ELECTRONICS Australia

with CB and HIFI NEWS

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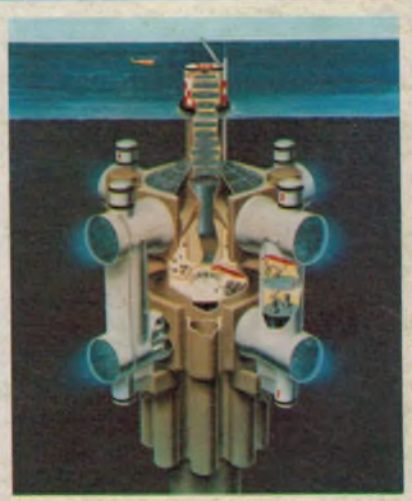

FEATURE INSIDE:
SOLAR POWER FROM OCEAN "SUPERBUOY"

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A LOOK AT THE NEW 18-CHANNEL CB RIGS

HOW ROMS & PROMS WORK • LED "VU METER"

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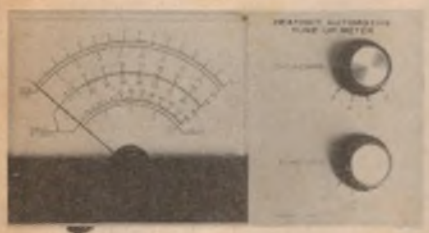
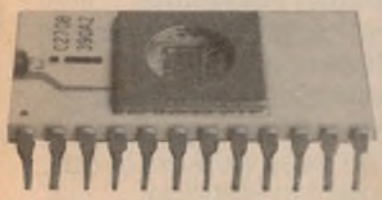
VOL. 39 No. 7 OCTOBER, 1977



You can keep your car's engine in good tune with this build-it-yourself tune-up meter. Turn to p62 for the details.



With the growth of hobby computing these days, many people are using ROMs and PROMs. Find out how they work on p85.

On the cover

EA staff member David Edwards uses our new He-Ne laser to "zap" a red light emitting diode. The details of this intriguing project are on p50.

FEATURES

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THE AUSTRALIAN CB SCENE

PROJECTS AND CIRCUITS

COLUMNS

DEPARTMENTS

Editorial Viewpoint

The microcomputers are coming!

Over the last few weeks, developments in the microcomprocessor and hobby computing area have certainly been coming thick and fast. In the USA, birthplace of the microprocessor, Commodore Business Machines has released its PET 2001—claimed to be the first mass-produced turnkey computer for home and small business use. Self-contained with its own keyboard, video display and cassette interface, it offers programming in full BASIC language—yet sells for around $600!

Also the Heath Company, well-known throughout the world for its electronic kits, has just launched in the USA a broad range of Heathkit Computer Systems. These include both 8-bit and 16-bit computers, a full range of peripherals, software and instruction courses.

Another development in the USA has been the very rapid growth of the "Computerland" chain of franchised mini-microcomputer stores, offering all of the major product brand-names together with full backup facilities for both hardware and software. Although established only a year ago, there are already around 30 stores operating—with nearly double that number planned to be open throughout the USA by the end of this year.

There's good news for local enthusiasts, too. A few days ago I learned from Mr Rudi Hoess, managing director of Electronic Concepts Pty Ltd, that his firm is opening the first of a planned chain of Australian Computerland stores here in Sydney, early in November. A second store is due to be opened in Melbourne before Christmas, and Rudi Hoess tells me that he expects stores to be operating in all major cities within two years.

There seems to be a growing awareness of the implications of the microprocessor revolution within the established computer industry, too (some would say not before time). As I write this in early September I have just been invited to attend and speak at the conference on microprocessors in Canberra, later this month. The conference is being organised jointly by the Canberra branch of the Australian Computer Society and the Canberra College of Advanced Education, and I am looking forward to it.

In short, things really seem to be happening in microprocessors and microcomputers. And just as we've been keeping you in touch with the developments in this area during the last year or so, we plan to continue running up-to-date articles in the coming months. It's certainly an exciting and rapidly developing field.

—Jamieson Rowe

ON SALE THE FIRST MONDAY OF EACH MONTH

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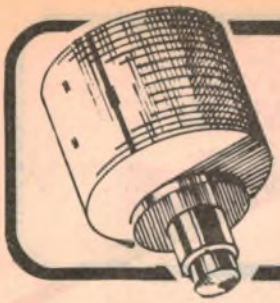


News Highlights

50 years of negative feedback —Bell holds the patents

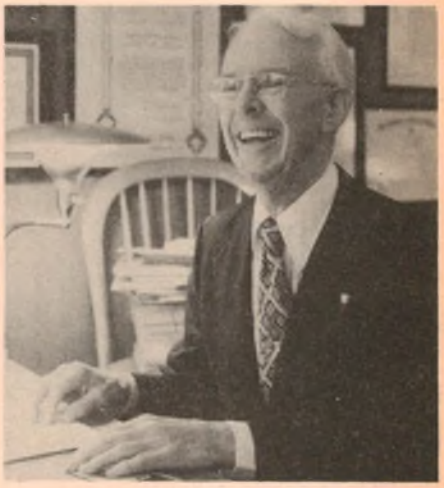
One of the most fundamental inventions in the history of communications was born 50 years ago last August on a Hudson River ferryboat in New York City.

Harold Black, a Bell Telephone Laboratories engineer, was seized by a bold idea. He quickly sketched a diagram and several equations on a blank page of his copy of the "New York Times". These hurried notes were Black's conception of the negative feedback principle, which helped make possible long-distance communications as we know it today.

Black's idea was for a device to correct error and distortion in the process of amplifying communications signals. This was a common problem in the early days of long-distance telephony. By taking some of an amplifier's output and feeding it back to the input, Black reasoned, the two signals could be electronically compared and any distortions corrected.

The idea, refined by Black and later by others at Bell Labs, is used not only in telephony. Negative feedback has found widespread use in radio and television, hifi, computers, braking and steering mechanisms, spacecraft guidance systems and chemical control systems.

Black's patent for negative feedback has turned out to be among the most important in the field of electronics. The patent was widely licensed to the electronic and control industries by the Bell System, and Black's invention and its associated mathematical theory have been extensively used throughout industrial, military and consumer electronics.



Harold Black, formerly of Bell Labs.

Jobs go in telecommunications

. . . 4,000 retrenched in two years

Australia's telecommunications manufacturing industry has had to retrench more than 4,000 workers between January 1975 and April this year, according to a survey just released.

The survey was carried out by the Australian Electronics Industry Council.

The Australian Telecommunications Development Association (ATDA) discussed the latest employment figures at a council meeting on July 25. The chairman of ATDA, Mr A. T. Deegan, said that the figures, when taken with the 8,000 workers who were retrenched in the industry between 1972 and 1975, showed the serious position the telecommunications industry in Australia had reached.

"At the start of 1972 there were more than 21,000 people directly employed in the telecommunications manufacturing industry in Australia," he said. "In just over five years more than half of these people have lost their jobs."

Mr Deegan said that the decline of the telecommunications industry was a result of a combination of factors—the fluctuations of the Australian exchange rate, Telecom Australia's cut back in expenditure, Australia's high labour costs and the reduction in tariffs in 1973.

He said, the drop in demand for telephones and the cut back in forward orders by Telecom Australia had seriously affected the local telecommunications manufacturing industry.

The consumer industry has also suffered because of the drop in sales of colour television sets and has retrenched 2,554 during the same period—1246 of these workers went in the four month period between January and April this year.

The components industry also retrenched some 1619 workers during January 1975 and April this year. That industry lost the bulk of its workforce in the period between 1972 and 1974 when tariff cuts virtually wiped out the whole of Australia's component industry.

Since 1972 approximately 23,000 jobs have been lost in Australia's electronics industry.

Tentative site selection for Omega!

The Minister for Transport, Mr Peter Nixon, announced recently that the Commonwealth Government had taken an option on about 308 hectares of land in Gippsland as a possible site for the Australian Omega long-range navigation facility.

The land is at Darriman on the south-eastern side of the South Gippsland Highway, about 45km south of Sale.

Mr Nixon said that an environmental impact assessment would be prepared and that certain soil tests had to be made before the suitability of the site could be confirmed. He added that when the environmental impact assesment had been completed, the public would have 28 days in which to comment.

Mr Nixon stressed that the land purchase would not be finalised until all technical and environmental questions had been satisfied.

Zenith rebuffed in trade action

Those readers who last month read Gene Gregory's excellent article on the battle for the US TV market will recall the decision by the US Customs Court of New York to impose countervailing duties on a variety of electronic goods from Japan. This decision followed an action brought by Zenith Radio Corporation, and was subsequently strongly condemned by the GATT Council (General Agreement on Tariffs and Trade) at a special June 16 session in Geneva, as a violation of international trade law.

Our correspondent has now informed us that on 28 July, following the GATT condemnation, the US Court of Customs and Patent Appeal overturned the lower court decision, ruling that the US Treasury Department acted correctly last year in rejecting the countervailing duties.

The Appeals Court decision is not the end of the matter however. Zenith has announced that it will now appeal the decision to the Supreme Court—a potentially lengthy procedure with an uncertain outcome. However, it would seem likely that the Supreme Court would sustain the majority view of the Appeals Court.

In the meantime, Japanese companies will be relieved of the necessity of posting bond to cover the increased duties on imported sets which would have applied if the original ruling of the Customs Court had been upheld. But much damage has already been done. In the confusion following the original ruling, many importers raised prices to cover themselves in the event that the duties were eventually levied; others cancelled their contracts with Japanese suppliers altogether.

Gene Gregory's article continues on page 18 of this month's issue. In it, he examines the impact that new technology will have on television manufacture, and the structural reorganisations in the industry that will surely follow. It makes excellent reading.

Ultra-thin calculator has LCD, clock

A "Panasonic" liquid crystal display (LCD) electronic pocket calculator with clock and 24-hour alarm function has just been released in Australia by Haco Distributing Agencies, distributors of "National" appliances and electronic products.

The ultra-thin (10mm) and ultra lightweight (100g with batteries) calculator fits easily into a shirt pocket. It has an addressable memory and performs percentage, add-on and discount computations; automatic square root; constant and repeated computations; chain and mixed calculations; approximate 16-digit calculations; and has a sign-change key. Battery life is extremely long: approximately one year for clock operation only, or 1200 hours continuous use for calculations. The brown vinyl carrying case doubles as a 2-position deck stand.

The inbuilt clock and alarm function, which is accurate to within 1 second in 24 hours at 20°C, makes the unit doubly useful, especially for busy executives, professionals, representatives, and travellers.

Dick Smith opens new store

The new store is modern on the outside . . . and a supermarket on the inside.

Dick Smith Electronics has opened a new store at Parramatta. The store, situated in Perkins House, 30 Grose St, is the 6th in a growing chain of Dick Smith stores—Grose St runs parallel to Victoria Rd, north of Parramatta. Manager of the new store is Bill Edge, who formerly managed his own electronics business in Sydney under the name Edge Electrix. The usual wide range of electronic parts, tools, kits, CB gear, radio and hifi equipment will be available.

CB convention

The Apex club of Bright, Victoria, is conducting a giant CB Convention on the weekend of October 8 & 9 in Bright.

The club has arranged for demonstrations by Philips, Scalar Antennas, Hill Antennas and Farad Electronics, as well as lectures on UHF, TVI, antennas and set operation. As well, there will be displays of equipment, a ham radio set-up and a "test-your-rig" booth.

Money raised at the convention will go to aid leukemia research—the Apex Association's project for this year. Sounds like a worthy cause, all you CBers!

. . . and it's mail order 100,000!

Pictured at right is Mr. L. Attard of Cairns who recently became Dick Smith's 100,000th mail order customer—much to his good fortune. To mark the occasion Dick Smith Electronics filled Mr Attard's order free of charge. Mail orders at Dick Smith's are run as a separate company department to ensure good service to country clients.

NEWS HIGHLIGHTS

More on medical lasers

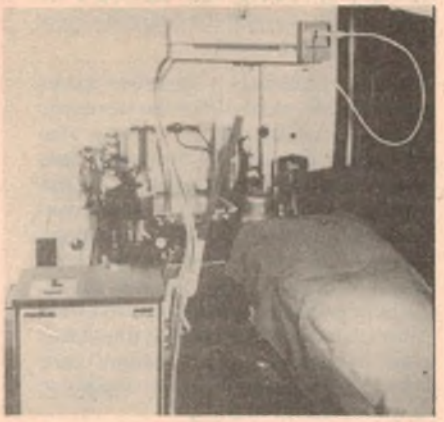
Following the article, "The Laser in Modern Surgery", in the August issue we have been advised of further advances in one application mentioned briefly in that article.

Pacific Communications Pty Ltd, Rydalmere, N.S.W., are Australian agents for Messerschmitt-Bolkow-Blohm (MBB), of Munchen, W. Germany, makers of a YAG (yttrium-aluminium garnet) laser specifically designed to provide high orders of coagulation via fibre optic endoscopes.

As mentioned in the August article, this arrangement is intended to control internal bleeding from, typically, but not exclusively, stomach ulcers, without recourse to major surgery.

The YAG laser produces infra-red energy at a much shorter wavelength (1.06 microns) than the carbon dioxide laser (10.6 microns). Among other things, this permits the use of fibre optics, which have a relatively high opacity at 10.6 microns making them unsuitable for use with the carbon dioxide laser.

The particular unit is the MBB Medilas. It uses an Nd:YAG crystal optically pumped by two krypton arc lamps. The laser is directed to the working area by a flexible fibre optics light guide. A pilot light is provided to indicate the working point. This light guide can be coupled to a fibre optic endoscope.

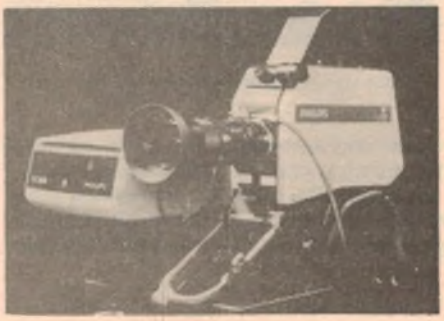


A beam diameter of 0.2mm to 0.3mm permits very precise working, but it can coagulate blood vessels up to 8mm diameter. It has been used for gastroenterology, urology, neurosurgery, ENT, and dental medicine. The last application is most valuable in the case of haemophiliacs.

It is reported that Dr Kiefhaber, of the endoscopic department of the Universtiy of Munich medical clinic, has now treated some 250 cases using laser-gastro-duodenoscopy with a success rate better than 93%.

Pacific Communications advise that this equipment will soon be on demonstration in Australia. Enquiries may be directed to their NSW office, 231 Victoria Rd, Rydalmere, or to their offices in other capital cities.

What's new in colour TV cameras?



RCA's newest colour TV camera, the TK-760 (pictured left), for studio and field use, made its Australian debut at the IREE convention held in Melbourne last August.

According to RCA officials, the compact TK-760 offers the high degree of stability needed in a portable field camera, plus a flexible control system for operation in any studio or field situation.

Also released at the convention was the Philips LDK 15L lightweight portable broadcast colour camera (pictured right). This uses three one-inch Plumbicon tubes and standard circuit modules from the LDK 5 and LDK 25 studio cameras.

Long-life calculator batteries

Button cell batteries that provide 1,500 hours service time, a liquid crystal display and vest pocket size are the three main features of the newest National Semiconductor hand-held electronic calculator, according to Jack Rutherford, Managing Director of N.S. Electronics.

"We are estimating that the battery life of our new Model NS/100 will be two to three years of normal usage", Rutherford said.

The NS/100, which will carry a suggested retail price of $29.99, is about the size of a bridge playing card in width and length and measures only seven millimetres in depth.

Bell working on new solar cells

Bell Labs scientists are devising new solar cells that combine liquids and solids, and may be more economical than all-solid cells.

The new Bell Labs cells, called liquid-junction cells, are promising because they can use less-expensive materials, are easier to make, and can be long-lived.

All solar cells change light into electricity at the junction of two materials. When the junction is formed by two single-crystal solids, highly efficient solar cells can result. Less-efficient but less costly solid cells can also be made using polycrystalline materials.

The liquid-junction cells Bell Labs researchers have devised can use the less-expensive polycrystalline materials too, and these are also more economical to make than all-solid cells. That's because junctions in all-solid cells are difficult to form, since layers of crystals must be aligned precisely. Liquids conform to solids easily.

The Bell Labs devices are the work of Adam Heller, Barry Miller and Murray Robbins. They have two electrodes immersed in a water-based solution. One of the electrodes is a semiconducting material, and the other can be made of carbon or a variety of common metals. When light falls on the semiconductor, current flows from one electrode to the other via the liquid, much like in an ordinary wet-cell battery.

The chemicals in the solution (sulphide polysulphides in water) remain little affected by the process. This chemical stability is what promises to make the cells long-lived. A three to four-year life has been simulated in one laboratory experiment.

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Solar power from the oceans

by GEORGE HABER,
maritime journalist based in New York

For an energy-hungry world worried about the radioactive by-products of nuclear reactors, solar power schemes offer one of the few hopes for future low-risk production of large amounts of energy. Ocean thermal energy conversion is emerging as one of the solar power energy schemes most likely to suceed.

In the late afternoon of 8 May 1975, J. Hilbert Anderson and his son James rolled an 8-foot-high rectangular structure onto the patio near the swimming pool of the Shamrock Hilton Hotel in Houston, Texas. The box-like structure contained two tanks—one of cold water and one of warm—and assorted equipment, including a boiler, a small vapour turbine, an alternator, and a condenser. Draped around the structure were 20 small Christmas tree bulbs of about 1 watt each and two 30-watt spotlights.

As the refrigerant R-11 was circulated through the system, it was vaporised by the warm water in the boiler; the vapour turned the turbine, which drove the alternator which produced enough power to turn on all the lights—to the accompaniment of a rousing cheer from some 150 spectators.

For all its Heath Robinson overtones, the demonstration was a serious engineering enterprise. The Andersons' model, which actually had a generating capacity of 200 watts was built under a small National Science Foundation grant. To the mechanical and ocean engineers on hand it provided a graphic demonstration of a principle which most had thought to be valid, but have never actually seen validated: ocean thermal energy conversion (OTEC)—the use of thermal differences between different levels of the ocean to generate power. Appropriately enough, the occasion for the demonstration was the Third OTEC Workshop, conducted by the Applied Physics Laboratory of the Johns Hopkins University, and sponsored by the US Energy Research and Development Administration (ERDA).

As fossil fuels become more expensive and supplies grow scarcer, OTEC with its promise of "fuel-free" power is emerging a strong contender as the solar energy scheme most likely to succeed, despite its high capital cost.

By the early 1980s, ERDA hopes an experimental prototype OTEC plant will be available that could generate 25 megawatts; by 1985, according to this timetable, a commercial demonstration plant will be operating that will generate about 100MW. A plant of this capacity could conceivably supply all the electricity demands of a community of 50,000 people.

The OTEC concept is new to America, but it dates back to the nineteenth century in Europe. In 1881, a 30-year-old French physicist named Jacques d'Arsonval predicted that electrical power would some day be extracted not only from fossil fuels but also from the temperature differences between the warm waters of ocean surfaces and the cool waters a few thousand feet down. The idea attracted little interest and languished for more than 40 years.

In the 1920s, a French student of d'Arsonval's, Georges Claude, built a small OTEC plant and, in 1930, operated it in Matanzas Bay, Cuba. Claude's plant had various shortcomings, not the least being that it generated only 22kW of power. Two weeks after being erected, the plant was destroyed by heavy seas.

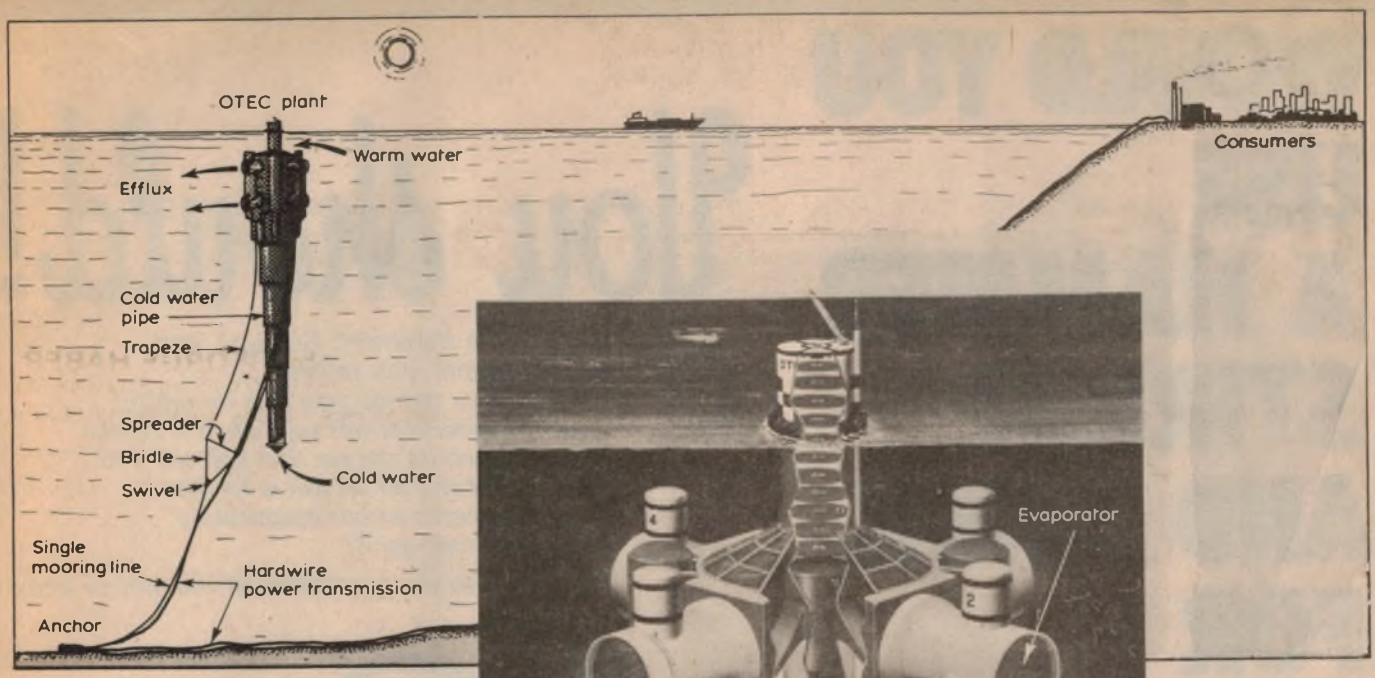
Claude's failure dampened OTEC interest for more than three decades. But on 10 November, 1964, J. Hilbert Anderson, a consulting engineer from York, Pennsylvania, who had earned his bachelor's and master's degree in mechanical engineering at Pennsylvania State University, told a joint sectional meeting of the American Society of Mechanical Engineers and the Institute of Electrical and Electronics Engineers about this "revolutionary" scheme for generating power "from the Sun via the sea". Anderson said that he and his son, a graduate of the Massachusetts Institute of Technology with a bachelor's degree in both mechanical and electrical engineering, had studied the ocean energy scheme for two years and had decided that it constituted "a means of deriving cheap and plentiful electrical power from the everlasting energy of the Sun, the greatest energy source available to man." An outgrowth of the talk was Hilbert Anderson's creation of Sea Solar Power, Inc, in York, which was the first company devoted exclusively to the development of OTEC plants.

