; 2000-2100GMT on 9645, 11805 and 17845kHz; and 2200-2300GMT on 5995 and 9645kHz.

KTWR GUAM

Now that KTWR Guam is fully operational it is providing excellent reception in this area for morning broadcasts from 2200GMT. Two frequencies have been used from the start of this new service: 15155kHz and 15115kHz. The original schedule listed 15175kHz, but at the last moment this was replaced by 15115kHz. The station, in its early broadcasts, reported reception reports from hundreds of listeners in over 20 countries for the initial broadcast.

The problem in finding new frequencies which give better reception is compounded by the fact that these are assigned by the Federal Communications Commission in Washington. The station commented that they had received letters from listeners concerning the interference on 11780kHz at 0900GMT from Pyongyang, and that they are trying to move from this frequency.

BELGIUM CHANGES

Soon after the Belgium Radio at Brussels introduced its schedule, which is in effect up to April 1, 1978, some frequency changes were made. In the English transmission to North America 0015-0100GMT, 9675kHz replaced 9680, while 6080kHz replaced 6065kHz. The English transmission to Africa 1715-1800GMT is now on 9755 and 11940kHz. The DX Corner program is broadcast on the second and fourth Sundays of each month.

Most other programs are beamed for primary reception in Africa. Daily programs in French are scheduled from 1000GMT until 1300GMT on 15210 and 21460kHz; Mondays to Saturdays from 1800-2000GMT on 11735 and 15225kHz, and on Sundays from 1700GMT. There is a further service for Africa — Mondays to Thursdays between 2015 and 2215GMT, using the frequencies of 9730 and 11735kHz. On Fridays, Saturdays and Sundays, this program is extended until 2230GMT.

Broadcasts are beamed to South East Asia Mondays, Wednesdays, Fridays and Saturdays from 1305-1330GMT on 21690kHz.

MADRID'S NEW FREQUENCIES.

The Spanish National Radio in Madrid has a transmission to Australia and the Philippines in Spanish each day from 0800 till 1100GMT, and is now using new frequencies for this service. The transmissions can be heard on 9530, 11755 and 17750kHz.

The new frequency of 11755kHz provides very good reception in this area and this channel has been used recently by other stations after a lapse of many years of little use. Recently, we have heard Seychelles using the frequency of 11755 for the FEBA service broadcasting from 0310GMT. Radio Finland also uses 11755kHz for several of its broadcasts throughout the day. The frequency of 9530kHz has been used before by Madrid, while 17750kHz has also been in operation, but in this part of the world suffers from light jamming on the channel.

The English broadcasts in Madrid best received in this area are at 2030-2130GMT and 2130-2230GMT of 9505 and 7100kHz.

LISTENING BRIEFS

EUROPE

GREECE: The latest schedule received from Athens is valid up till March 5, 1978, and includes two transmissions to Australia for both morning and evening reception. The first broadcast is 0900-0950GMT on 9655 and 15160kHz, while the second transmission is 2100-2150 on 6140, 9655 and 9760kHz. The second transmission is repeated at 2200-2250 on 9655kHz.

PORTUGAL. Lisbon has been heard on 11875kHz to closing at 0300GMT after a transmission to Latin America. This frequency has provided clear reception. The station closes with the usual clock chimes and the national anthem.

AFRICA

NIGERIA: Two frequencies have been reported recently during our afternoons, with Radio Nigeria at Jos being received on 5965kHz at 0600GMT. There is some interference from the Voice of America. The other frequency of 6195kHz has been heard during the period when the BBC is not using the frequency. The best period for reception is between 0530-0540GMT, as at 0545GMT the BBC European service returns to the frequency. The station carries the national news at 0600 from Radio Nigeria.

ASIA

AFGHANISTAN: Radio Kabul is using the additional frequency of 4080kHz for its broadcast, with the same program being available on 4775kHz. The English transmission is 1400-1430GMT on these two frequencies and the BBC Monitoring Service reports that 4775kHz gives the best reception.

TURKEY: Ankara Radio has replaced 11880kHz with 11800kHz and 7175kHz. Broadcasts on 11800kHz are 0500-1900GMT and on 7175kHz 1900-0030GMT. The frequency of 7175kHz has also been heard at 0300GMT with the home program.

INFORMATION CENTRE

OP AMPS, CAPACITORS: I have a query regarding the Playmaster Twin 25W audio amplifier you recently described, and in particular the two 741 ICs in the preamp. You have stated that these are noisy and hence the two extra transistors, etc. I have a couple of LM307 ICs which a technical friend claims are 'super 741s", are much quieter and which he claims should be substituted for the 741s. Are the 307s in fact compatible with 741s and would some advantage accrue through substitution?