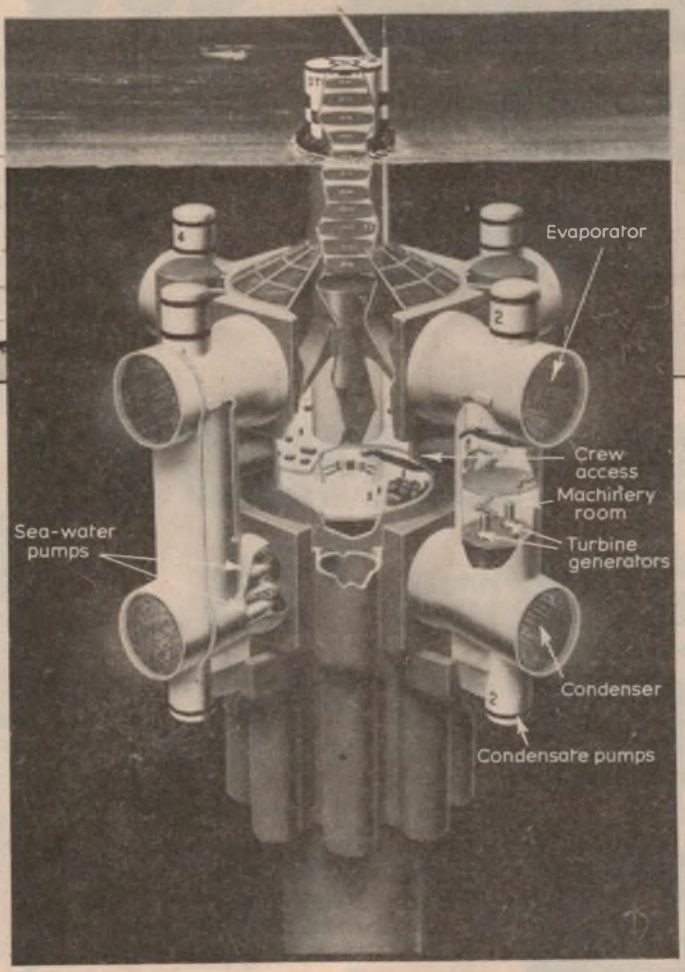
"Everybody thought we were crazy in 1964 for promoting sea solar power", the elder Anderson recalls. "They all said, 'Who needs it? We already have fossil fuels that are plentiful and inexpensive'."

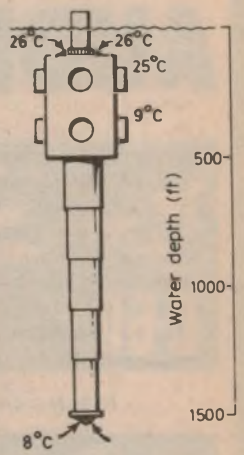
Times, of course, change. And with the election of Jimmy Carter as President of the United States, those who recall his advocacy of solar energy development are optimistic about the future of OTEC.

In 1972, the National Science Foundation, under it solar energy research program, dedicated only $84,100 to OTEC. The amount rose to $3 million in 1975. In early 1975 the OTEC program went from NSF to the newly created Energy Research and Development Administration (formerly the Atomic Energy Commission). The OTEC budget for fiscal 1976 climbed to $8.2 million.

But these amounts hardly represent a full-fledged commitment to the concept. In a panel discussion at the Third OTEC Workshop in 1975, Hilbert Anderson declared, "Many of the powers that be







The Lockheed-designed OTEC power plant would use hardwire power transmission from offshore site to consumer. The cutaway view shown inset illustrates its major components. Sketch, far right, shows the operating temperature regime and the huge scale of the installation. The power from such generators could be used "onboard" to make energy intensive products such as ammonia, methanol, hydrogen, oxygen, and fresh water, using the sea and air as raw materials.

are right now spending millions of dollars to brainwash us that we need a breeder reactor . . . It certainly is not best to spend $10,000 million on a breeder reactor and only $3 million on sea thermal power."

Despite their difficulties in wringing funds out of ERDA (thus far, they have received a total of about $70,000 and have invested about $50,000 of their own money on specific projects), the Andersons are proceeding with their design of a 100MW OTEC plant. To date they have done preliminary design work and have built a scale model of it which sits in their offices. ERDA would like to see a plant of this size operating by 1985, but the Andersons say they could have their plant in operation by 1981—if adequate funds were assured.

The Andersons are just one of some two dozen teams of researchers from private industry and the academic community who have been engaged in ERDA-sponsored OTEC research and development. Most OTEC plant designs in these studies share fundamental principles, the main one being their use of a working fluid, distinct from sea water, which is vaporised and then converted into its original liquid form for re-use. This closed-cycle, or Rankine-cycle system was the one proposed by d'Arsonval in 1881.

Two of the major studies were conducted by two California companies—TRW, Inc of Redondo Beach, and Lockheed Missiles and Space Company of Sunnyvale.

The TRW team proposed a 17-storey, 100MW plant in the shape of a 340ft-diameter concrete cylinder whose platform extends above the water line. The structure would house four power modules and a central, cold-water intake pipe made of glass fibre: This pipe, with a 50ft diameter, would extend down into the ocean approximately 4,000ft and would bring up cold water. In the upper layers of the ocean the temperature difference between surrounding surface water and the water in the pipe would be about 20°C, which would be enough to boil the working fluid, ammonia, to drive electric generators.

The TRW design calls for the sea water exaust from the heat exchangers to serve as thrusters in a dynamic positioning system that would keep the OTEC plant in place. "An OTEC plant processes enormous amounts of water", said Robert H. Douglass, manager of Ocean and Energy Systems of TRW, "and its kinetic energy must be dissipated somehow. We decided to use that available kinetic energy for station-keeping."

Like TRW's, Lockheed's proposed OTEC design would use ammonia as the working fluid and contain four power modules. Unlike it, the plant would generate a total of 160MW, its cold-water pipe would be made of concrete, and the pipe would telescope to its maximum depth of 1500ft. Each of five pipe sections would be approximately 200ft long; diameters of sections would decrease from 129ft on the top section to 105ft on the bottom. The telescoping capability, says Lloyd C. Trimble, program manager

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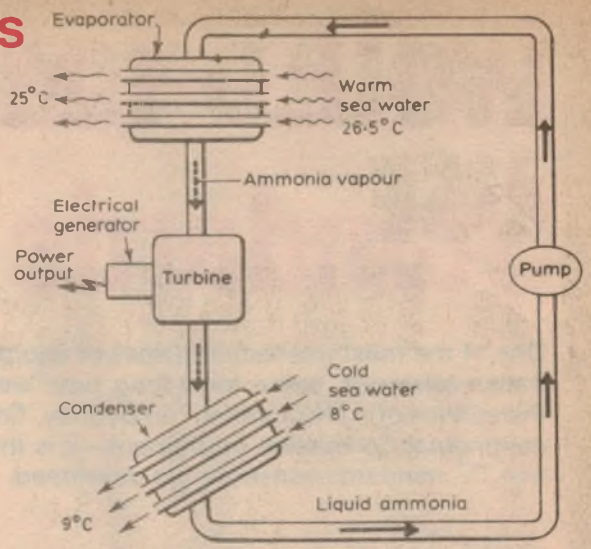


In the basic OTEC concept, surface waters of about 27°C are pumped through tubes in an evaporator. Outside these tubes flows a "working" fluid with a low boiling point, such as propane. The working fluid is vapourised by the heat from the water, and expands through the turbine, which turns a generator. Vapour is then condensed to a liquid once more by cold deep-ocean waters. A pump returns the working fluid to the evaporator to begin the cycle anew.

of Lockheed's Ocean Energy Systems, would simplify the tasks of building the gigantic pipe and moving it to the site.

Lockheed's proposed design calls for a single-point mooring in which the OTEC structure would be connected by a series of steel links to an anchor planted on the sea floor. Lockheed engineers say the mooring system can be used in the 2,500ft depths of the Gulf Stream off Florida or far at sea in waters of 20,000ft.

As opposed to the TRW design, which even allows for a helipad on the above-water portion of the semi-submerged platform, Lockheed's plant has only a small "spar-buoy" projecting above the waterline. Lockheed engineers say the spar-buoy would prevent the plant from being affected by wave and wind forces—an important consideration since proposed prime sites for OTEC plants have included hurricane-prone areas such as the Gulf of Mexico and off the south-eastern coast of the United States.

Ideally, OTEC plants should be situated where the highest temperature differences between surface and subsurface waters can be assured on a year-round basis. Such locales exist in the tropics and in a region off the northern coast of South America. But, in order to have direct pipeline transmission of electricity to US shores, OTEC plants must be located no farther than roughly 100 miles off the coast. For this reason, workers at Carnegie-Mellon University (CMU) are studying the Gulf of Mexico, and researchers at the University of Massachusetts, the Gulf Stream.

Basing OTEC power plants in the Gulf Stream is favoured by Professor William E. Heronemus of the Department of Civil Engineering of the University of Massachusetts. Heronemus estimates that the ultimate power potential of a section of the Stream 15 miles wide by 550 miles long, from Charleston, South Carolina, to the Florida Keys, is about 2000 million MW a year. The Massachusetts researchers have proposed harnessing enough potential power to produce a net output of 400MW, which could supply a population of some two million along the eastern seaboard of the United States.

Researchers at Carnegie-Mellon favour OTEC siting in the Gulf of Mexico, instead of the Gulf Stream, because of the considerably slower current in the former. This, CMU researchers maintain, would eliminate some design problems that stem from the need to stabilise the massive OTEC structures.

For all the feasibility studies and theoretical designs, however, OTEC R&D is conspicuous in its absence of hardware, and some developers are anxious to take the power plants off the drawing boards. "We should be building sea thermal power plants right now," J. Hilbert Anderson of Sea Solar Power believes. Although it is widely stated by those in the field that no scientific or technical breakthroughs are required for the construction of large-scale OTEC plants, few researchers expect to see an actual working OTEC plant with a 25MW output before 1980.

Economics—not technology—is the main factor holding up OTEC development. Of all the considerations governing the economic success of the OTEC concept, Professor John A. Fetkovich of the Physics Department of CMU says, the nature of the heat exchanger is the most critical.

The heat exchanger consists of the evaporator and condenser. Each of these comprises many tubes through which sea water would flow; the working fluid would flow outside the tubes. The function of the tubes is to transmit heat between the sea water and working fluid without allowing any mixing of the two.

Corrosion or fouling of the heat exchanger by marine organisms could cause leakage and seriously impair the efficiency of heat transfer and therefore the entire OTEC operation. Unfortunately, many of the methods to prevent corrosion and fouling (including the use of corrosion-and fouling-retardant metals; providing for continuous mechanical cleaning; or introducing a chlorination process into the system) are expensive.

In an attempt to find the most economical metal for the construction of the heat exchanger, CMU has been testing scale-model heat exchangers off the coast of Oahu, Hawaii. In one test, sea water was run through a bundle of seven tubes, each about 1 inch by 10 feet long, made of copper-nickel, and the impact of biofouling on the effectiveness of heat transfer was monitored.

In early testing, Professor Fetkovich said, biofouling had almost no effect on heat transfer. He added, however, that the expense of the copper-nickel alloy might make extensive use of it in a full-scale OTEC plant unrealistic. Another concern is that because copper is toxic to marine life, its large-scale use might cause extensive destruction to fauna around an OTEC plant and upset the food chain in surrounding waters.

Tests over the next two years will examine the efficiency of heat exchanger components made from other metals, such as titanium, a strong metal with excellent corrosion resistance, and aluminium. While the latter is not as effective in controlling corrosion as copper-nickel or titanium, it is considerably less-expensive than either, and has been used satisfactorily in desalination plants.

The environmental impact of huge OTEC structures relatively close to shore is an issue that all researchers know must be conclusively determined. At the Third OTEC Workshop, a 24-member panel which studied the environment and OTEC concluded unanimously that the impact of the environment on an OTEC plant would be more important than the impact of the plant on the environment. The OTEC plant, it was felt, could be adapted to the environment to correct any damaging features, but if the marine environment poses inherent problems for OTEC plant components—such as fouling the heat exchanger to an extent that proves uneconomic to combat—then actual implementation of the OTEC concept may be unfeasible.

To answer an array of other environmental questions (for example, what are the chances of the working fluid leaking into the ocean), the panel recommended that "at least 20 percent" of the total OTEC funding be spent, in these early stages of R&D, on environmental considerations. At the level of current funding, that would represent more than $1.6 million. It seems like a disproportionate allotment, but it would prove a small price to pay for reassurance to scientists, governments, and the general public world-wide that OTEC is indeed an energy alternative worth pursuing aggressively.

Reprinted from "New Scientist", by arrangement.

DICE—Latest TV Standards Converter

One of the most interesting pieces of equipment to appear on the Australian television scene for a long time was demonstrated recently at the studios of ATN Channel 7 in Sydney. Called DICE—for Digital Intercontinental Conversion Equipment—it is the most advanced and effective TV standards converter yet developed.

by
PHILIP WATSON

DICE was originally developed by a team of engineers from Britain's Independent Broadcasting Authority (IBA) led by J.L.E. Baldwin. It is now being manufactured under licence by Marconi Communications Systems, Broadcast Development Section.

The IBA team commenced development in November 1971 and one year later an experimental model was operational and feeding pictures of the United States presidential election into Europe. In March 1973 it was installed at the studios of Independent Television News and used to convert 525 line signals from both satellite and video tape sources.

The unit installed at ATN-7 is the commercial outcome of this early work, and represents a very significant advance in the whole field of standards conversion. It was first used by Channel 7 to convert the US program, which came live by satellite, of the Academy Award presentations on 29th March 1977. Those who saw this program can vouch for the excellent quality of the picture.

The Channel 7 equipment was demonstrated to me by Mr Russell Dalliston, their chief engineer, ably assisted by the Marconi representative, Mr Paul Batho, who had come from England to supervise the installation and acceptance tests of the equipment.

My first impression was one of two monitors, each displaying an indentical picture. Since I knew beforehand that one was a PAL picture and one an NTSC, it became a question of whether I could pick the difference. I did—eventually—but not from a normal viewing distance. Close up, minor differences in definition, comparision of the line structure etc., provided the necessary clues. But that is hardly a fair test.

At a normal viewing distance either picture would have to be classified as virtually perfect for the standard involved. Definition was excellent, colours accurate and fully saturated where appropriate, and movement smooth and free from jitter, jerkiness, or "comet tails".

Since programs have been exchanged between 525 and 625 line systems for many years, in both directions, and many of them live, this is obviously not the first standards converter. It is not even the first fully electronic one. What, then, is its claim to fame?

Its main advantage is simplicity of operation and high reliability. There have been previous all electronic converters, most of them capable of a first class end result. Unfortunately, they were bulky and critical of adjustment. One such system has been described as consisting of seven racks, "... with an engineer for each rack."

While that last part may be an exaggeration, it is true that they needed constant supervision and "tweaking" to maintain their performance. They also need a long warm-up time.

By comparison, DICE occupies only two racks, is ready for use immediately it is switched on, and needs no adjustment. In fact no adjustments are provided. The only controls are operational ones, in the form of press buttons, plus one variable one to correct any phase errors which may be present on incoming NTSC signals.

It can work either way, from PAL to NTSC or vice versa, and can be changed over by operating a single press button

The complete DICE conversion and monitoring set-up at Channel 7. The actual DICE system is in the two left hand racks. The two right hand racks are monitor units similar to those used elsewhere in the station, and are not directly part of the DICE system. They were simply provided in this instance to give a side-by-side comparison of the two pictures. Note the minimum number of controls on the DICE panels.

on the control panel. The system can also be provided with a SECAM encoder if required.

But, while DICE may be simple to use, it is in no sense a simple device. On the contrary it must be one of the most complex single pieces of electronic equipment in use today, with the possible exceptions of large computers. What is virtually a good size textbook has been written about its operation, so there is no way that an article like this can do more than skim the surface.

To get a better idea of what is involved in standards conversion, and the problems which have to be overcome, it may help to take a brief look at the history of the problem.

In the early day of television, when long distance TV transmission was little more than science fiction, nobody was very worried by the fact that different countries were evolving different TV standards. Since no two systems were likely to get together, and most program exchanges were likely to be via film, which was universal, there didn't seem to be any real need for concern.

Britain kicked off with a 405 line, 50 field system which, at the time, was considered to be technically very daring. Not long after the United States settled for a 525 line, 60 field system. Later, most European countries adopted the 625 line, 50 field system. France started with a 441 line, 50 field system, then introduced an 819 line, 50 field system, and ran the two systems in parallel for several years.

The first hint of things to come was in 1952 when the English channel was bridged with a microwave link capable of carrying TV signals. In theory, British viewers could now watch European programs and vice versa, but it was one thing to get the signals across the channel and quite another to make them compatible with the receivers in the new service area.

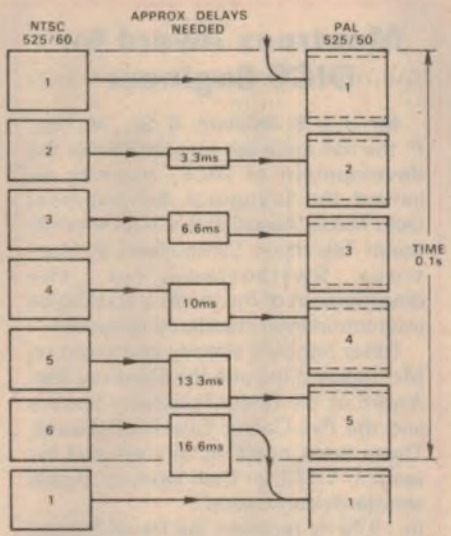
BBC engineers provided a "brutal but effective" solution. They simply pointed a TV camera operating on one standard at a monitor screen operating on the other standard, the screen having a long persistance phosphor. Thus was born the optical or scan converter.

Brutal though the approach may have been, it worked. And, while the engineers concerned would have been the first to admit that results were far from perfect, they were adequate for many types of program, particularly sporting events, news coverage etc., where immediacy was more important than picture perfection.

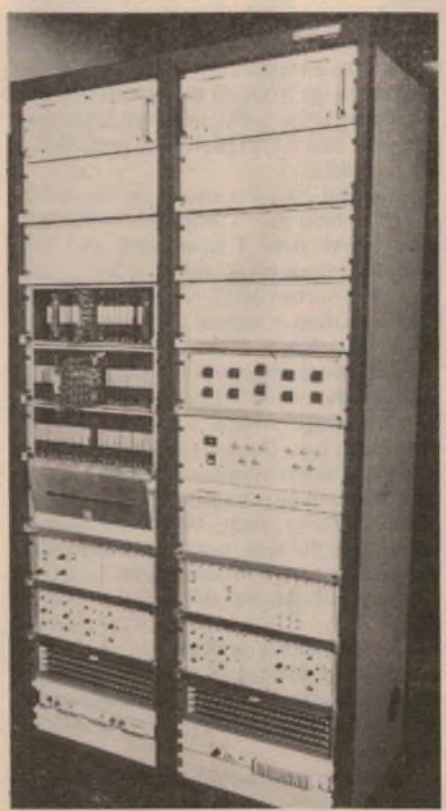
In fact, the system was refined considerably as time went on and was capable of surprisingly good results. Significantly, optical converters are still being used, even for colour conversion.

The next step was optical conversion between the North American 525/60 standard and the European 625/50 standard, and vice versa. American programs were already available on video tape and there was talk of trans-Atlantic links via cable or satellite.

This was a more difficult task. The difference in field frequency caused an objectionable 10Hz flicker until the BBC engineers solved it with ingenious electronic circuitry. The new converter was first used in December 1959 to produce a 525/60 video tape of the Paris Summit conference for the US news services.



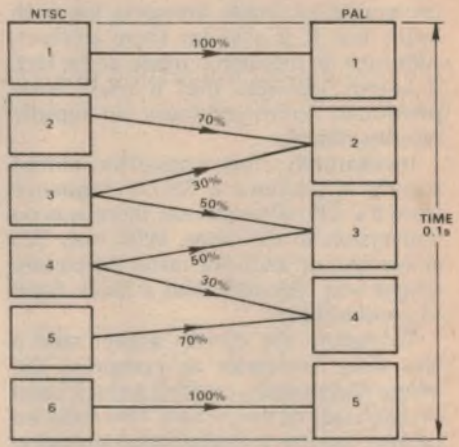
The first all-electronic field rate conversion system, developed by the BBC. It used glass delay lines, and equalised the movement by combining the sixth and seventh NTSC fields.



The two racks of the DICE system proper. The left hand rack is open to show the shift register boards, with one partly withdrawn. Note the simple press-button controls on the other rack.

In 1963 BBC engineers produced the first all-electronic converter, designed to feed the 405 line monochrome transmitters from the new 625 line colour transmitters to come into service the following year.

Next, BBC engineers developed an all-electronic converter for 525/60, 625/50 conversion. This was first used to convert "Early Bird" satellite pictures in Septem-



The DICE field rate conversion system. Using digital storage techniques it is able to spread the equalisation over a sequence of several fields, virtually eliminating jerkiness.

ber 1967. As before, the main problem was the difference in field frequencies. A closer look at this, and how it was solved, will make it easier to understand the DICE system.

Basically, the problem boils down to this. In the period (0.1s) during which six 525-type fields occur there will be only five 625-type fields. Somehow, whatever movement information is contained in the six 525 fields must be presented in the five 625 fields.

One way to do this is to delay each successive 525 type field, up to the fifth, by increments of 3.3ms so that these five fields, which occupy .083s, are made to occupy 0.1s. One obvious result of such an arrangement is that the rate of movement will be slowed by this ratio.

This means that a point of reckoning is reached at the sixth 525 field, which must be accounted for in some way so that the sequence can start over again with the seventh 525 field becoming the first field in the next 625 five field group.

While the sixth field could simply be discarded this would be highly undesirable visually. Up to this point the rate of movement has been reduced and if it is suddenly allowed to catch up by dropping a field the visual effect is one of pronounced jerkiness.

The BBC's 1967 converter adopted a fairly simple approach. It used five glass delay line systems, each of 3.3ms, cascaded so as to provide the increased delay required for each successive field. These provided a total delay of 16.6ms, or the period of a 525 field, and this allowed the sixth field to be combined

with the seventh field to produce the first field of the second five field group.

The fields were combined by using 50% of the video amplitude in each to produce a normal amplitude video signal, but one containing equal amounts of movement information from each field. This process is known as movement interpolation.

Such an arrangement is certainly preferable to simply dropping the sixth field, but it is still far from perfect. Although no mention is made of the fact, it seems obvious that it must have produced some jerkiness on rapidly moving objects.

Incidentally, this converter aimed merely to produce a 525/50 sequence from the 525/60 sequence; there was no conversion to 625 lines. With only 525 active lines on a 625 line raster the picture height was reduced, with a black band top and bottom.

To restore the correct aspect ratio a line store converter to compress the image horizontally, creating a black band on each side of the picture. This reduced picture size was a fundamental limitation which was overcome in later, more elaborate, versions.

Coming now to DICE it is interesting to consider the much more refined movement interpolation system which it provides. First, however, it is necessary to appreciate that DICE is a digital system, as distinct from earlier systems which used analog storage devices, such as the glass delay lines etc.

The incoming analog signal is converted to an 8-bit digital code, which is capable of interpreting 256 distinct amplitude levels; more than sufficient to present a smooth transition to the eye. The signal is sampled at three times the chrominance sub-carrier frequency, or 10.7MHz (approx) for the NTSC system.

Once in digital form, the information may be stored in shift registers. To provide for conversion from 60 fields to 50 fields, with movement interpolation, it is necessary to store two complete fields. These are stored in 24 recirculating shift registers, 12 for each field, each storing 21 lines. (The 252 lines per field this provides is less than the theoretical 262.5 lines, but is adequate to store the active lines. Blanking periods can be created artificially.)

Breaking the storage system up into a number of small shift registers, rather than using one large shift register of the same capacity, simplifies the problem of writing into, and reading out of, the shift register at different rates. These two functions cannot be performed simultaneously, so it is necessary to adjust writing and reading sequences so that they do not clash. With the information for one field stored in 12 separate registers, information can be written into one register while it is being read out of another.

The movement interpolation process faces the same problem as outlined for the early BBC converter; the need to spread the movement contained in six NTSC fields over five PAL fields. However, instead of waiting for the sixth field before equalising the movement, the DICE system spreads the equalisation over all six fields.

An incoming NTSC signal, after analog/digital conversion, is fed to two field stores in sequence; the odd numbered lines to one store and the even numbered lines to the other. To make a new PAL field information is read out of these two stores simultaneously. PAL field No. 1 is made up from all the information in NTSC field No. 1. PAL field No. 2 is made up from 70% of NTSC field 2 and 30% of NTSC field 3.

PAL field No. 3 is made up from 50% of NTSC field No. 3 and 50% NTSC field No. 4, PAL field 4 from 30% and 70% respectively of NTSC fields 4 and 5, and PAL field 5 from 100% NTSC field 6. PAL field 6 is then a repeat of the PAL field No. 1 situation.

These percentages refer to the amplitude of the video signal. In those parts of the image where no movement is involved, i.e., backgrounds etc., both pieces of video information will be identical and will add together to produce a perfectly sharp image. Where movement is involved the two pieces of information will produce two images, both less than 100% amplitude, and displaced one from the other. This produces a certain amount of blurring, which is consistent with the recording of a moving image, and tricks the eye into anticipating the movement to be presented in the following field.

Thus, the movement contained in the six NTSC fields is transferred to five PAL fields and, moreover, spread evenly over these five fields so as to virtually eliminate any jerkiness.

At this point the signal has been converted from 525/60 to 525/50; it still has to be upgraded to 625/50. That is, an extra 100 lines, 50 lines per field, have to be created. Breaking this ratio down to the smallest number of complete lines it becomes 21 NTSC lines for every 25 PAL lines. In fact, an extra line is inserted, on average, every 5.25 lines to make 6.25 lines.

More exactly, a new line is added after every five lines for three consecutive five line groups, then after the next six line group. This means four lines added every 21 NTSC lines to make 25 PAL lines. This sequence is repeated every 21 NTSC lines.

To permit construction of the new lines, several line stores are used. Each new line is constructed from information contained in the lines immediately before and after its position in the raster. The information is mixed in varying amounts, most coming from the lines immediately adjacent to it, lesser amounts from the next furthest away, and so on.

More exactly, each new line contains information from five NTSC lines. The proportion in which these five lines are used varies, as already explained, but varies also from line group to line group according to which NTSC line is closest to the new line position. This line will then provide most information, the line on the other side of the new line contributing slightly less, since it is marginally further away, and so on in both directions.

Other operations which have to be performed on the line include changing its active period from 52.6us (NTSC) to 52us and its total period from 63.55us (NTSC) to 64us. The active line time is changed by reading information out of the store at a slightly greater rate than it is written in, while the total line period is adjusted by increasing the blanking time between lines.

Montreux Award for DICE Engineer

Mr. J. L. E. Baldwin, B. Sc., M. Inst. P, the IBA engineer responsible for the development of DICE, recently received the inaugural Achievement Gold Medal Award at the 10th International Television Symposium at Montreux, Switzerland, for "the development of the world's first digital intercontinental standards converter".

Other honours already conferred on Mr. Baldwin include the Geoffrey Parr Award of the Royal Television Society and the Pye Colour Television Award. These were made to himself and his team in 1973 for their work on digital standards conversion.

In 1975 he received the David Sarnoff Gold Medal Award for meritorious achievement in television engineering.

Marconi engineer, Mr Paul Batho, displays one of the 96 shift register boards making up the field store.

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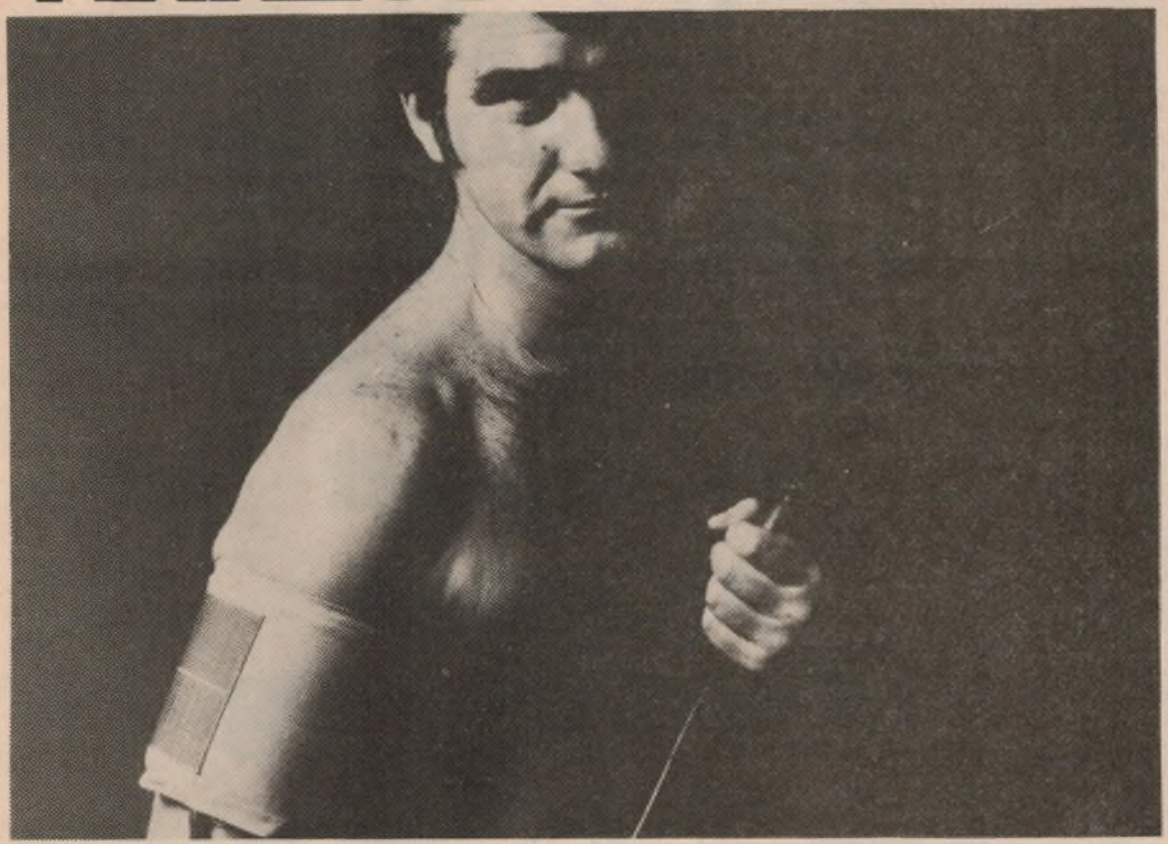

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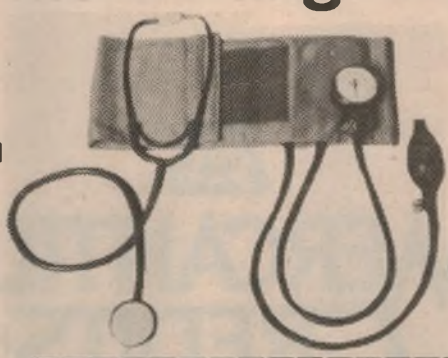

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As well as the line and field changes it is necessary to reprocess the colour signals. Very precise filters, called spatial filters, are used to separate the luminance and chrominance information. These filters are very effective and very little of either piece of information is lost in the separation process. As well as separating the chrominance from the luminance these filters also separate the "I" and "Q" components within the chrominance signal.

Subsequently these separate luminance and chrominance signals are fed to a combining matrix and then to an encoder which produces a normal PAL signal. Alternatively, it can be fed to a SECAM encoder.

Including the 96 field store boards there are a total of 285 boards in the system. These perform such functions as store control (27 boards), movement interpolation (11), line interpolation (33), analog/digital conversion and vice versa (64), and spatial filters (16 each). There is a grand total of 6411 ICs, 538 transistors and 575 diodes.

Quite obviously, service procedures for such a complex piece of equipment need to be well thought out. A small test jig has been developed with which any of the boards can be tested. As well as indicating whether the board is functioning correctly it delivers useful data to assist in locating any faults.

Many of the boards used in a particular section are identical, thus simplifying both service and stock control. All the boards in the field store, for example, are interchangeable and, even if no spare board was available, the failure of one board would not be serious.

The test jig used to aid service and repairs to the various boards. Mr Batho is shown testing one of the field store boards, but positions to test other boards can be seen to the right of the board under test.

Complete removal of the chrominance information from the luminance signal is very important. The chrominance signal causes an interference pattern on a normal TV picture, but this is minimised by arranging that the bright areas are staggered on succeeding lines.

Not surprisingly, this relationship is completely wrecked by the various line and field processes involved and it is essential that only the re-encoded chrominance information appear on the reconstructed lines.

Some statistics about the shift register may help to convey some idea of the complexity of the system. It has a storage capacity of 2.2Mbits, made up from 2304 MOS type 1024-bit registers. These are accommodated in lots of 24 on 96 250mm x 159mm (10in x 6in) plug-in boards. Each 1024-bit register represents over 6000 FETs, which adds up to over 14 million FETs in the complete store.

In a paper by Baldwin and his team it is pointed out that, prior to 1969, such a store, in shift register form, would have cost over £1,000,000; a completely impractical figure. The development of 1024-bit shift registers, using the MOS technique, rapidly brought the price down until, when the paper was written, it was only £5000.

These boards are classified as carrying "most significant" and "least significant" information. Failure of a "most significant" board would remove almost all the information from a 21 line segment, but it can be replaced by a board taken from a "least significant" position. This would restore all the information to the faulty segment, but would rob the other segment of only a small amount of detail; a noticeable, but not serious loss.

In spite of the efficiency of solid state devices, the power required is impressive. Four power supplies are used, each delivering 5V at up to 60A, or over 1kW. Forced draught ventilation is used in the two racks.

Altogether it is a most impressive piece of equipment, whether one looks at it in terms of end result, technical achievement, or sheer complexity. More importantly it represents another step forward for the already high technical standards of Australian TV. Channel 7 is to be commended for its initiative in acquiring this converter, at very high cost, for the benefit of Australian viewers.

The dramatic battle for the US TV MARKET

The impact that fundamental technological change and aggressive marketing policies had on US calculator manufacturing now looks like being repeated in the TV industry. As before, industry observers predict American manufacturers to dominate as the infusion of MOS/LSI technology renders television production suitable to US capital-intensive mass-production capabilities. In this, the second of a two-part article, the author examines the impact of the new technology to come, and the structural reorganisation in the TV industry that will follow.

by GENE GREGORY

The global structural effects of technological change in calculator manufacture have been ultra-revolutionary. With the emergence of the solid-state calculator, the entire electromechanical industry was replaced by a new generation of manufacturers in a few short years; wedded to old technology, none of the electromechanical calculator manufacturers were able to grasp the opportunity presented by technological change to enhance their position in the market. On the contrary, most failed entirely to adapt to the change and disappeared from the world industrial scene.

With the introduction of MOS/IC technology and the new strategy and structures it requires, great pressure is exerted on individual producers to continually increase the efficiencies of manufacturing and distribution operations to remain profitable in a mass market. These pressures have produced successive shake-outs of structurally weak or relatively inefficient assemblers and manufacturers. Others have retreated to the more profitable and less competitive upper end of the price spectrum.

The evidence suggests that the object lessons of this experience have not been lost on other sub-sectors of the consumer electronics industry. The impact which fundamental technological change accompanied by aggressive marketing had on the US calculator industry is very likely to be repeated with the development and the diffusion of IC technology. Television receiver manufacture is now undergoing just such a far-reaching structural reorganization after several years of rapid technological change.

In the 1960s, about all that was necessary to assemble TV sets was a conveyor belt and a plentiful supply of trainable female workers. Since the conveyor belts, and such test equipment as was necessary, were easily transportable, production tended to move to the lowest-cost labour source. Other factors such as accessibility by transport, the local supplies of components and services, and the relative efficiency of government administrations, and a sweetened mix of investment incentives were among the important secondary considerations determining the location of TV plants of US manufacturers.

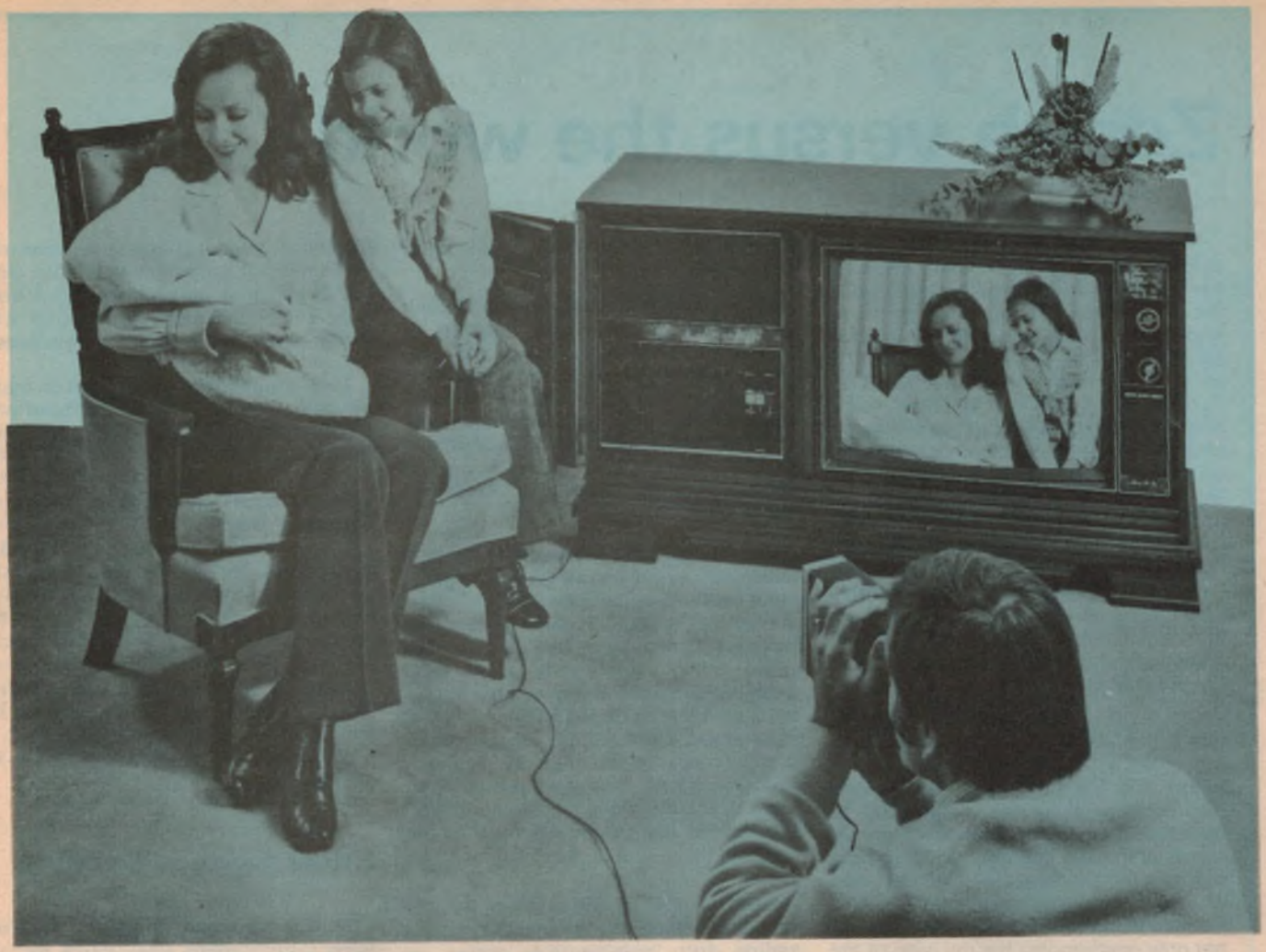
Labour costs differentials were so high that it was economical for some US makers to close their existing plants and move production entirely to Taiwan or Mexico. Partly as a result of this movement, US imports of complete monochrome receivers exceeded production at home throughout 1971-1975. Moreover, when monochrome receivers produced in the US from incomplete receivers assembled in off-shore facilities are subtracted from total US producers' shipments, both the quantity and value of such shipments are reduced to an even lower ratio.

The shift to solid-state technology in television manufacture has already changed this pattern significantly. Solid-state technology has simplified the circuitry of colour TV, as well as monochrome receivers, with substantial savings in labour. But most important, the new technology introduced the possibility of more intensive automation. Automatic sequencers, automatic insertion of components in printed circuit boards, wave soldering equipment and computer-controlled automatic test equipment have eliminated much more of the need for manual labour.

A single machine can insert components into a printed circuit board at the rate of 72,000 pieces per hour, compared with a hand rate of 300 pieces per hour. It would require 240 workers to achieve the 72,000 pieces per hour insertion rate, yet automatic insertion machines can be operated by as few as 11 workers. "Once you automate, the question of whether you're paying 25 cents or $3 an hour becomes (an) awful lot less important," Zenith Chairman John Nevin noted in explaining his company's recent changes in strategy and structures.

But the advantages of automation do not stop with direct cost efficiences. Automated processes also increase yields (reduce the number of rejects), upgrade quality and reduce maintenance costs. With labour an increasingly less important factor in the total cost of production, and with the other positive advantages that accrue from automation, the US industry is now capable of becoming completely cost competitive with Japanese and Taiwan producers.

To be sure, automation costs money, which is another way of saying that TV assembly has become a capital-intensive process. From this it follows that the critical mass of a production unit of an automated plant is much higher than labour-intensive assembly using old technology. While small-scale labour-intensive assembly can continue to com-



Typical American-style colour TV console. This 1972 model incorporated video replay facilities.

pete favourably, manufacturers now have the option of large-scale automated production. And in the case of TV receivers, which, because of their bulk, are relatively costly to ship, substantial economies can be obtained by moving the assembly plant to the market, reducing transport costs and multiple handling charges.

Furthermore, location of assembly plants in the home market tends to reduce risks as well as the drain on managerial resources for US companies.

Some of the implications for Asian industry of these changes in factors of competitive power were demonstrated by Zenith's recent transfer of production of 16-inch monochrome sets to the US from its plant in Taiwan. Zenith found that it could achieve net savings in cost by manufacturing close to the market.

For Zenith, this move was part of a major structural reorganization which began with the switch to an entirely new line of solid-state sets in 1972. Zenith management re-thought every activity the company was in, discontinued some, and relocated others. Having decided that Zenith's main business is home entertainment, the company got rid of a lot of sophisticated electronics and military equipment production which were spawned during the Cold War and space race. Resources since then have been concentrated on expansion and automation of consumer electronics production, related R&D, and a more aggresive advertising and marketing effort. In 1974 alone, capital spending on new plant tripled, from $15 million to $47 million.