In a more general vein I, and probably many others, have often wondered about the voltage ratings of electrolytic capacitors. Say a 100uF 6.3V capacitor is required (for use at 5V, for example), is it an advantage to use a higher voltage rated unit, say 25V? Would operating a 25V unit at 5V mean that eventually it would not withstand the full 25V without reforming? (An electrolytic capacitor of any voltage rating must be reformed at its rated voltage if left unused for an extended period.)

Finally, how critical is the voltage rating, i.e., by how much is it possible to over-volt an electrolytic capacitor before breakdown?

Also, why is TTL logic always limited to operation from 5V + 10% (N.W., Peakhurst, NSW.)

● It is true that the LM307 is a pin-for-pin compatible substitute for the 741 and is improved in respect to lower noise and lower offset in high impedance circuitry. But these improvements would be of no benefit in the Playmaster Twin 25 circuit. Moreover, in terms of slew rate, the LM307 is inferior to the 741 so that substitution might result in a degraded high frequency overload characteristic.

On the question of electrolytic capacitors we can first make the general remark that capacitor manufacturers have largely rationalised their voltage ranges. This means that, almost invariably, it is necessary to use 16V and 25V rated capacitors where much lower rated units would be adequate.

Second, electrolytic capacitor technology has greatly improved in recent years so that, in general, electrolytic capacitors not only have reduced size, but also better power factor and lower leakage. They also have very long shelf life and there is little need for reforming (the thin dielectric film on the positive electrode of the capacitor) whether the capacitor has been lying unused or in a circuit with low voltages.

Even so, with large filter capacitors of more than about five years old it would probably be wise to reform them before installing in a circuit. To do this, connect the capacitor to a DC power supply and apply the rated voltage via a series resistor to limit the current to a reasonable value, say 30mA. Monitor the current. The job is complete when the current falls to a low and stable value.

The voltage rating of a capacitor is critical only in that the "surge voltage" rating must not be exceeded. This is usually not stated on the capacitor itself. For most run-of-the-mill capacitors, the surge rating is about 25 per cent more than the rated voltage. As a general rule, the rated voltage of the capacitor should not be exceeded as it can lead to reduced life.

5400 series TTL devices are rated at 5V +10%, but the more common 7400 series are rated at 5V + 5%. Originally, 5V was picked as a compromise between silicon circuit requirements and device dissipation. All manufacturers have followed suit, in the interest of conformity.

MUSICOLOUR III: I have been building your Musicolour III and am having some problems. In the regulator circuit I used a BD135 and not a BD137. Could you advise me on the reasons for not doing this? The 12V supply seems to be pulsing between 12V and 8V in unison with the low channel. And the standby switch does not seem to stop the low channel from pulsing. Also all three channels do not seem to be pulsing correctly when compared to the Musicolour II.

Could you please put my name on your mailing list and send me the bill for 12 months' subscription. (M.L., Wellington, NZ.)

● The BD135 should be quite satisfactory in place of the BD137 as it differs only in voltage rating. We did not specify the BD135 at the time of publication since it was not readily available from the bigger parts stockists. Even so, it does appear that you could have a defective component in the regulator circuit, and this should be checked along with the other malfunctioning sections by referring to the troubleshooting procedure in the article. Errata have been published in the November 1976 and May 1977 issues. Copies of these notes are available via the usual information service.

Unfortunately, we cannot place your name on the subscription list until we receive the appropriate remittance ($A17.00 for NZ and other countries). A subscription form is to be found on the back page of every issue, and such a form should ideally accompany your remittance.

LED LEVEL METER: I am writing this letter concerning the LED Level Meter (June 1976, File No. 1/MS/14). I have two of these, and I think they are great, but I want to put them or another two on my disco console. I want the LEDs or readouts to be of a larger size, so they look better and are more eye-catching. Could you please tell me how I could go about doing such a thing? (D.G., Alloway, Qld.)

● Simply use larger LEDs. They would best be mounted onto a piece of Veroboard, instead of on the display board. Wire the UAA 180 (IC) and the LEDs together in the same fashion as shown in the circuit diagram on page 48 of the June 1976 issue. That should be all there is to it!

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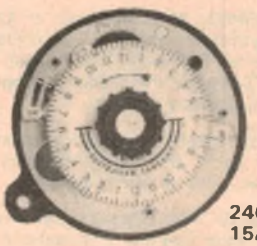

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