Zenith's wager on a revival of the US television industry is echoed at RCA. In his keynote address to a recent industry conference, RCA's William Boss, who is Chairman of the Electronic Industry Association's Consumer Electronics Group, expressed the industry's confidence in most positive terms that "The video industry (is) now poised for unparalleled growth that will be fuelled by a continuing supply of new products and new features". He went on to predict a 1977 retail market for video-related products reaching $4 billion. This hardly fits with recent rhetoric which has depicted the industry as being on the abyss of extinction.

Significantly, the optimisitic view is clearly held by Japanese manufacturers, as well as by Philips of Holland, which have recently invested in colour television manufacturing in the US. Of course, their recent acquisitions have substantially enhanced the competitive strength of the US industry by the infusion of a new capital and technology from abroad.

Matsushita is modernizing the production facilities it acquired from Motorola, introducing advanced production techniques developed in Japan and other parts of the world. Sanyo's acquisition of the Forest City, Arkansas, plant of Warwick, a prime contractor of Sears Roebuck, was finalized last December. Sanyo will invest substantially in new plant and equipment to improve Warwick's technology and quality control and hopes to double the number of workers employed at the plant by mid-1977.

More Japanese manufacturers are expected to follow suit. The Mitsubishi Group, Hitachi and Toshiba are all involved at various stages of plans for manufacture in the US.

Not surprisingly, the first company on either side of the Pacific to understand the structural changes in the industry that would logically follow from solid-state technology was Sony. Sony pioneered solid-state television receiver manufacture, having first produced and marketed

Zenith versus the world...

In record time, after just two days of deliberations, a 23-nation GATT Working Party meeting in Geneva last June found the US Customs Court's decision to impose countervailing duties against Japanese imports of electronics products to be in violation of the General Agreement on Tariffs and Trade and a prima facie impairment of Japan's rights under the agreement. Not only did the US not object to the finding, but US Delegate Richard R. Rivers made it a point to stress that "The United States shares the concern of other countries regarding the seriousness of the case." He went on to add that the Customs Court decision did not reflect the views of the US Government and that the administration is in fact appealing the Court's ruling.

Clearly, the undisguised haste with which the GATT action is proceeding is prompted by the timing of the case now before the US Court of Customs and Patents Appeals which is expected to hand down its verdict before the summer recess or in early autumn. In a rare show of force, the Working Party has reported its unanimous findings to the GATT Council in the most unequivocal terms, not only condemning the decision of the US Court, but calling specific attention to the disadvantages of domestic procedures involving judicial review and consequential decisions of a quasi-automatic nature which could too easily lead to uncontrollable situations in trade relations. The ultimate action of the Council, due to meet later this month, will be intended to reinforce the case of the US administration for the reversal of the Customs Court's ruling.

Overseas Concern

Such concerted and expeditious action, uncommon in the annals of GATT deliberations, reflects the deepening concern of America's trading partners over the growing crisis in US trade policy. Clearly, much more is at stake in the Zenith case than the violation of Japan's rights under the General Agreement. Should the US Customs Court's ruling be allowed to stand, it would strike at the very foundations of GATT, endanger the present Multilateral Trade Negotiations, and adversely affect world trade in general, serving as an open invitation for a proliferation of similar actions by US industry in the courts, introducing even more chaos into an already troubled international economic system.

What began as just another Zenith legal action to restrict the imports of Japanese colour television sets has suddenly taken on global dimensions, affecting almost all manufactured products exported to the United States not only by Japan, but by most other countries as well. In short, it is no longer a case of Zenith vs. the US Treasury, but Zenith vs. the World.

For 30 years the international trading rules established by the General Agreement on Tariffs and Trade have held that the rebates of indirect taxes such as the Japanese Commodity Tax are not subsidies. If the United States now unilaterally declares that they are subsidies, its trade with the entire industrial world will be affected. This case, US Deputy Assistant Secretary of the Treasury, Peter O. Suchman warns, "has more potential for harm to the international trading system than all the rest of the trade cases put together."

It all started in 1972 when the US Treasury Department initiated a countervailing duty investigation, acting on allegations of Zenith and Magnavox that the Japanese government was subsidising exports of consumer electronic products by 20 different practices that constituted bounties or grants in violation of the US Countervailing Duty Law of 1890.

After the US Secretary of the Treasury made his final determination on January 7, 1976, that no bounty or grant was paid or bestowed on those products from Japan, Zenith instituted an action for a review of this determination by the US Customs Court, focusing on one of the 20 alleged practices, contending that the exemption of the Commodity Tax on the exportation of consumer electronic products was clearly a bounty or grant under section 303 of the US Tariff Act of 1930. Last April 12, the Customs Court ruled in favor of Zenith and charged that the Department of the Treasury had been acting in violation of US statutory law for the past 75 years by construing the Countervailing Duty Law as applying only to excessive remission of taxes.

Subsequent to the Court ruling, the Treasury Department directed customs offices to suspend appraisement and liquidation of Japanese consumer electronic products and introduced a bonding procedure on all imports and withdrawals from bonded warehouses.

Even though the full amount of countervailing duty will not be imposed until the final decision on the case, which may not be for several years if it goes to the Supreme Court after the forthcoming appeals court ruling, the effects on imports of Japanese consumer electronic products are already being felt. Bonding procedures are complicated and time-consuming, and the costs vary from importer to importer, depending on the size and credit rating. While the bond is minimal, generally $7.50 per $1,000 on the f.o.b. (free on-board) value, or less than one percent of the total import bill for television sets, which amounted to $1,890 million in 1976, it mounts up rapidly.

Uncertainty is Costly

But the immediate impact of the Customs Court's ruling goes much further. Uncertainty is always costly. Risks must be covered. Credit becomes more expensive and strict. And then there are the long negotiations between manufacturers, importers and dealers about who will bear the burden of risk. The risks will be so great that some importers may simply stop buying Japanese electronic products. Other Asian sources of supply are much less troublesome and more predictable.

While most US subsidiaries of Japanese manufacturers are still checking out the new situation, several have already announced their plans to increase prices by 10-20 percent as soon as current inventories run out. Future duty charges must be hedged.

Still another element in rising costs of operations is likely to impact on prices of Japanese consumer electronic products in the US, a factor that has become sufficiently important to warrant consideration by the GATT Council. With the increasing legal harassment by US industry, Japanese manufacturers have been subjected to what the Japanese representative to GATT has described as "multiple jeopardy." Anti-dumping duty

action, Escape Clause action under the US Trade Act, unfair practices investigations under the Tariff Act, anti-trust litigation and the countervailing duty action—all involve continuing and often duplicating procedures, requests for detailed information and data some of which the companies concerned regard as highly confidential, and repeated appearances of industry representatives before investigatory bodies or tribunals. Japanese companies must invest heavily in specialized staff at substantial cost, and employ a battery of legal experts capable of handling the proliferation of cases.

The potential impact of resort to continual legal action, as exemplified by Zenith, is not limited to Japanese imports of electronic products, but already affects many other products from a large number of countries, both developed and developing alike. The international ramifications of the escalation of this legal harassment are, in the words of Bernie Mitchell, President of the US Institute of High Fidelity, "rather scary." Apart from the high cost of legal services, "any lawsuit launched by a US manufacturer against any overseas company will probably win," he warned. "This could lead to a trade war in which we'd all be losers."

It is the reality of this threat that prompted the expeditious action of the GATT Council on the Japanese proposal last week. If the US Customs Court decision is not reversed by higher courts, it is estimated that from 60 to 70 percent of US imports will be subjected to countervailing duties, resulting in possible retaliation by Japan and other major trade partners.

Representatives of the European Community are especially vigorous in their criticism of the US Court's ruling. They point out that Zenith itself is a beneficiary of exemption from state and local taxes on its exports from the US, and link the Court's decision with deferment of taxes on profits made by US companies on their export sales under the US DISC (Domestic International Sales Corporation) provisions to show the inconsistencies in US trade laws. Moreover, unlike the exemption from indirect taxes, such as the Japan Commodity Tax and value-added taxes in Europe, the DISC provisions have been determined to be in violation of the GATT regulations by a recent working party.

All of this makes for a rather explosive mixture, and explains the seriousness with which the GATT Council views the Zenith case. Thought is already being given to what action must be taken by the GATT Council if the US Treasury Department should fail in its attempt to reverse the Customs Court ruling. One alternative to retaliatory measures which will be considered is an agreement among the Contracting Parties to allow the US a period of grace in which to resolve the conflict between domestic statutes and US international commitments through the introduction of new legislation which would harmonize the two.

But the outcome of any major trade legislation is problematical at best. In a recent paper prepared for President Carter on this issue, the Treasury Department reportedly explained its reluctance to go to the Congress with these words: "There are obvious risks in opening up the subject of imports of Japanese electronic products, including television sets, to Congressional scrutiny at this time."

Much is at stake, then, in the coming ruling of the US appeals court on this issue, and no one in the industry or in diplomatic quarters is taking any bets on the final outcome.

Major Adjustments

Meanwhile, the consumer electronics industry in the United States is in for some major adjustments. The uncertainty surrounding the Zenith case adds to the pressures imposed by the voluntary restraints recently negotiated by Special Trade Representative Robert Strauss to encourage Japanese manufacturers to expand investments in US production and use more US labour in assembling partially completed sets. But it also is likely to serve as further inducement for some Japanese firms to increase their supply of the US market from off-shore plants in Asia in countries whose exports are not subject to countervailing duties, if they are eventually levied. By the same token, local manufacturers in these countries would stand to reap some of the windfall of Japanese misfortunes.

solid-state monochrome TV in 1960 and colour TV in 1968. By 1971, Sony had already built its wholly-owned plant in San Diego to produce Trinitron colour television receivers and tubes, and is now putting the finishing touches on a video recorder production facility in Alabama.

Sony President Akio Morita, who was quick to grasp the import of changing economies in the industry, confided at a Foreign Correspondents' Club luncheon in Tokyo in 1973 that Sony would make no further investments in production facilities in Japan. Both economic and political considerations dictated the transfer of TV set manufacturing to Sony's major markets.

It is noteworthy, in this regard, that the ITC recommendations to increase import duties to 25 percent, from the 5 percent presently imposed, on both colour and monochrome receivers, whether complete or incomplete, was expressly intended to spur the readjustment of the industry. Since the increased duty would offset the cost advantage of off-shore production, it is likely that it would tend to encourage the return of colour and monochrome assembly from Taiwan and Mexico to the US. And to give further stimulus to this process, the Commission intentionally excluded sub-assemblies and components from the increased levies, an exception that was included in the "voluntary" restraint agreement reached last week. Higher duties on complete and uncompleted sets would serve as added inducement to manufacturers to invest in more automated assembly, and in R & D, while continuing to rely on off-shore sources for more labour-intensive component and sub-assembly supply. Under the voluntary restraint arrangements, the same result will obtain from the increased pressure of competition from Japanese manufacturers, whether producing in Japan or the US.

If the resultant turn-around in the US television industry may not be as dramatic as that achieved in calculators, the significance of this development is likely to be greater because of the central role of television in entertainment, information and data communications. With a growing number of new television functions and applications—in interactive communications as well as in one-way reception, as a household computer terminal, a facsimile terminal and a component of a home video system—the industry has tremendous growth potential for coming years. And the evolution of solid-state technology renders television production ideally suited to US capital-intensive mass-production capabilities.

Analog technology currently used in television integrated circuits makes it possible to reduce the entire colour television receiver to five bipolar ICs. This is what, in fact, Sinclair Radionics has done with its 2-inch Microvision book-size receiver, already being shipped to world markets from Sinclair's factories in

The battle for the US TV market . . .

England. But if solid-state technology using digital signals is applied to the television circuitry, semiconductor manufacturers agree that production of a single-chip colour television receiver is possible and not an unlikely basis for the next generation of small-screen, low-cost (throw away?) television equipment, a development that likely will take no more than a decade.

On the other hand, rapid changes in the function of television, already in the pipeline, will require increasingly sophisticated circuitry. These multi-function units—perforce larger console or table models—will utilize more ICs, but will be assembled in larger-scale highly-automated production units close to the marketplace.

As solid-state technology evolves, the impact of technological change on television manufacture seems likely to follow the pattern of the calculator industry. Television manufacturers, whether they are vertically integrated manufacturers or assemblers of purchased components, whether they are new entrants or established industry leaders, whether they are in Singapore, Seoul, Chicago, or Chigwell in England, will find the pace of change quickened, the capital intensity of the industry increasingly higher, and the demands on resources intensified for continued and effective participation in the marketplace. Final assembly will tend to locate closer to the marketplace, and to the source of technology, than in the past, while more labour-intensive production of components and sub-assemblies which have a low ratio of transport to total production cost will continue to be produced off-shore from the world's major markets.

The broader implications of this development for Asian industry are clearly far-reaching. The restructuring of television production in Asia does not depend entirely on the impact of semiconductor technology change, of course. Among other things, the growth of the Asian market for television receivers will become an increasingly important determinant of production location, scale and profitability in the region. Significantly, although the immediate purpose of Grundig's recent investment in television production in Taiwan was to supply European markets with monochrome television receivers, the company's longer-range view and primary motive for the investment was to establish a base from which to develop a share of Asian markets, likely to be among the world's fastest growing in the last two decades of this century.

However, the number of firms in the Asian television industry is likely to decline rather than expand in coming years. Substantial financial resources will be critical to success of new entrants, vertical integration will become an increasingly important ingredient of success, and the linkage between mass merchandisers and manufacturers will tend to become more permanent and direct.

Since established brand name television manufacturers in the United States, and in Europe, have been reluctant, unwilling or unable to supply mass merchandisers from home production, a natural alliance has developed between Asian consumer electronics manufacturers and large US and European mail order and discount houses, department and chain stores which is now threatened by changing economics of television production and the parallel development of protectionist measures. Not all Asian manufacturers can follow the example of Sanyo to acquire production facilities near their major customers. Nor is it certain what the nature, timing or phasing of changes in this global production-distribution network will be. But structural changes will proceed at an increasingly rapid pace just as they did in the calculator industry, and in the recent boom-bust cycle of CB radio and TV games.

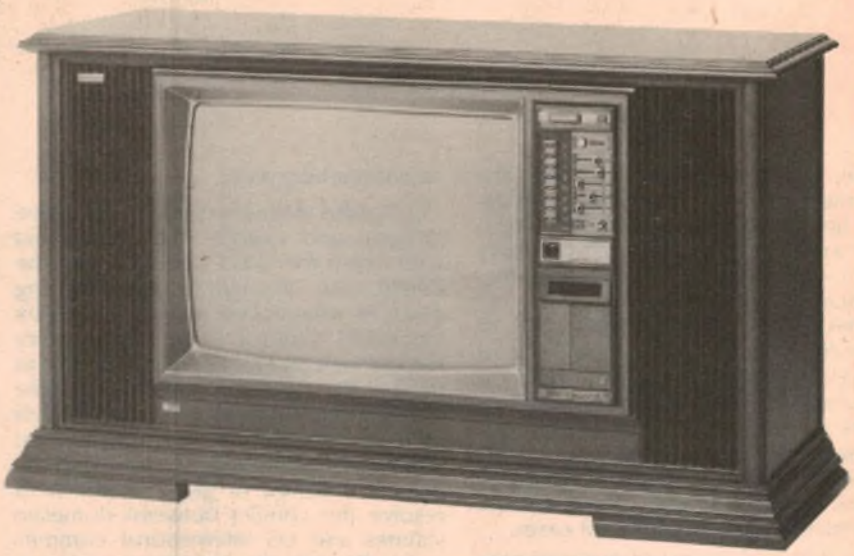
If the Asian industry retains its momentum in miniaturization, the division of labour on a screen-size basis that has persisted between Japanese industry and the US and European industries, may continue. But the exploits of US semiconductor manufacturers in the production of handheld calculators suggests that this pattern may also change in the television industry.

While their response will necessarily be different, Japanese and off-shore Asian manufacturers will have to adjust to these rapid changes in technology and market conditions. Experience of the past two decades suggests that these adjustments will be made dynamically and with a resultant closer integration between industries and markets in Asia and the US. The US television industry has the technological, financial and managerial resources to play a leading role in this process.

But this is unfortunately not the case in Europe, which is likely to be the focus of the next round of painful readjustments in policies and strategies in response to changes in technologies and in world markets. By and large, European consumer electronics industries do not have the global reach of either the US or the Japanese industries; nor, with the exception of Philips, do they have the same degree of vertical integration.

The European industry, fragmented largely on national lines, will have difficulties achieving the critical minimal size needed for large-scale automated production. If structures are not broadened through mergers, acquisitions and investments across borders, integrating the industry more fully and dynamically into the global system, chances are that European markets will become more protectionist than they are already, with more rather than less restrictions on imports from Asia.

New for the Australian market



Recently introduced by Kriesler, the "660/55 Chroma Skill Leisure Centre" is more than an advanced 62cm colour TV receiver housed in an impressive oiled timber veneer cabinet. Incorporated as standard are: an integrated video game (tennis, handball and hockey); a 20-button ultrasonic remote control unit; an electronic digital clock with automatic turn-on function; and a video cassette recording facility. Other features include touch tuning with 8-channel pre-selection (including UHF/VHF and VCR facility) and automatic fine tuning.

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Forum

Conducted by Neville Williams

On modifying loudspeaker systems . . .

The 3-75L loudspeaker system described in the May issue sparked a lot of interest amongst readers, but it also prompted quite a few questions, many of which turned up in conversation and correspondence. What follows may forestall yet more inquiries and help to put the subject into better perspective.

The questions asked might be summarised thus: I read with great interest your article on the 3-75L loudspeaker system, but would like to know how it would perform:

1. If I built a version of it using . . . which I have on hand?
2. If I added a couple of additional drivers in line with current Japanese practice?
3. If I upgraded it by using a more elaborate crossover network and/or more expensive drivers?
4. If I were to build it as a ported system?

The short answer to most such questions is a simple "we wouldn't know", which sounds like a put-off, even if it is quite sincere.

The fact is that a multi-unit loudspeaker system is the end result of a certain combination of components, selected because they best satisfy the design criteria. If changes are made, resulting in a combination of components that the designers have not checked out, the designers can do no more than guess what the effect of those changes might be, short of checking them out in practice.

In introducing the 3-75L, we explained our own design objectives: a particular consumer demand, good performance, readily available components, and a practical price level. Subsequent acceptance of the design has clearly indicated that it "hit the spot" with quite a few readers.

However, we also indicated in the article the dilemma of anyone who may feel obligated to check out each and every possible combination of drivers. We expressed relief at having been able to bypass much of the tedium and frustration when the Nisco system came to light, as finally featured. It provided just the kind of answer we had been looking for and, having found it, we simply did not attempt to check and catalog all the other possible answers, most of them potentially less promising, anyway.

So we are no better placed than anyone else to give instant answers about the combinations that readers may dream up.

One of the more curious reports we received was from a reader who commended us most warmly on the article and said how successful his "version" of the 3-75L system had been. He had made one change only: he had used Philips components which he had on hand, instead of the ones specified!

As someone in our office remarked: he had built a Holden car using Ford parts, or vice versa!

If he used matched components from the Philips range in the 75-litre enclosure (as mentioned in the original article) he would probably have ended up with what was virtually a Philips system—possibly their System 14.

We could have no quarrel with that, because Philips systems are good in their own right. But there is no point whatever in thinking of any one of them as a version of the 3-75L, any more than the 3-75L is a version of a Wharfedale or a Leak or a JBL or anything else!

Perhaps the real question that flows from this is not so much whether the reader's system is a Philips or a Playmaster design, but whether it is a hybrid. As such, it may be quite okay but, again, it could as easily bring together aspects of the designs which are really incompatible.

A feature of the Philips System 14 was that it used a fairly complex crossover network which was especially designed to confine each driver to its own part of the spectrum, with a minimum of overlap. The network was specified partly to facilitate accurate instrumentation by close miking, and partly to prevent the tweeter and squawker from running into resonance problems below their natural "piston" range. Those who designed the system felt that the performance of the particular drivers would be prejudiced by using a simpler crossover, although I'm not sure whether they or anybody else got around to listening tests to see whether the difference would have been subjectively significant.

Without being sure whether the constructor in question used the Philips/Elcoma crossover or the simpler one suggested for the 3-75L, one cannot draw any particular conclusions—apart from the fact that the constructor is happy with what he has!

Another letter which caught our attention was from a reader who was keen to re-equip with a pair of 3-75L systems, but who wondered whether he could save money by using the components from the much earlier Playmaster 3-45L—buying some kind of a 12-inch woofer, if necessary.

To be sure, one could build up a system along these lines and it could possibly be made to work quite well if someone went to enough trouble to check it out and sort it out as necessary. But in no sense would it be a "version" of the 3-75L. It would simply be another design, which would stand or fall on its own merits.

What would be the effect of transferring the 8-30 Magnavox woofer from a 45-litre ported enclosure to a 75-litre sealed enclosure? We're not absolutely sure, but we doubt that there would be any advantage in so doing; it may not even work out quite as well, because an 8-inch cone can get a lot of help from a properly tuned port.

But, assuming that the difference was not profound, our expectation would be that the 3-45L components transferred into the 3-75L enclosure would sound very similar to the original 3-45L. The character of the sound, so dependant on the middle and upper register, would still be that of the two drivers involved.

How would the sound compare with that of the 3-75L? We would expect to find it not quite as full and clean, but there would be something wrong if our expectation was any different, because the 3-75 is a more recent development, is larger and more expensive.

Our advice to the particular reader would be: sell your 3-45Ls—they're still a good system—and put the proceeds towards the more expensive one.

What about the idea of substituting a 12-inch woofer for the 8-30?

It would all depend on the woofer chosen. It would have to be a low resonance type with a generous magnet to behave properly in the sealed enclosure, and it would need to have a suitable order of sensitivity to balance with the other two drivers.

The second group of questions had to do with the addition of one or more midrange units or tweeters—fairly obviously prompted by some of the systems currently displayed with five or more cones.

An appropriate reaction to this proposition is to make the point that the performance of a loudspeaker system is not measured by the number of drivers displayed. If the number of drivers has been increased, without prejudice to their individual quality, and if the divider network ensures that each driver operates over a proportionately narrower portion of the spectrum, there may be some reduction in intermodulation effects.

However, if the quality of the drivers has been prejudiced in favour of quantity, and the divider network does not strictly segregate the various parts of the spectrum, intermodulation may be worse rather than better, with the added possibility of phase confusion from the multiple sources.

Some see this as an objection to multiple sources, anyway!

So, without taking sides either for or against 4-speaker or 5-speaker systems, our intuitive reaction would be not to fiddle with the 3-75L, as is. It works fine, so leave it that way.

If somebody really wants a 5-speaker system, it should be designed from the ground up, in its own right, and not viewed as a tentative adaptation of something else.

What about using more expensive drivers and a more elaborate crossover network—proposition 3?

Certainly such units are available and one should rightfully expect them to outperform something less expensive and pretentious. But, again, why start with the 3-75L?

Different woofers, different squawkers, different tweeters may require different crossover frequencies for optimum results.

Any multiple set of drivers needs to be compatible in this respect, so that the whole spectrum will be covered. And, of course, the crossover network has to be designed to produce the right kind of crossover at the right places.

This, in addition to the whole question of driver sensitivity, as mentioned earlier.

So, having been inspired by the 3-75L article, anyone seeking something more pretentious should forget the 3-75L and start searching through manufacturers' literature for designs that are already worked out, that appeal, and that are still within the reach of your cheque book.

Right at the moment, we don't have anything in our files, or immediately in view, that would meet this need.

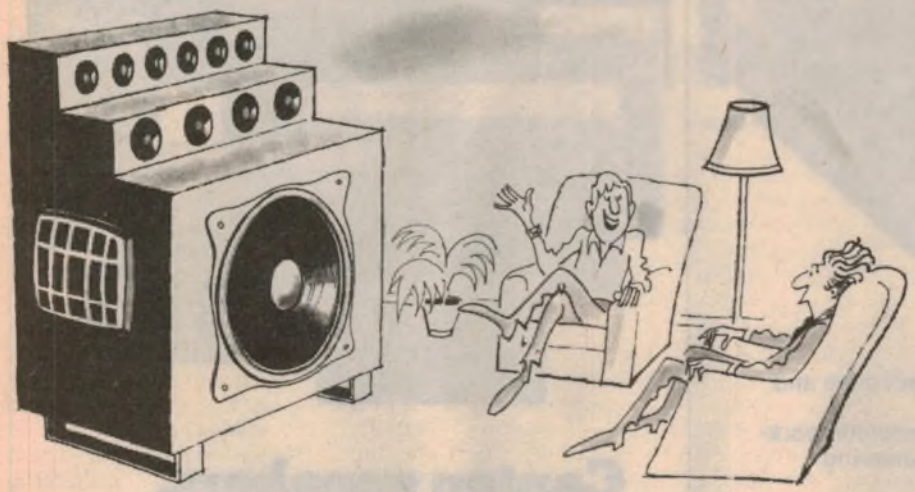
And, finally, what about the idea of porting the 3-75L enclosure?

It's a possibility, but it's an exercise that we did not pursue, because one has to draw the line somewhere.

The manufacturer's literature suggested the use of a sealed enclosure and, in this respect, took a similar line to that reflected in many of the Philips designs. It worked fine, in practice, and it suited our purpose in that a large sealed enclosure was likely to be more accommodating than a ported type in the event of it becoming essential to nominate some other kind of quality woofer. That point was made in the article.

So there it rests. If someone cares to derive the parameters of the Nisco woofer, determine its "Q" and the need for possible damping, and to work out the optimum port for the particular enclosure, we'd be delighted to hear about it.

But, in the meantime, we'll quite happily enjoy the 3-75Ls as they are. They sound fine!



Well it's basically the Playmaster 3-75L, with a few minor mods . . .

The beginning of beautiful music.

DD30

Micro Seiki turntables.

A sophisticated range of direct drive and belt drive turntables.

Excellence of materials, meticulous workmanship, attention to minute engineering details . . .

A combination to produce impressive overall performance in sound reproduction.

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The unique floating suspension system of the DD-30 ensures crisp, clean sound. Direct drive from the DC servo motor results in wow and flutter of less than 0.03% WRMS.

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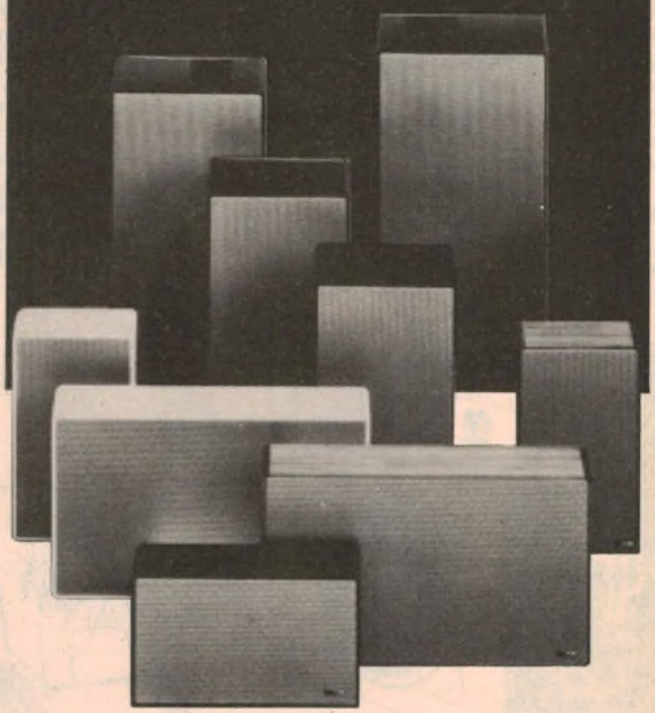
Select from belt driven models MB-10 and MB-15, direct drive models DD-20, DD-30 and DD-40. Ask for a demonstration soon.

The greatest range of sound from the smallest of enclosures.



Canton speakers.

For value, none better.

Canton sets new standards in compact domestic enclosures. Among the smallest on the market, Canton are built to high specifications and their sound is superb.

The Canton range of Hi-Fi loudspeakers includes seven units: The LE250 is the smallest at 30 x 17.5 x 13 cm with an RMS rating of 40 watts. The LE900 is the largest – 58.5 x 31.5 x 27 cm – with an RMS rating of 90 watts.

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Southern Cross A-1270 stereo amplifier

The Southern Cross model A-1270 is a rarity in today's hifi market: it has a low price. It is well finished and offers a power rating of 10 watts per channel together with good control facilities.

Do not be mistaken now. This amplifier is not the answer for the man who wants the ultimate hifi system. A modest price commands a modest performance. As far as we know Santa Claus does not live at the North Pole (he lives at the South Pole, which is why Dick Smith flies there regularly).

Having said that, the Southern Cross is an attractive unit at its modest price. The front panel is finished in satin black with white engraved labelling which is highly legible. All the usual controls are there, with the exception of a Mode switch to allow mono reproduction. All the controls operate smoothly.

The rear panel is relatively uncluttered. Three pairs of RCA sockets provide for connection of a stereo cartridge, which may be magnetic or ceramic, and two high level sources. A five-pin DIN socket provides recording and monitoring facilities for a cassette or tape recorder.

Two sets of screw terminals are provided for connection of two pairs of loudspeakers. Here we must complain about penny-pinching. Instead of four terminals for each pair of loudspeakers, only three terminals are provided. This might be satisfactory if the loudspeaker leads are fitted with spade lugs but the risk of shorted connections is not favourable.

A three-core mains flex and three-pin plug are fitted. Good.

Inside, the main PC board is upside down and has a veritable "bird's nest" of wiring connected to it. While it is not the tidiest chassis we have seen recently, it certainly has good accessibility. That cannot be said of many amplifiers these days.

No circuit was supplied with the unit but the circuitry appears to be fairly conventional. The power amplifiers employ four transistors each in what appears to be a simple complementary circuit. The loudspeakers are coupled via 470uF capacitors. The main filter capacitor is a modest 2200uF.

Power rating is quoted at 10 watts RMS per channel into 8 ohm loads. The mains voltage specified is 220 VAC so our mains voltage of 240VAC could be expected to boost the rated power by about 20% to 12 watts per channel. Even so, using a regulated 240VAC mains source, we measured power output at 6.2 watts per channel with both channels driven. With one channel driven, the power rose to 6.8 watts into an 8 ohms load.

With 4 ohm loads, the power output was 4.6 watts per channel with both channels driven and 5.7 watts with one channel driven. Rated distortion at full power was not quoted. We measured harmonic distortion full power at between 2 and 2.5% depending on load and frequency (within the audio range). At 5 watts into 8 ohms, harmonic distortion was down to 0.9% while at one watt it was down to around 0.5%.

Frequency response at 1 watt was 40Hz to 45kHz at the −3dB points. This was obtained after adjusting the tone controls for equal response at 100Hz, 1kHz and 10kHz. The tone controls gave ±13dB at 50Hz and ±13dB at 10kHz.

The high filter had the usual inadequate slope of 6dB/octave but was started at 1.5kHz (−3dB point). This translates to a cut of 16dB at 10kHz. It amounts to a preset tone control with a little more cut than is available with the treble control at minimum setting. So, like most amplifiers, the high filter is merely for decoration and is quite ineffective.

Phono and high level sensitivities checked out as specified. Phono overload margin is rather low, at only 30mV at 1kHz.

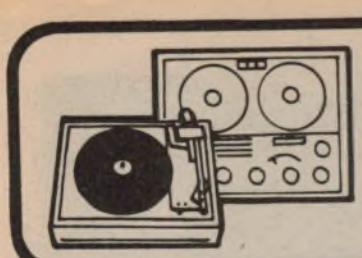
Signal to noise ratio for the high level inputs was 59dB with respect to 6.8 watts into an 8 ohm load. For the phono input, the equivalent figure was 57dB with respect to 2.5mV (or 69dB with respect to 10mV input and 6.8 watts output at 1kHz). At high settings of the volume control the amplifier was sensitive to mains radiated interference, when using the phono input.

Stability with capacitance up to 2uF shunting the load was good. No problems at all.

Sound quality of the amplifier was quite good although we felt that the residual hum could have been lower. This would easily be improved by increasing the size of the main filter capacitor.

Overall, the Southern Cross A-1270 is a reasonably priced unit. With reasonably efficient loudspeakers it can give quite a good account of itself. Recommended retail price is $120.00. A matching tuner is also available at $120.00.

The Southern Cross A-1270 stereo amplifier and matching tuner are available from all branches of Dick Smith Electronics. (L.D.S.)



Hi Fi News

The Chicago Electronics Show

The annual Consumer Electronics Show in Chicago is now established as the major showcase for the world's hifi and consumer electronics market. Our correspondent George Tillett visited this year's show, and reports here on new products displayed by the leading manufacturers.

This year, the eleventh annual Consumer Electronics Summer Show opened with a great feeling of optimism. Exhibitors numbered over 700—a record—and they were spread out in the huge exhibition halls at McCormick Place, while another 150 had audio demonstration rooms or suites at the nearby plush McCormick Inn. A further contingent of nearly 100 were dispersed in hotels all over Chicago, making it next to impossible to see more than a fraction of the exhibits.

Digital watches were well in evidence, although many of the companies who jumped on the bandwagon two short years ago have folded up. Some of the larger firms have also left the business, but the general opinion is that the industry will now settle down to a more stable growth pattern—let the chips fall where they may (sorry about that!). Already, digital watches account for nearly half the total watch sales in the US and there are no signs of a reduced demand.

One watch on display was combined with a 9-digit calculator and another had full chronograph facilities with elapsed time, lap time and split-time. It boasted a 6-digit display for hours, minutes, seconds, tenths and hundredths of a second! A programmable message model gave the user a choice of a 5 word, 5 letter program from any 26 letters, 10 numerals and 5 symbols. It was said to be very easy to change displays—a point that might appeal to those who wanted to show the name of their girl friend!

There were several calculators that use solar power, but most of them had rechargeable batteries. One that didn't was the Teal 14-function model. It measures only 111 mm by 65 mm by only 7 mm thick and it runs entirely on solar power—so there is no on/off switch.

One of the sensations of the Show was the introduction of JVC's Vidstar video recorder, which can play up to two hours with a cassette. Tape width is ½-inch, the same as Sony's Betamax; but the two systems are not compatible. Cassette sizes are different and whereas the Betamax speed is 40 mm/sec, the Vidstar tape moves at 33.35 mm/sec. So now we are faced with another situation similar to the one which has held back quadraphonic sound, with two different systems backed by opposing groups. RCA, Panasonic, Hitachi and Mitsubishi are backing the Vidstar format while Sony, TEAC, Pioneer, Aiwa, Zenith and Sanyo will be using the Betamax system. What can I say?

The trend towards higher powered receivers and amplifiers continues with Marantz still claiming their Model 2500 "The World's most Powerful Receiver". If it isn't it must come pretty close, as it puts out over 330 watts per channel into 4 ohms! It features provision for a Dolby unit and has a built-in scope.

Both Sony and Infinity were showing PWM amplifiers, but I was also interested in two other possible solutions to the problem of obtaining higher efficiency with reduced cost. One was the Hitachi "Class G" system and the other was Soundcraftsmen's "Class H". A "Class G" output stage consists of four devices, two to handle the positive swings and two to handle the negative swings. One pair is fed from a low voltage supply and functions as a low power Class B amplifier, but when the signal reaches a certain value, it cuts-off and the high power stage takes over.

Hitachi claim a considerable saving in the power supply and heat sinks and so they will use Class G in a range of amplifiers and receivers—several of which have already been released here. A receiver which was demonstrated had a rated power of 75 plus 75 watts, but it was claimed that it could easily handle 160 watts per channel on peaks. The top of the line Class G amplifier was rated at 200 plus 200 watts, with double the power available at maximum outputs.

A rather different approach is taken by Soundcraftsmen in their Class "H" circuit. Why "H" I wanted to know: well, according to the designer it was chosen just because H comes after G—so I suppose we will be seeing a Class I amplifier any time now. (Yes, I know about Class K . . .)

A Class H amplifier uses two power supplies with one voltage being about two-thirds the other. As the input signal increases, a "vari-portional" circuit turns on the high voltage supply long before the clip point. Thus, the amplifier is operating at a lower voltage most of the time, reducing power stage dissipation. Even under high power conditions, the high voltage supply is only on for peaks and a sine wave signal will cause the second supply to turn on for a fraction of the waveform. This was clearly demonstrated on a scope and it was possible to gradually increase the input signal until the high voltage trace began to show a rise too!

The big advantage of this system is that there is no switching inside the signal path or feedback loop as all the control functions are confined to the power supply. So distortion, slew rate and stability is not affected. The amplifier demonstrated had a maximum output of 250 watts per channel and it featured LED indicators showing operation of the "vari-

The new Soundcraftsmen 250 watts per channel amplifier, with inbuilt logic to increase the output stage supply voltage on signal peaks.

portional" circuit.

As always, there was an almost bewildering variety of loudspeakers around but I will try and pick out the most interesting. Koss, for example, introduced three new models, all designed on the basis of the theories of Australian designers Small and Thiele. One model used a passive radiator with a removable brass plug, which moved the system resonance from 35Hz to 40Hz and gave a rise of some 2dB and 60Hz. The second model had a 10 inch bass driver, a 4½ inch midrange unit and a 1 inch dome tweeter while the top model had two domes and two midrange speakers. All three sounded very smooth with a clean but solid bass.

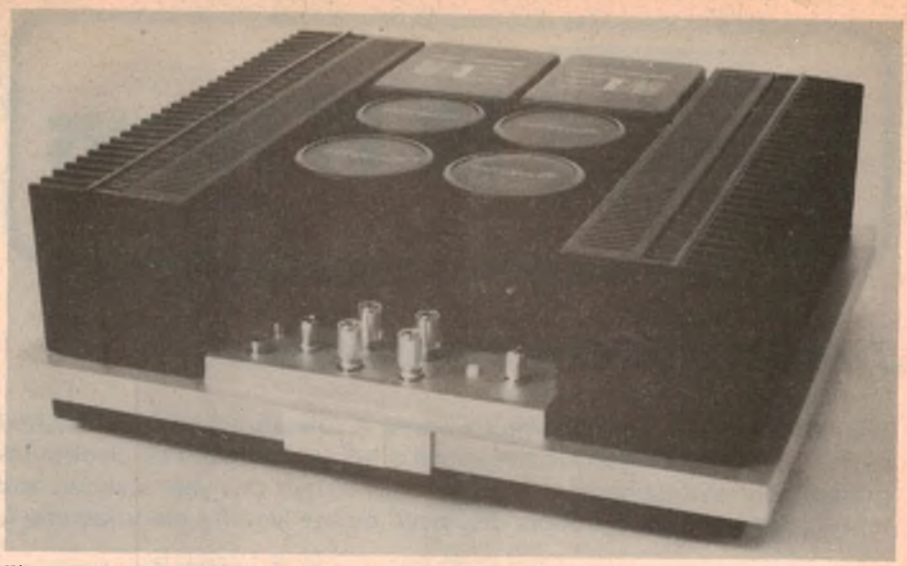
Cerwin-Vega (loud is beautiful) introduced a new system which had a plastic bag filled with an inert gas inside. The idea is to increase the apparent capacity of the enclosure and so drop the resonant frequency.

A number of Linear Phase loudspeakers were to be seen, including models by Dynaco, Sonic Energy, Technics plus imports from England—the B & W, Leak and KEF versions. The last-named was the Model 105 and when I read the advance Press reports describing the method adopted for correct positioning I was somewhat disturbed. The story was that the angled top section must be pointed to the listener for best results and to that purpose an LED was built-in. So if the listener was on the beam so to speak, he saw the light. I thought, no—we can't go back to the old "stereo seat"! But when I went to the demonstration, I was pleasantly surprised to find that the horizontal dispersion was quite wide, better in fact than many so-called wide-angle systems. On the other hand, the vertical angle was relatively narrow, which means that under normal conditions the units are adjusted for listeners who are sitting down. The bass driver is a 12-inch model with a Bextrene cone and at 300Hz it crosses over to a 4½ inch midrange cone speaker.

At 2.5kHz, the signal is fed to a 1-inch dome.

In order to arrive at a "linear phase" the midrange and trable units are set back in the now familiar staircase formation. To be strictly accurate, I must say that linear phase is not claimed, it is stated that "there is minimum inter-unit time delay, to provide depth and perspective". A subtle difference there.

But what did they sound like? Well, it was certainly one of the best demonstrations at the Show. But what impressed me more than anything was the definite sense of depth, of radiation from the rear, although there are no rear facing speakers! Uncanny to say the least. Unfortunately, I was unable to hear the B & W demonstration but I was told it was outstanding.



The Pioneer M-22 power amplifier, which operates wholly in Class-A. Rated power output is 30 watts per channel.

I did manage to hear the latest version of the ESS "Transar" Heil system, which uses an unusual bass driver. This employs a vertical stack of five small plastic diaphragms, interconnected by four long carbon fibre rods and driven by a more or less conventional two-inch voice coil and magnet assembly. The system is mounted in a large transparent plastic tube which in turn is mounted in the centre of a large baffle board. One of the advantages of this kind of construction is that all the associated resonances are well outside the crossover frequency, so no damping of any kind is required. The crossover point is at 1 kHz, where a standard Heil unit takes over. This is mounted near the top of the board and radiation from both units is di-polar. The demonstration consisted of several musical items, but I was especially impressed with the reproduction of a cello, which all too often sounds as if it was inside the loudspeaker box.

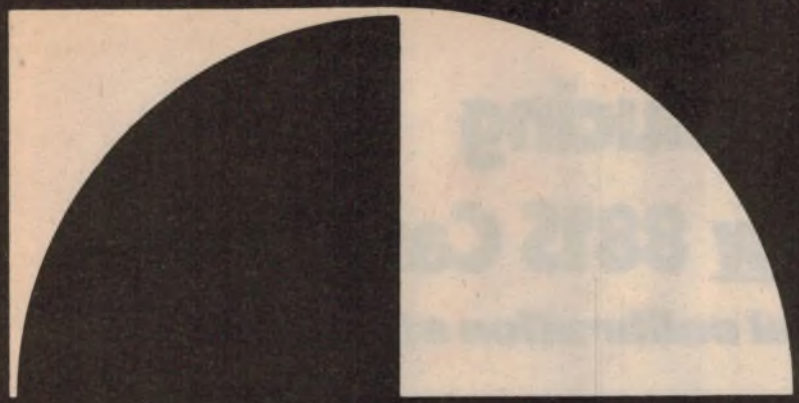
Although the Transar system is unquestionably one of the finest and most accurate systems I have ever heard, I have to admit ESS have a big problem. How can two large baffle boards be disguised to make them acceptable for domestic use? (I had enough trouble with ONE years ago!)

The ESS AMT-1 monitor system, with its Heil air-motion driver for midrange and treble, and a woofer/passive radiator.

Although many of the audio demonstrations were excellent, I often found myself missing the sense of ambience and spaciousness that good quadraphonic sound can give. There were very few such demonstrations but records are still appearing and much work is going on behind the scenes. CBS were demonstrating the new Scheiber and Tate decoders, both of which have separations in excess of 35 dB. The former is a deluxe studio model while the Tate unit employs three National Semiconductor IC's (types LM 1852 and LM 1853) and I understand it is being offered to licencees. Results in the SQ mode were extremely good but there was an amazing sense of location and perspective when ordinary stereo records were played in the "enhancement" mode.

I was also interested in something called the Narrow Band Voice Modulation or NBVM system which was invented by Dr. Harris of the University of the Pacific. Briefly, NBVM works by isolating and down-converting the band from 1.5-2.75kHz to 0.25-1.5kHz on transmission and re-constituting them at the receiver. The system relies on the observed fact that voiced (vowels) and unvoiced (consonants) speech sounds have a strong tendency to be temporally separated and to have separate spectra. Because these sounds do not occur at the same time, they can occupy the same transmission bandwidth without causing any significant interference.

In general, unvoiced utterances (consonants) use the band from 1.0kHz to 3.5kHz and are temporally separated. If the band from 1.5 to 3.0kHz is preserved and added to a fundamental-like carrier,



NAKAMICHI

It is not so very long ago that the name Nakamichi first came to the notice of Hi-Fi enthusiasts.

The introduction of the Nakamichi TT1000 3 head Cassette Deck set entirely new standards of performance for a cassette recorder. In a similar manner the DT550 established performance standards previously not thought possible in a portable cassette deck.
Dr. Nakamichi's design philosophy was to produce equipment which would capture and reproduce pure uncoloured sound. The same philosophy has been applied in the greatly extended range of Nakamichi hi-fidelity equipment which is now available.

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Nakamichi 620*	Power amplifier
Nakamichi 630*	FM Tuner Pre-amplifier
Nakamichi 500	2 head Cassette Deck
Nakamichi 410	Pre-amplifier
Nakamichi 420	Power amplifier
Nakamichi DT550	Portable versatile Cassette System
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Nakamichi 250	Cassette Player
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**Combined make up the "System One" Rack console.*

Plus an extensive range of peripheral equipment – microphones, digital timers, reference pick up phono cartridge, headphones etc. Only accredited Nakamichi dealers (look for the sign 'Nakamichi Spoken Here') are provided with the Technical Bulletins essential to fully understand and demonstrate Nakamichi equipment. The Nakamichi warranty** applies only to equipment purchased from accredited Nakamichi dealers in the country of purchase.

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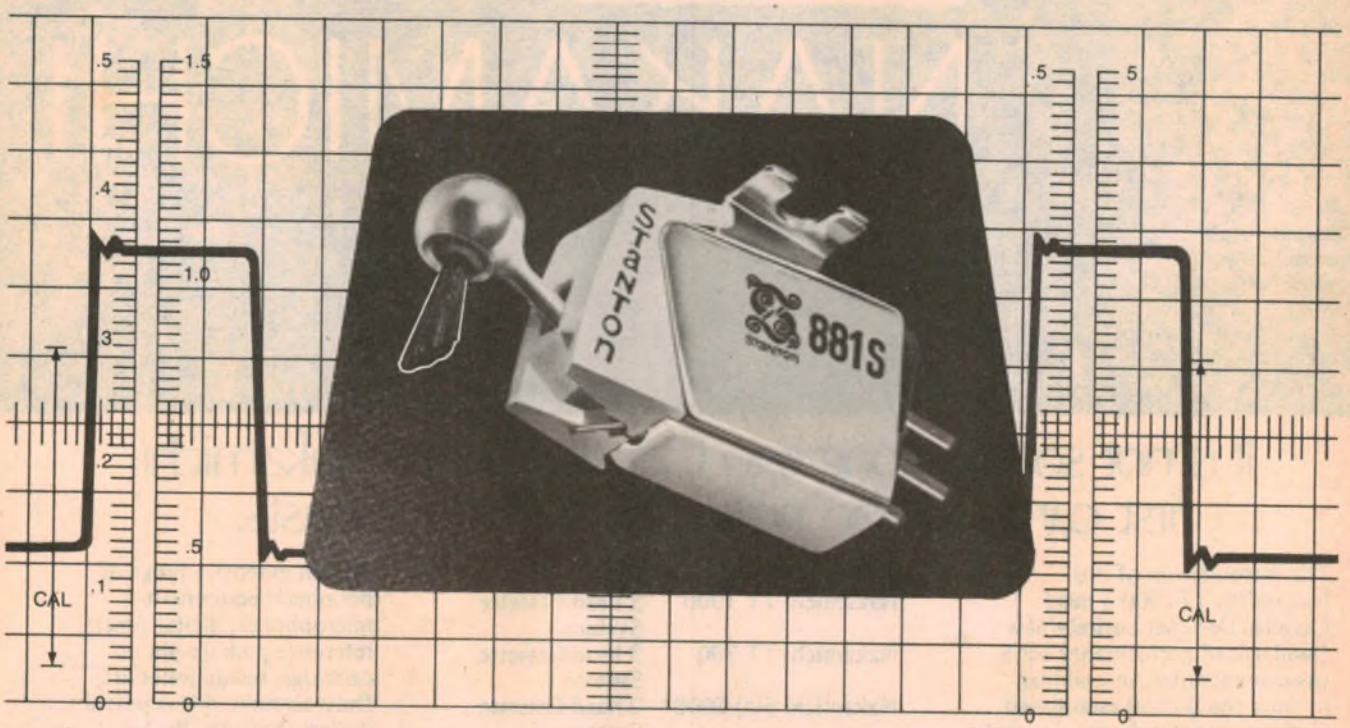
the Professional calibration standard



Stanton's 881S Professional Calibration Standard represents the first in a development of a whole *new* generation of cartridges.

Its whole design concept is based on producing a cartridge which would have the highest possible ability to protect records.

This requires a brand new tip shape ... the 881 has it ... it is the Stereohedron®.

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The list of innovative features in addition to the 'Isolated Loop' includes direct-drive reel motors; aluminium diecast chassis; multivibrator pitch control; tape tension control; electrobrake; separate microphone and recording amplifiers; plug-in type head assembly and 3-way bias and equalization selectors.

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True open reel performance.

You want the highest quality sound. Right? You also want cassette convenience. Right?

Meet Sony Elcaset, the world's newest tape format and the first to give you both.

It's simply the nearest thing yet to sound perfection in an easy tape package. It's an entirely new type of cassette and player system which moves twice as much tape, twice as fast as a standard cassette for a performance that truly rivals the best in reel-to-reel.

Always something new from Sony

Our restless search for something better has given the world some products that have truly revolutionised sound and sight.

And in the case of Elcaset, it's backed by a consortium of Japan's leading electronics manufacturers.

Much more than a bigger cassette

In developing Elcaset we took the bugs out of the standard cassette system. To do so we utilised the superior tape transport system of videotape. The tape is actually removed from the case for better alignment and tape to head contact—3.3 times more per second!

The tape comes with three other dramatic improvements: • Reel hub locks to prevent tape spill • Permanent, in-place, anti-erase tabs • Another most amazing of all—Elcaset tape comes with its own built-in detectors that automatically set bias and equalisation and Dolby noise reduction.

Tape is freely available, including Sony's famous double-coated FeCr.

Elcaset is sensational. Elcaset is a major step forward.

Elcaset *is* the future of Hi-Fi in tape.

As *"Hi-Fi Review"* said (November '76)
"The format as represented by the EL-7 is an ideal one for home use, with obvious performance superiority compared with even the best compact cassettes, yet without the fiddle of open reel . . .
. . . The Elcaset has enormous potential for listeners seeking both top quality sound and convenience."

And *"Electronics Today—International"* (December '76)
"The Sony EL-7 was judged to be a very good performer, and certainly convinced us that the Elcaset format is a welcome introduction to the Hi-Fi field . . . the Elcaset system is likely to have enormous appeal to critical Hi-Fi enthusiasts."

Main Features: EL-5 Elcaset Deck $795

• Front loading vertical cassette • DC servo motor • Feather touch logic controls with optional remote • Dolby* NR System • 3 position bias and equalisation selectors • Line mike mixing • Soft eject cassette lid • Punch in recording • Optical auto shut-off • Timer activator control.

EL-7 Elcaset Deck $1225

• Front loading vertical cassette • DC servo motor for capstan • Feather touch logic controls with optional remote • Dolby* NR System • 3 position bias and equalisation selectors • Three motors • Three heads • Line mike mixing • Soft eject cassette lid • Punch in recording • Optical auto shut-off • Timer activator control • Closed loop dual capstan drive

Performance:	**EL-5**	**EL-7**
Signal to noise:	62db (FeCr) Dolby off	62db FeCr
Frequency response:	25Hz-20kHz (FeCr)	25Hz-22kHz (FeCr)
Wow and flutter:	.06% (WRMS)	0.04% (WRMS)
Total Harmonic Distortion:	.8%	.8%

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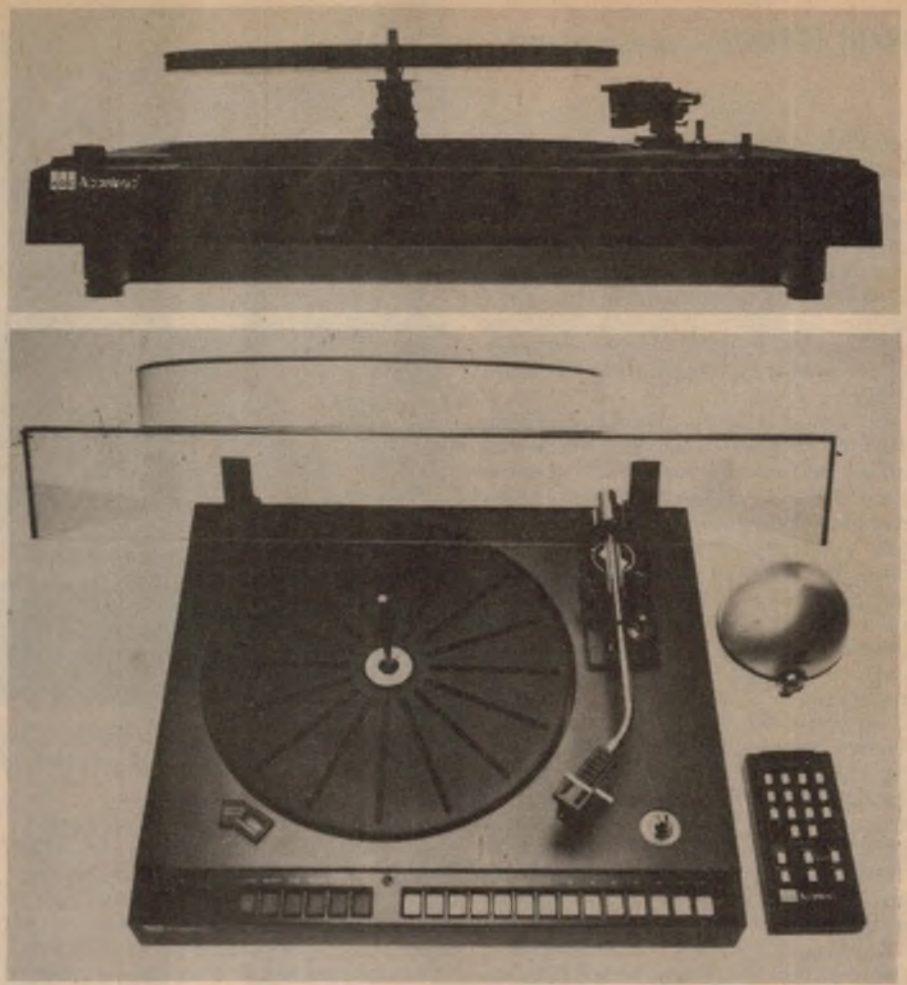
the resulting speech, when re-constituted is still intelligible, although only occupying half the bandwidth. In the transmission mode, the low frequency signals (below 700Hz) are amplified so a fundamental-like carrier signal is obtained. This is fed through a balanced modulator to the output. At the same time, the higher frequencies containing the vowel sounds are band-limited to 2.75kHz, inverted and down-converted by the balanced modulator and 3.0kHz oscillator. The whole process is reversed at the receiver. Naturally, distortion is quite high by hifi standards but the system would appear to have applications for CB and AM communications. In the case of FM, it could significantly increase the carrier deviation to arrive at a higher modulation index.

A great many new tape recorders were to be seen and it was apparent that the majority of new cassette decks are front-loading. There is also a trend towards vertical placement of the cassette—Sansui, for example bringing the tape heads outside the front panel for convenient loading and easy cleaning.

Technics were showing their new Elcaset model, the RD-750US, and it is claimed that the maximum output level (MOL) at 10kHz is almost 15dB higher than levels attainable with compact cassette decks, while the frequency response extends up to 20kHz. A photosensitive transistor arrangement detects the transparent tape leader at the end of a reel and activates an oil-damped eject mechanism. The deck can take three different kinds of tape: low-noise high output, ferri-chrome and Cr02. The appropriate bias and equalisation is selected automatically by indentations in the Elcaset case, and front panel indicators show which kind of tape is being used.

But Technics are not neglecting the ordinary cassette deck, and one of the new models is the RS-9900US, a semi-professional model with three heads, Dolby, three-motor drive and a pitch control. It comes in two stackable units, one for the tape transport and the other for the electronics. Other features of this "landmark in high fidelity cassette technology" include a built-in 8kHz test oscillator for head alignment, full logic control, feather-touch sensor buttons and a useful tape timer that indicates how much time remains on the cassette. Technics also had a sophisticated open-reel machine using a quartz-locked direct-drive DC motor which rotates at the low speed of 3.6rpm, for a tape speed of 15ips. Because the speed is absolutely stable, a strobe ("the world's first") is incorporated and a pitch control can vary the speed by 6%.

Quartz-lock servo systems are now used on a number of single-play turntables, although at the moment prices are high. Perhaps the most interesting turntable is the new BSR Accutrac Plus 6—an even more versatile unit than the original Model 4000. It allows a listener to play six albums and select the tracks on each record, in any sequence. The small hand-held control unit can adjust the volume as well as select the particular record or track, but the most ingenious feature of the machine is the automatic record selection.



Two views of the new Accutrac +6, based on the earlier model 4000. Fully programmable, it incorporates a very sophisticated record changer.

A computer activated rotary action cylinder spirals up through the platter to retrieve each record in sequence and then places it gently, very gently on the platter. At this time the platter is at rest, so there is no friction that might harm the record—and note, the records are not dropped on the platter! No less than 27 separate "commands" can be stored at a time and the wire-less remote control unit is optional as the functions are all duplicated by a keyboard on the front of the turntable.

Infinity had a prototype of the curiously named "Black Widow" turntable, which has a built-in pump so the platter is literally floating on a cushion of air. Also Audioanalyst were demonstrating the new Dynavector arm, a beautifully made twin-pivot job that costs over $500!

Highlight of the Show for many people was the introduction of Superscope's Pianocorder, a remarkable instrument that can "play" a piano by using pulses recorded on magnetic tape. The story really began back in 1904 when one Edward Welte invented a player piano that really captured the original performance in an amazing way. He had attached to each key a light carbon prong that made contact with a tray of mercury, thus when the key was depressed, an electrical circuit was made that would measure the initial transient and duration. Similar devices were attached to the foot pedals and these electrical impulses were recorded on a paper roll by a kind of pen recorder. The tracings were then laboriously punched out by hand.

Now, if you thought all that was ingenious, wait until you hear about the player mechanism. This consisted of a wooden box fitted with eighty felt-tipped fingers and two feet for the pedals, called the Vorsetzer—which means "sitter-in-front". And this is what it did—sit in front of a piano—any piano—and play. It was operated by air suction, controlled by the perforations in the roll.

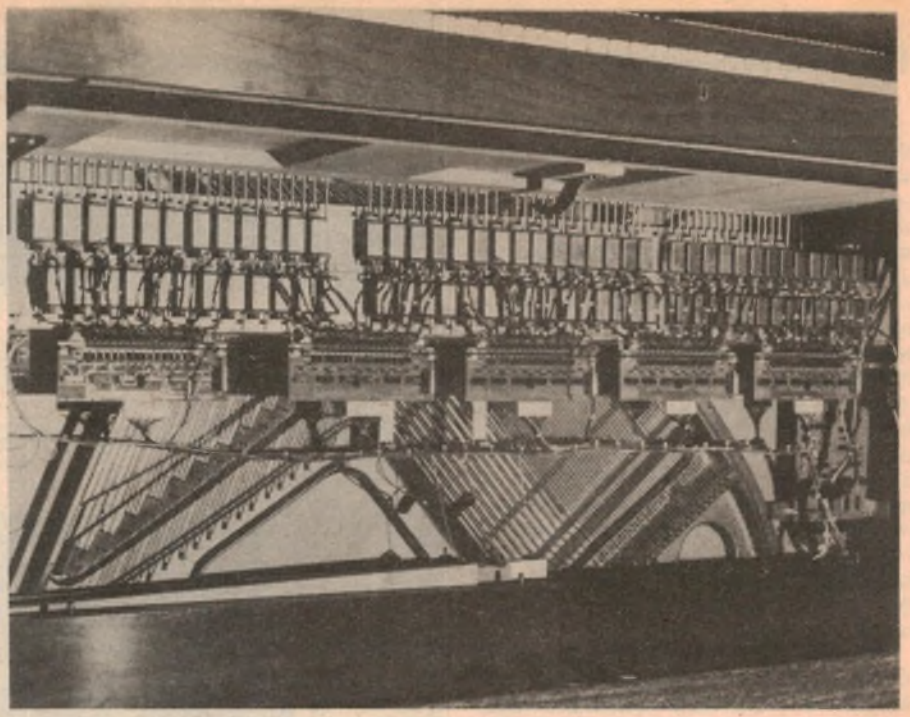
Not only was Welte a remarkably talented engineer and musician, but he was a showman too. He rented a

fabulous castle on the Rhine where he invited the piano virtuosos, the Great Masters of the day to a gourmet vacation with a chance to record their genius for posterity. Soon Welte was established and the artists were full of praise. Said Debussy "It is impossible to gain a greater perfection of reproduction" and similar endorsements were made by Glazounoff, Rachmaninoff and many others.

So Edward Welte prospered and by 1927, his catalogue listed no less than 264 artists performing over 5000 compositions. But this was the peak year and the decline in popularity was so fast that the last Vorsetzer was made only 5 years after. Whether this was due to the growing popularity of the phonograph and radio is not certain, but whatever the reason, Vorsetzers fell into disuse and rolls gathered dust in attics and basements.

Nearly 40 years later, Joseph Tushinsky, the dynamic president of Superscope, was given a Welte catalogue which so aroused his interest that he began a hunt for rolls and Vorsetzers which soon spread to Europe. By 1968, he had unearthed over 300 rolls and spent a small fortune on restoring Vorsetzers. He had also started the "Keyboard Immortal" program two years earlier—soon to be heard from stations all over the country.

When I visited Joseph Tushinsky in 1970, he had collected 5000 rolls, but this has since increased to nearly 18,000 which are now being put onto tape by a digital process. Ordinary cassettes are employed and they are inserted into a control unit which is mounted near the front of a piano. The electrical impulses activate a bank of solenoids and relays inside (Welte would have been fascinated!). At the CES demonstration, selections from the Great Masters were played along with Ragtime Tunes of the Twenties and more. One item consisted of a small selection played by a local restaurant pianist—mistakes and all!



A view inside the new Superscope Pianocorder. A modern version of the Welte Vorsetzer, it plays the piano from cassette tape recordings.

You see the Pianocorder can not only play recorded programs, but it can record as well, playing back note for note exactly as in the original. So it will be of great value to students. Price of a complete installation here will vary from $1300 to $1600, depending on the type of piano. The price includes 100 tapes. As the adverts put it "Let Rachmaninoff play on Your Piano" or words to that effect. I must admit I find it very pleasing that the very technology that overwhelmed Welte all those years ago is now helping to make his genius known to millions.

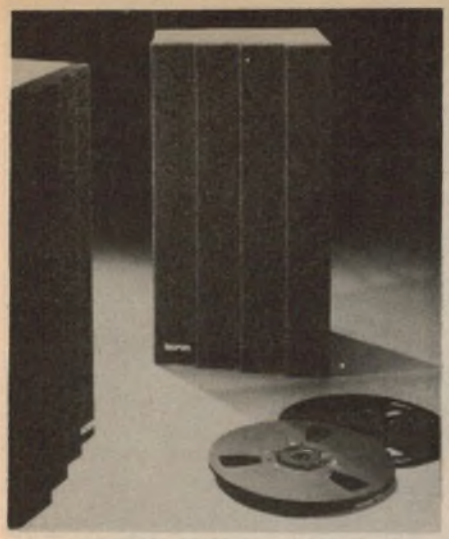
This year, more than twenty-one companies from Britain were represented at the Show, most of them under the aegis of the Federation of British Audio. Goodmans returned to this market after an absence of more than ten years and so have Leak-Wharfedale who are both in the Rank group.

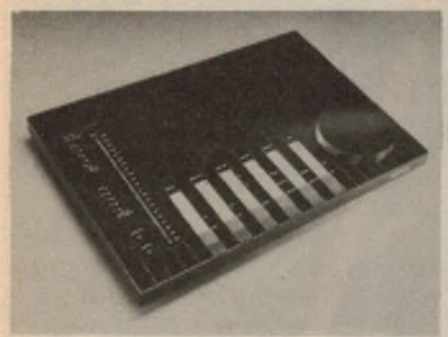
Most of these exhibitors were showing what we call "high-end" products. For example, there were several elaborate turntables carrying price tags of over $1000! Lecson had a range of loudspeakers but their uniquely styled FM tuner was attracting most attention. Among its features is a LED "tuning array" and an optional crystal controlled frequency meter. Monogram had 3 amplifiers which use a switching circuit to change models from Class A to AB and then B.

Monitor also had a range of loudspeakers plus a novel turntable which has a binary readout. H.H.Electronics were showing a 500 watt amplifier—which means it can put out 1 kilowatt of power! Nothing unusual about that, nowadays, but this unit only weighs in at 45 lbs, so it can be used on location.

As mentioned earlier, Leak have a "linear phase" loudspeaker. Wharfedale's designs are more conventional, although some models feature a higher than average efficiency.

Companies like Decca, Quad, KEF,

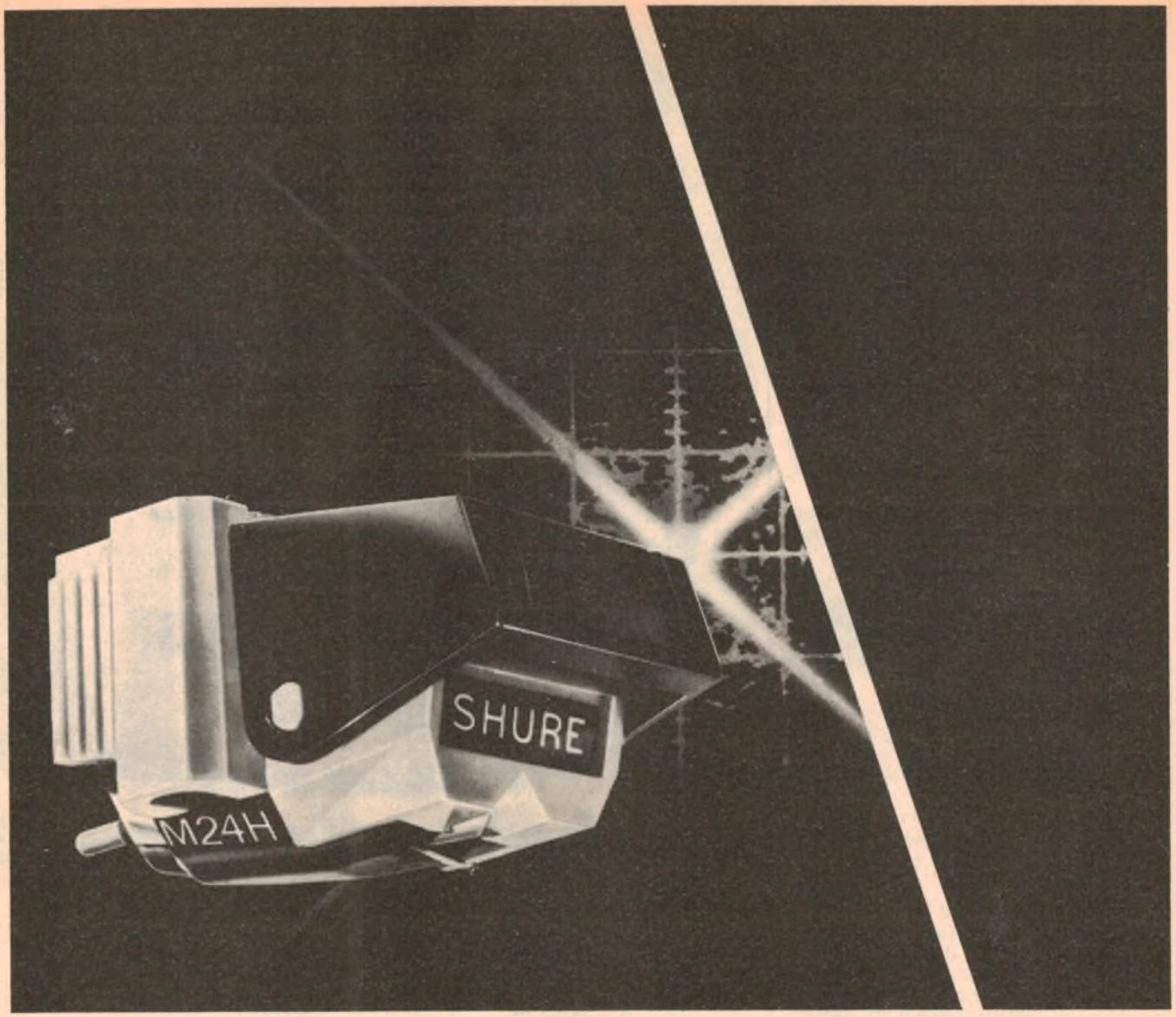




A new compact loudspeaker system and high performance FM stereo tuner, both from the UK firm Lecson Systems.

Connoisseur, B & W and Tannoy are very well known in the US (and Canada) and I have no doubt that they will continue to prosper. So will the other firms if they can provide a range of well-engineered (and styled) products which are distinctive enough to be considered as genuine alternatives to those generally available this side of the Atlantic. In other words, buying products from Japan, Taiwan or elsewhere and putting British labels on them will be doomed to failure.

IN BRIEF. Hitachi are experimenting with a Hall-effect semiconductor tape head . . . Yamaha have a Class A amplifier rated at 30 plus 30 watts, a switch converts the output to Class B when the power jumps to 120 watts per channel. The Pioneer U-24 amplifier is also Class A with an output of 30 watts per channel; it has no Class B switch . . . A French company, Setton, were demonstrating an elaborate tuner-control unit with unique throttle controls, quartz frequency meter, digital frequency readout etc., etc., and styled by Cardin—all for $3,500! . . . And how about the "Sonic Stimulator", which consists of a transducer of sorts in a box having several flexible plastic outlet tubes connected to suction cups. These are "placed on your body anywhere you wish to feel the message. The Beatles on your back, Bartok on your belly . . ." I did not get around to hearing one of these gadgets—which is probably as well. My favourite composer is Bach.



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Technics SU-8600 stereo amplifier

Previously Technics have been prominent with high performance turntables and cassette decks. Now they are moving to gain more prominence with amplifiers and receivers. A recent release is the Technics SU-8600, a stereo amplifier with plenty of operating facilities and a rated power output of 76 watts per channel into eight ohm loads.

Styling of the Technics SU-8600 stereo amplifier follows the recent trends to produce domestic high fidelity equipment which looks as though it might be intended for "professional" use. This is implied by the sombre charcoal panel, rugged handles and slots for rack mounting.

In this reviewer's opinion, these features are merely sales gimmicks which tend to detract from an otherwise excellent product. Some of the more worthwhile features are the precision multi-step volume control, facilities for recording and dubbing with two cassette or tape decks, and the high and low filters which have a realistic slope of 12dB/octave.

In other respects the control and input and output facilities are fairly standard, and comparable with those on other middle of the range amplifiers. The unit is fitted with a three-core mains flex and three-pin mains plug to suit Australian conditions.

All the controls operate smoothly and positively although legibility of the front panel markings is poor, especially in subdued lighting.

The tone control potentiometers each have eleven detents which enable easy resettability. The balance control potentiometer also has a detent to mark the central setting.

The large volume control knob and its associated precision dual ganged potentiometer are very similar to that on the Pioneer stereo amplifier reviewed in these pages recently. The control has 26 detents which give a total control range of 60dB. The calibrations on the control are very accurate, as is the tracking between channels.

We approved of the high and low filters which have a rolloff of 12dB/octave, instead of the more usual and almost useless 6dB/octave found on many other amplifiers. The 3dB point for the low filter is 30Hz, while the corresponding breakpoint of the high filter is at 8kHz. This latter figure may seem rather low in the audio spectrum but if it was any higher many older listeners would be hard-pressed to notice any effect.

Internal layout of the SU-8600 is neat and relatively uncluttered. The mains fuse can be easily changed while the loudspeaker protection fuses are on the rear panel, housed in a clear plastic box.

The power supply employs a large transformer fitted with a copper strap to reduce flux leakage. The main bridge rectifier is mounted on the main PC board and looks like a TO-3 power transistor. The main filter capacitors are also mounted on the PCB, even though they are very high in value. Both are 15000uF with 55V rating.

We were a little surprised at the connections to the output power transistors. Instead of using transistor sockets, the transistors appear to be assembled into the heatsinks and connections made via small PCBs and interconnecting leads. There may be technical advantages in this method but it would appear to make output transistor replacement a complicated procedure.

A relay is employed for muting at switch-on and switch-off, and presumably also for protection of the power amplifiers and loudspeakers.

We did not have access to the circuit diagram at the time of writing this review so we are unable to give much detail. All the circuitry appears to use discrete components, with the exception of the dual differential transistors in the input stages of the power amplifiers. Dual differential transistors are used to eliminate the necessity to adjust output offset voltages and also to minimise the effects of temperature on this parameter.

We began the performance testing with a one-hour pre-conditioning with the amplifier delivering 30% of rated power into 8-ohm loads. Under these stringent conditions the output transistors rose to 75 degrees Celsius (case tem-

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Lenco L-833DD

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perature) which indicate that the transistors have adequate heatsinks. The top of the amplifier does become quite hot during this test, but not hot enough to burn the unsuspecting operator.

During normal operation the amplifier and its heatsinks are quite cool.

Maximum power tests at just before the onset of clipping yielded the following results: into 16 ohms, 52.5 watts with one channel and 50 watts per channel with both driven; into 8 ohms, 84 watts with one channel and 80 watts per channel with both driven and into 4 ohms, 116 watts with one channel and 100 watts per channel with both driven.

Notice that there is little difference between the figures for single channel and dual channel operation. This indicates a well-regulated power supply.

Rated distortion is quoted as 0.08% at full power and 0.02% at half power at 1kHz. We can confirm that distortion was less than 0.08% over the range 20Hz to 20kHz at full power and considerably less than 0.08% at lower powers.

Frequency response of the SU-8600 checked out at between 15Hz and 20kHz at the −1dB points with the tone controls out of circuit (by means of the defeat switch). Separation between channels with respect to full power was 44dB at 10kHz, 54dB at 1kHz and 63dB at 100Hz. These figures were taken with a 4.7k resistor loading the undriven channel input.

Tests of stability with values of capacitance up to 1uF shunting the load revealed no problems. Nor was there evidence of transient intermodulation distortion. Nor were there any problems with RF or mains interference.

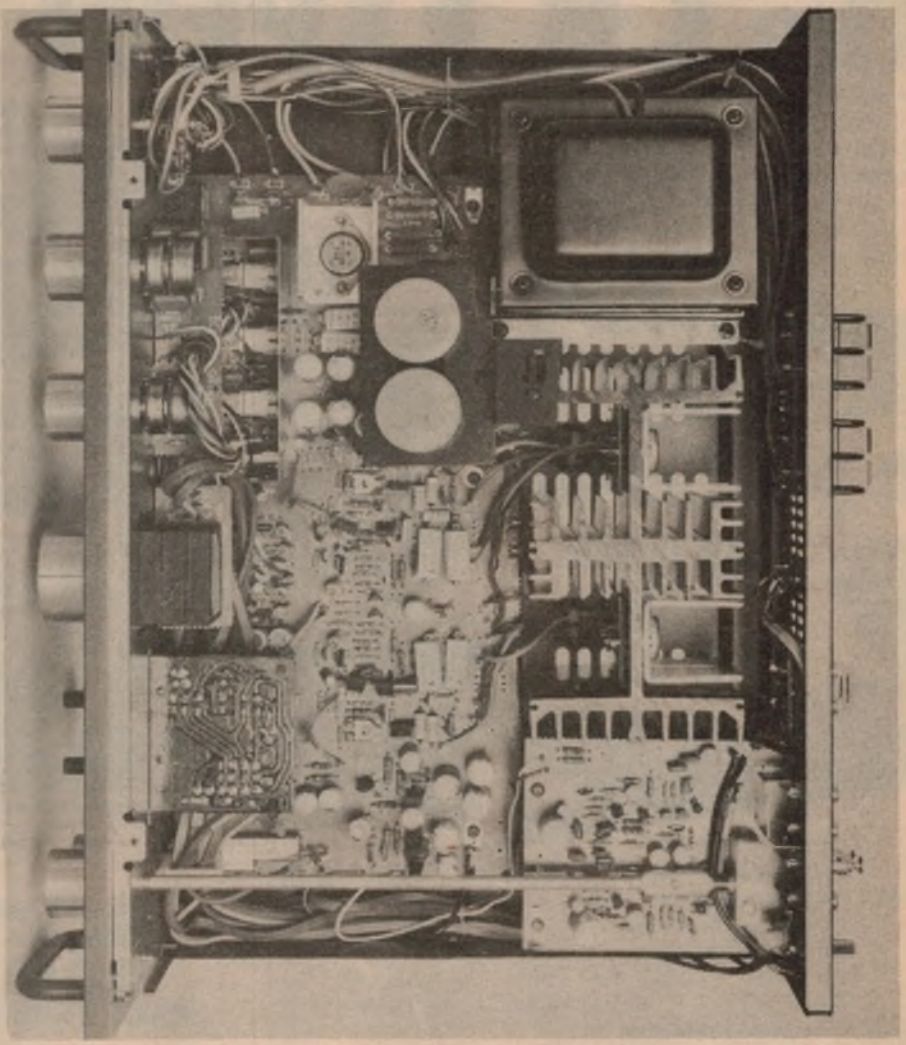
Phono signal-to-noise ratio was 72dB unweighted with respect to full power and an input signal of 10mV at 1kHz, with a typical cartridge connected. Auxiliary and tuner inputs yielded a S/N ratio of 85dB unweighted with a 4.7k input load.

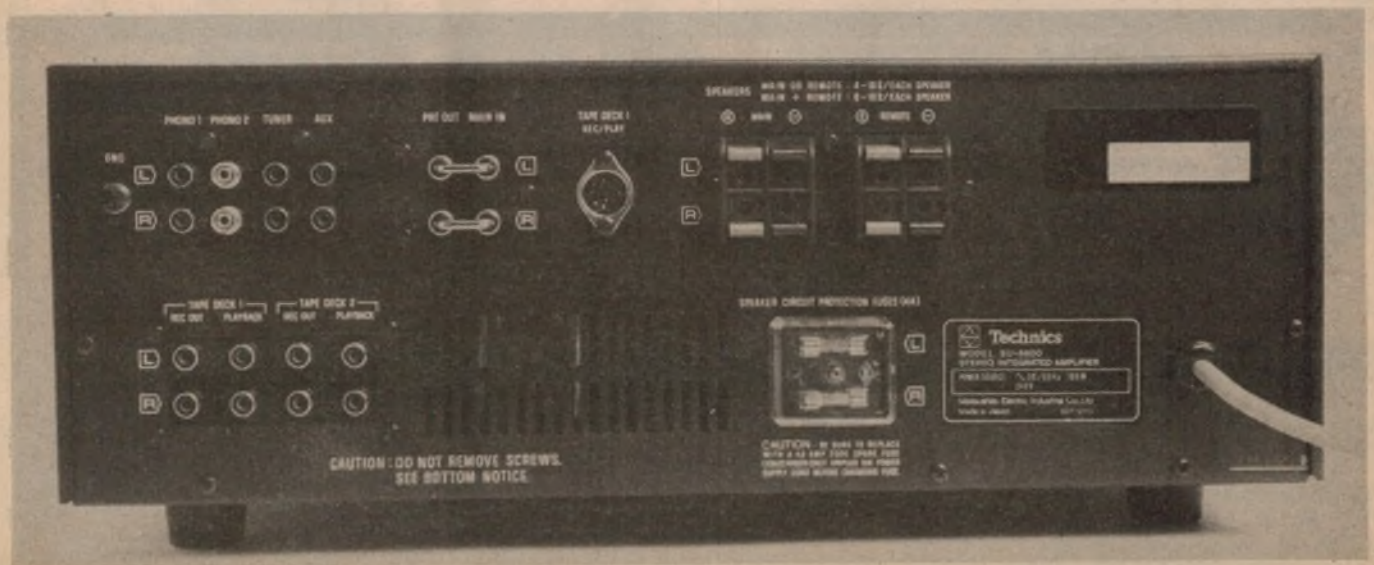
As you can see, it is very quiet.

Phono sensitivity is quoted as 2 millivolts for full power but we measured it at 3mV, a figure which is entirely adequate for a high power amplifier. Phono overload is 190mV at 1kHz, and RIAA equalisation is within 0.4dB over the range 20Hz to 20kHz, as specified.

Just as there was nothing to fault during our measurements, so the same can be said of the listening tests.The SU-8600 is very quiet, has plenty of power and gives every impression of being a very reliable and satisfying performer.

Recommended retail price of Technics SU-8600 is $499. Further information can be obtained from high fidelity retailers throughout Australia, or from the Australian distributors for Technics, Haco Distributing Agencies Pty Ltd, 57 Anzac Parade, Kensington, NSW 2033. (L.D.S.)





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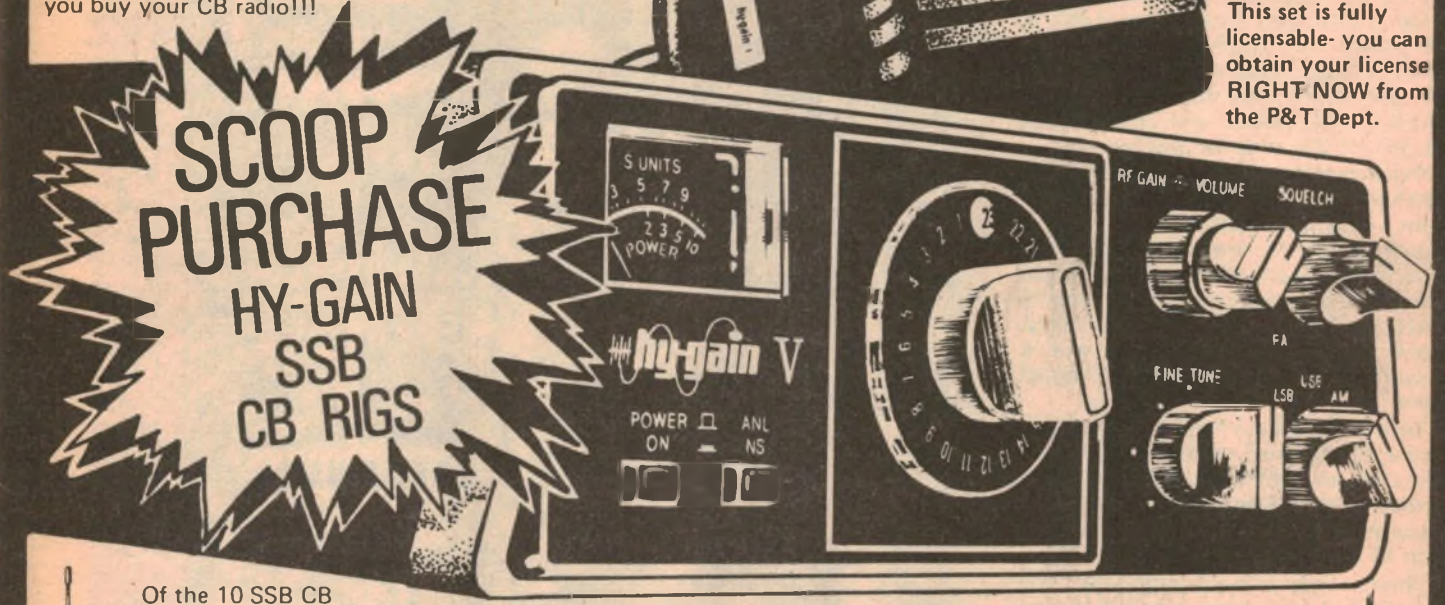

156 cm

Of the 10 SSB CB transceivers reviewed in "CB Australia" magazine, June '77, only two stood out. Here's what the reviewer, Roger Harrison, said about the Hy-Gain V... ".. .. .. outstanding in functional design & operation.. .. .. the controls had the best feel of all the units.. .. .. good, clear sound.. .. .. handbook is very informative.. .. .." In fact he didn't have one point of criticism on this unit!

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The Australian CB SCENE

18-channel rigs are on the way!

The first 18-channel CB rigs designed to meet Australian specifications will be available shortly from Dick Smith Electronics Pty Ltd.

First off the rank will be the Midland Model 77A-857 (pictured above), a high quality AM rig that will be supplied complete with microphone, mounting bracket and manual. Features of this model are: delta tune; an advanced noise limiting circuit that can be switched in for optimum reception; a built-in signal level and RF power meter; and facilities to connect an external public address speaker.

The Model 77A-857 will sell for $139.50, subject to changes in duty and sales tax rates.

Also about to be released by Dick Smith Electronics are the three new models pictured at right. They are:

- the Dick Smith "Bumble Bee", an economy 18-channel AM rig;
- the Dick Smith "Wasp", an 18-channel AM mobile rig; and
- the Dick Smith "Hornet", an 18-channel AM/SSB mobile.

An 18-channel AM/SSB base station—the Dick Smith "Scorpion" will be released at about the same time.

All the rigs feature European-style black matte finish. Main features of the AM rigs can be seen from the photograph, with the deluxe model Wasp carrying a separate RF gain control, delta tune switch, a combination automatic noise limiter/noise blanker switch, and digital LED channel indication.

The advanced Hornet is the first AM/SSB 18-channel rig to be designed specifically for the Australian consumer. Features of this set include: LED channel indication; noise blanker switch; automatic noise limiter control; and separate volume and squelch controls. A Tx lamp lights up when transmitting.

All four rigs are designed to meet Australian specification RB249. Prices will be $119 for the Bumble Bee; $169 for the Wasp; $299.50 for the Hornet; and $349.50 for the Scorpion.

The Australian
CB SCENE

CB Questions and Answers

Q: CB antennas are often not all that different to a car radio aerial: a metal rod, but made to a particular length and with a loading coil to make up electrically what it lacks physically. Seeing the price of them, isn't somebody getting ripped off?

A: It is one thing to dismiss an antenna as just a length of metal rod with a loading coil attached; it is quite another to manufacture, package and market one. The fact is that CB equipment has to sell in a very highly competitive market and if it was possible for someone to undersell their competitors with a product of equal quality, they'd be in there taking advantage of the situation!

Q: According to the textbooks, the impedance of a quarter-wave antenna mounted on a car, etc, is about 35 ohms. If the length is increased, the impedance at the feed point rises. At what length does the impedance equal 52 ohms for, say, a ¼-inch diameter rod? Does the reactance so created have to be cancelled with a series capacitor?

A: We have never been through the exercise in our lab. of designing, building and installing a ¼-wave whip for use on a car, so we can't speak from first-hand experience. However, you will find other textbooks that point out that a metal car body makes an imperfect "ground plane" at 27MHz, even if the antenna is mounted in the best spot—right in the middle of the metal roof. The whip may therefore have to be made rather longer than anticipated for resonance, so that the feedpoint tends, in effect, to be tapped part way down the ground plane. Under these conditions, the input impedance is likely to be up around 40 ohms anyway, which may be accepted as a good enough match for a nominal 50-ohm system.

Because of considerations like these, it is difficult to work strictly from a textbook and resource really has to be made to empirical methods which will show up what sort of compromises are appropriate for different positions on different vehicles—including semitrailer prime movers, which often have cabin tops made of fibreglass: no ground plane effect at all!

A couple of other points should be made: whips 9ft long are normally too long for vehicular rooftop mounting and, if used at all, they are more commonly attached to a bumper bar, putting up with the less effective "ground".

Faced with this, an obvious alternative is to settle for a shorter vertical whip with a bottom-end coil (using your words) "to make up electrically what it lacks physically". But, when this is done, it becomes possible to arrange the coil so that it provides a DC earth for the rod and also a tapping point which can be carefully selected to give an impedance at resonance of very close to 50 ohms.

Q: Could I use a 75-ohm line matched to a 75-ohm antenna?

A. A properly adjusted 75-ohm system would probably be nearer the mark than many maladjusted and makeshift systems that are currently in use. But why aim at the wrong figure? Virtually all CB equipment assumes a 50-ohm antenna connection and this is what you should be working towards.

Q: Could I use a quarter-wave antenna (35 ohms) with a 52-ohm feedline also a quarter-wave long (allowing for velocity factor) to give an impedance at the transmitter end of the feedline of 75 ohms?

A: You have apparently been studying amateur radio or other textbooks, as in fact amateur station operators often resort to this sort of thing to achieve proper matching. A quarter-wave section of cable will certainly act as a transformer at 27MHz, although you have to arrange for the cable to be an accurate quarter wave. But again the question: why go to so much trouble to achieve a wrong value? In general terms, a transceiver designed to work into 50 ohms will be no more efficient with a load of 75 ohms than with one of 35 ohms, so you would have gained nothing.

Q: Would either of the foregoing ideas cause a drop in receiver performance due to the mismatch between the feedline impedance and that of the receiver input stage?

A: We doubt whether, in practice, you would notice any difference at all in the receiver performance.

Q: What are the chances of destroying the transmitter output stage if the antenna and/or feedline are not of the right impedance?

A: If you mean by this question an antenna system which measures 70 ohms at resonance in the CB band, instead of 50 ohms, we would be very surprised if an output stage was adversely affected. However, your question merely says "not of the right impedance" and that could mean anything. We have seen CB transmitters operated without load and into a variety of antennas and stray bits of wire, without damage. But that doesn't mean that it's safe to do and, from what we hear, "blown up" output transistors are a common cause of transceiver failure. Certainly, most manuals stress the need for an approved 50-ohm antenna system and some distributors specifically exclude the RF output stage(s) from their warranty because the warning is often not heeded. In one sentence, therefore, the risk factor may not be high but it is certainly real.

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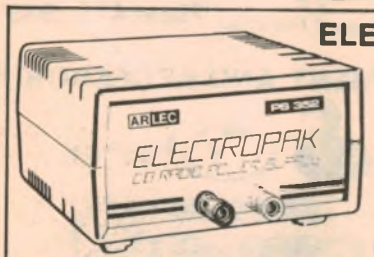

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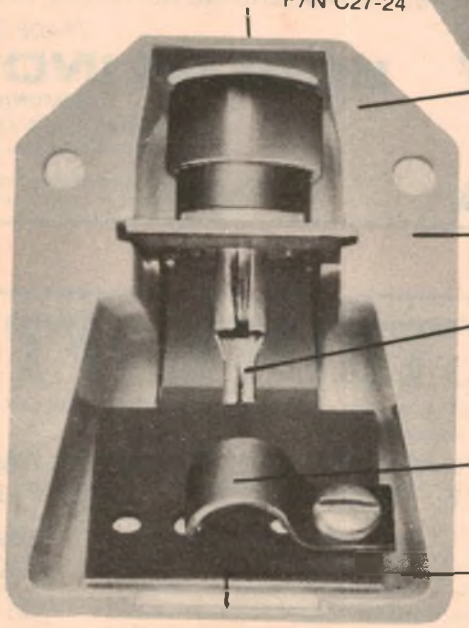

Ask for the ACME 75 ohm Coaxial TV antenna outlet socket at all leading suppliers or contact the ACME office or agent in your State for further information.

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The Australian
CB SCENE

CB Powermate with overload protection

Since we described this useful CB accessory in January 1977, quite a few have been built. Now we have modified it to incorporate simple short-circuit protection. The CB Powermate delivers a nominal 13.6V at 1.5 amps or more, enough to run most CB sets with an output rating of 5 watts.

by LEO SIMPSON

Our original circuit published in January 1977 was deliberately made as simple as possible to keep cost to a minimum and to make it easy to build. Short-circuit protection was thought to be unnecessary because the prototype was reasonably able to tolerate brief short circuits and in any case, most CB sets have at least one fuse in their supply lines.

Nevertheless, a number of constructors have managed to damage their Powermates by shorting the output. This has caused chagrin and nail-biting and has been inspiration for a number of letters, one of which indicated that the writer had lost faith in "Electronics Australia"(!)

Spurred on by these events, we have modified the Powermate to incorporate a simple overload protection circuit. With it, the Powermate can safely withstand a short circuit although if it is maintained for more than about ten seconds or so, a fuse will blow.

Maximum current delivered into a short circuit, before the fuse blows, will be between four and five amps. In other respects, the performance is virtually unchanged.

The unit puts out a nominal 13.6V, to enable the best performance to be obtained from CB and tape players which are normally powered from the 12V electrical system in cars.

Refer now to the circuit diagram. The power transformer has a centre-tapped 30V secondary winding which is coupled to a full-wave rectifier and 4700uF filter capacitor to develop about 21 to 23 volts DC at no load. The output of the 4700uF is coupled to a simple series regulator consisting of a Darlington transistor pair and a 15V zener diode reference.

The Darlington pair merely acts like an emitter-follower. The reference voltage at the base of T1 determines the voltage at the emitter T2. Because each transistor has a base-emitter voltage drop of approximately 0.7V, the resulting output voltage at emitter of T2 is 15–1.4 = 13.6V.

Low hum output is a feature of the circuit. This is because any ripple voltage (hum) applied to the input of the regulator is considerably attenuated by the voltage divider consisting of the 560 ohm resistor and the dynamic impedance of the zener reference (typically about 10 ohms).

Regulation of the circuit is about 5%. Put another way, the change in voltage from no load to full load at 1.5 amps is typically 14.2V to 13.6V. Ripple ranges from less than 10mV peak-to-peak at no load to about 40mV peak-to-peak at full load.

It is possible to obtain more than 1.5 amps from the Powermate but at some point in excess of this figure, the regulation will fall off, i.e., the output voltage will fall and the hum output will increase markedly. For non-critical applications, the Powermate can supply up to 2 amps for short periods.

Transistor T3 and associated resistors comprise the overload protection circuit. T3 monitors the output current of the power supply via a 0.33 ohm resistor connected between base and emitter. When the voltage across this resistor rises above 0.6V, T3 begins to conduct and thus remove some of the bias current from the zener diode and transistors T1 and T2.

Thus for currents in excess of about two amps, T3 turns on progressively harder to limit the current to a reasonable value. The 100 ohm resistor in series with the base of T3 prevents the base-emitter junction being damaged when heavy current is flowing in the monitoring resistor.

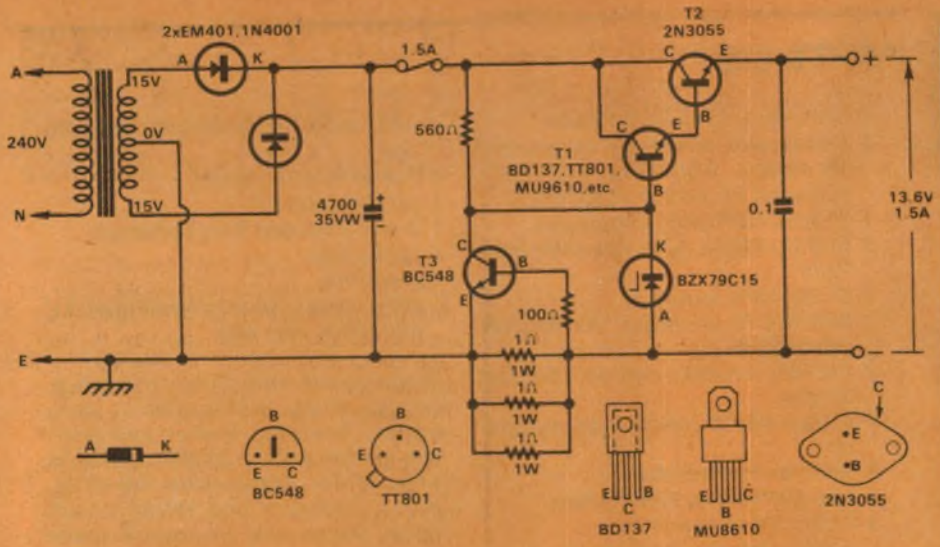
This system of protection is effective in the short term only. If the overload is maintained for any length of time the regulating transistors, transformer and rectifier diodes would all become overheated and eventually fail. For this reason the fuse has been added to provide back-up protection.

A "foldback" protection circuit would have been another method of eliminating damage from short-circuits, but this tends to make the circuit complicated and more expensive.

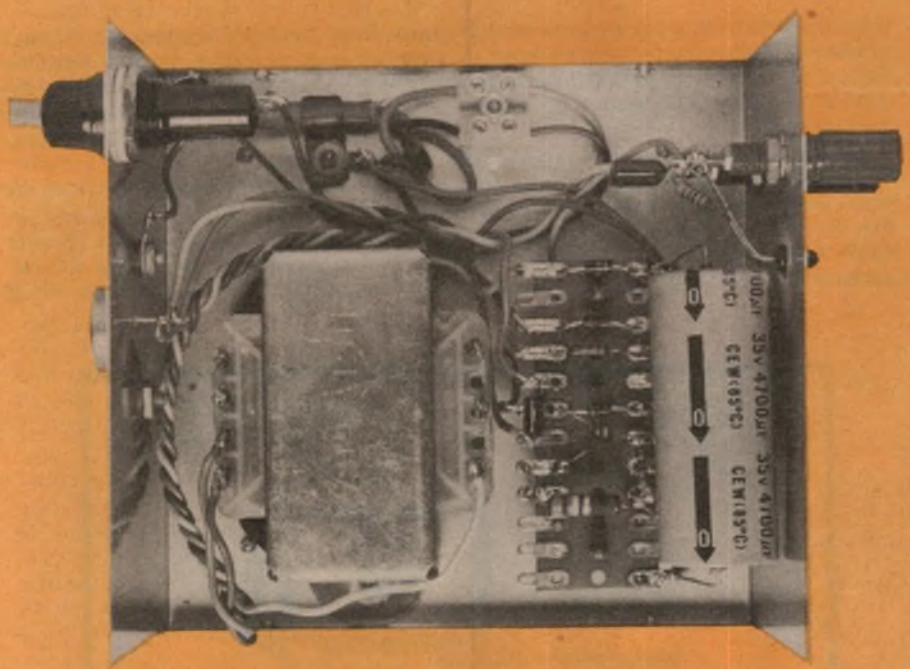
Even with the added protection circuit, Powermate is easy to build and layout is not critical. Even so, wiring should be kept reasonably neat and tidy.

We built our Powermate into a compact box measuring 134 x 76 x 150 mm (W x H x D) available from Dick Smith Electronics. Rubber feet are fitted to the case.

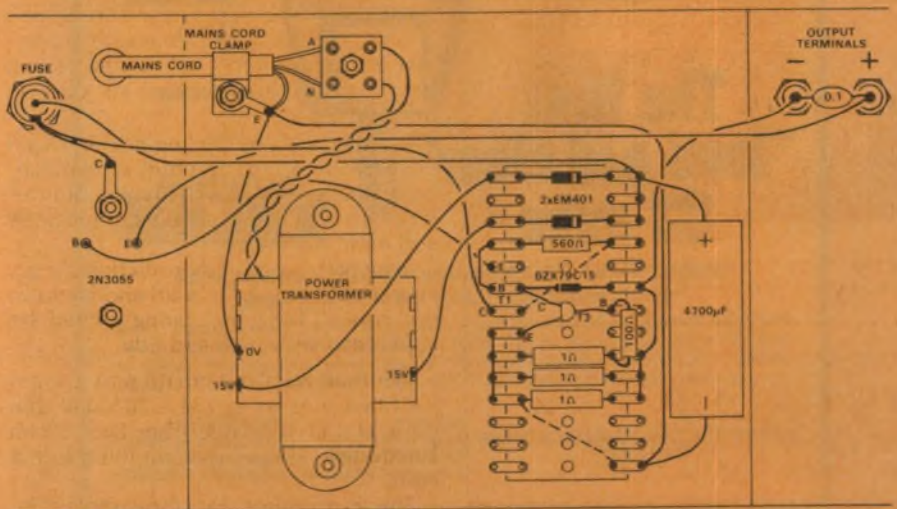
The transformer was also supplied by



CB POWERMATE (WITH PROTECTION) 2/PS/-



Refer to both the circuit and the wiring diagram while assembling your Powermate.



PARTS LIST

- 1 metal box, 134 x 76 x 150mm
- 1 transformer with centre-tapped 30V secondary, A&R 6672, DSE 6672, Ferguson PF 3559 or PL30/40VA
- 1 2N3055 NPN power transistor
- 1 BD137, TT801, MU9610 NPN transistor
- 1 BC548 NPN transistor
- 1 BZX79/C15 or similar 15V 400mW zener diode
- 2 EM401, 1N4001 silicon rectifier diodes
- 1 4700uF/35VW electrolytic capacitor
- 1 560 ohm ½W resistor
- 1 100 ohm ¼W or ½W resistor
- 3 1 ohm 1W resistors or 1 0.33 ohm 5W resistor
- 1 3AG panel mounting fuseholder and
- 2 2 amp fuses (1 spare)
- 1 12-lug tagboard
- 1 2-way insulated terminal block
- 2 solder lugs
- 1 grommet
- 2 4mm banana socket/binding posts, one black, one red

Mains cord and three-pin plug, screws, nuts, lockwashers, mica washer, insulating bushes and heatsink compound for 2N3055, hook-up wire, solder, Letraset for labelling. Note: Capacitors and resistors with higher ratings may be used if space permits.

Dick Smith, type DSE 6672. This is equivalent to the A&R 6672. The Ferguson PF 3559 or PL30/40VA would also be suitable. We accommodated the few circuit components on a 12-lug length of miniature tagboard.

Three 1 ohm/1 watt resistors are connected in parallel to provide the monitoring resistor for T3. At the time of writing, these were unavailable so we had to use the more expensive alternative, a 0.33 ohm 5 watt wirewound resistor.

Make sure that the zener diode and transistors are correctly wired, otherwise damage is certain to result.

Follow this procedure for wiring the three-core mains cord: Pass the cord through a grommet in the rear of the case and anchor it with a cord clamp. The active and neutral wires are terminated in an insulated terminal block. The earth wire is soldered to a lug which is bolted or riveted to the chassis. Leave a loop of slack in the earth wire so that if the mains cord is pulled out, the earth wire will be the last to break.

The 2N3055 transistor T2 is mounted in the following way: Drill the mounting holes if not already provided. Make sure that the contact area is free of burrs and swarf. Smear the contact surface and the underside of the transistor with silicone grease or heatsink compound. A mica washer and insulating bushes must be used to isolate the transistor from the chassis. Attach a solder lug to one of the mounting screws to terminate the collector lead.

When assembly is complete, check the circuit for errors. Use the wiring and circuit diagrams for comparison with your work. Now switch on and check the voltage output. It should be close to 14V.

Australian made coax connectors

Manufactured in Australia, these UHF connectors are part of a complete range of UHF connectors made by Acme Engineering Co., 2-18 Canterbury Rd, Kilsyth, Victoria, 3137. They should be of particular interest to CBers and retailers of CB radio accessories.

The UHF series are general purpose connectors of non-constant impedance. They are satisfactory for use up to 500MHz and are rated at a peak voltage of 500V RMS. (Where impedance matching is necessary the "N" series, or the "BNC" series connectors should be used.)

The connectors have either machined brass or die-cast zinc bodies, and all metal parts are silver plated to ensure maximum conductivity and low contact resistance. The range include various types of cable and jack plugs and receptacles, and the often handy "adaptor tee" and right angle adaptor plugs.

The General Electric Recharge Battery System Mini Charger

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Feature project:

Build your own

Employing a modern cold-cathode plasma tube, this new low power helium-neon gas laser should be of considerable interest to high schools, technical colleges and universities. Easy to build, it is particularly suitable for demonstrations and experiments in optics, and could even serve as the heart of an experimental light beam communications system.

First developed back in 1960, lasers were for many years described as an invention looking for an application. Now of course, lasers are used in all sorts of applications. Most readers will be familiar with their uses in military and industrial fields for such tasks as cutting and drilling hard metals, precision micro-machining, surveying, welding detached eyeball retinas, surgical cutting, range finding, and gun aiming. Looking further into the future, powerful lasers may one day be used to trigger controlled nuclear fusion reactions to power our homes and factories.

EA's first laser project was described back in August 1969, and was a low-power unit (0.5-1mW) intended for demonstration purposes. The design was based on the EOA-9040 plasma tube, a hot cathode helium-neon type imported from the United States by Laser Electronics Pty Ltd, of Southport, Queensland. This tube is now considered obsolete, and is no longer available.

Recently, however, Laser Electronics released a new plasma tube, of modern design, which they are now marketing as part of their "Educational Laser Kit, Model KED-1". The laser unit described here is based on that kit.

Let's talk first about the new plasma tube.

Basically, the KED-1 plasma tube is a cold cathode gas laser featuring coaxial construction and fitted with integral pre-aligned resonator mirrors. It is filled with a mixture of helium and neon gases at low pressure, which results in an output in the red region of the optical spectrum. Beam wavelength is 6328 Angstroms or 0.6328um.

Unlike our previous laser, the output beam from the KED-1 tube is polarised to better than one part in 500. The beam is also highly collimated (parallel), having a maximum divergence of only 1.3 milliradians (full angle). Rated beam diameter at the tube output is 0.63mm.

Guaranteed minimum optical power output from the KED-1 plasma tube is 1.0mW, with a quoted typical figure of 1.2mW. While this may seem a very modest figure, it is in fact quite adequate for most experimental purposes. Combined with the other tube characteristics listed above, it makes the KED-1 suitable for a variety of optics experiments, and for optical communications over short to medium ranges. More about some of the potential applications later on.

Despite the modest power output, there are some safety precautions to be observed when operating the laser. Due to the concentrated nature of the beam, it is possible for the full optical power output of the tube to enter the eye, producing an intensity exceeding that produced by a direct glance at the Sun. We advise you to take careful note of the precautions given in the warning panel.

In order to understand how the laser works, it is necessary to have some basic understanding of the nature of light. The following explanation should provide readers with the necessary background.

Most readers will be familiar with the concept of light as continuous waves of electromagnetic radiation and, for many purposes, this is a perfectly valid concept. However, it is equally valid to consider light radiation as consisting of tiny "packets" or particles of energy, and for some situations this concept is the more convenient. These energy particles are called photons.

WARNING!

The optical output of the laser unit described in this article, while of low power, is concentrated into a narrow beam potentially capable of passing fully through the iris of a normal human eye. The intensity which would be produced at the eye retina if this occurred is regarded as sufficient to cause permanent sight impairment, so that intending constructors are strongly warned against allowing this situation to occur.

A very worthwhile rule is "never look a laser in the eye", either directly or via a highly specular reflective surface such as a mirror or a polished metal or paint finish. Only allow such a beam to enter the eye when it has been widely diffused, as from a screen or white card.

laser!

by GREG SWAIN

Probably the most common way in which light is produced is when atoms which have become "excited" by absorption of heat or other energy suddenly revert to a less excited state, or to their original unexcited "ground state". When an atom thus reverts to a less excited state, the energy is expelled and emitted as a photon of radiation.

The amount of energy which is expelled as a photon when an atom "relaxes" depends upon the degree to which it was excited and the degree (if any) to which it remains excited after relaxation. The expelled energy is simply the difference between the two, and its magnitude determines the frequency of the photon emitted.

In an ordinary flame, electric arc, or incandescent lamp filament, many millions of atoms are constantly becoming excited and relaxing, the whole process occurring in a completely random and haphazard fashion. The light produced by such sources is said to be "incoherent", consisting as it does of vast numbers of independent photons differing from one another, both in terms of frequency and in terms of phase.

What distinguishes the laser from other light sources is its ability to generate "coherent" light radiation—that is, light made up of a steady stream of photons all of the same frequency and synchronised in terms of phase. Let's look now at how the laser does this.

Actually the name "laser" is itself a rather cryptic key to the way in which these devices operate. The name is really an acronym, formed from the initial letters of the words "light amplification by stimulated emission of radiation".

As this implies, the operation of a laser is dependent upon the effective amplification of light, by a process known as "stimulated emission". This is not a difficult phenomenon to understand, as we will explain.

What it amounts to is this: if an atom is in an excited state and potentially able to relax by emitting a photon of a particular frequency, it can be stimulated into this relaxation if it is struck by another photon of the same frequency. When this happens, the photon emitted by the relaxing atom is created in exact synchronism with the incident photon, the latter being undisturbed by the process.

In other words, if a photon of the correct frequency is incident upon an atom in an excited state, the atom will emit a photon having exactly the same phase and frequency as the first photon, and travelling in the same direction. This, then, is the process of stimulated emission, and is a potential means for achieving light amplification.

A gas laser is one way of realising this potential in practice. Basically, the tube consists of a light amplification region containing excited atoms, and two parallel mirrors which reflect photons of light back and forth through this region. This process gives rise to a continuing and rapidly cumulative series of stimulated emissions, or light amplification. And, because the stimulated emission mechanism produces new photons with the same frequency and phase as the stimulating photons, the amplification process will result in coherent radiation.

Actually, the mirrors serve a dual role. First, they provide the necessary optical path length for sufficient photons to be produced, so that cumulative light amplification or lasing can occur to a significant extent. Second, they form a positive feedback mechanism which ensures that the stimulated emission process is self-perpetuating.

In effect, the mirrors form a resonant cavity, such that coherent radiation produced within the light amplifying region can oscillate back and forth to maintain itself. Reflections at the mirror surfaces are not entirely lossless, but these losses are overwhelmed by the optical gain of the plasma path. In fact, one of the mirrors is intentionally de-

Build your own laser

signed to be only partially reflective, and this is the means used to extract the coherent light output from the "business end" of the laser.

Naturally enough, for lasing to occur at all there must be a situation whereby large numbers of excited atoms are present within the light amplifying region of the tube. In the "He-Ne" gas laser, this condition is realised by passing a small current through the gas mixture. However, at this point the actual operating mechanism becomes rather subtle.

In the He-Ne gas laser, it is actually the neon atoms that are associated with the stimulated emission mechanism. The helium atoms are used merely as an energy transfer medium, for "pumping" the neon atoms to the appropriate level of excitation.

The pumping system employed may be understood by reference to the excitation energy diagram of Fig. 1. Here the solid horizontal lines represent the various allowed excitation energy levels or states for the atoms of helium, on the left, and neon, on the right. The lowest lines in each case correspond to the relaxed or "ground" state.

When an electric current is passed through the gas mixture in the tube, the electric field combined with the high temperature existing in the discharge plasma causes helium atoms to be ionised and accelerated, thereby exciting them to energy levels above the ground state. One of the allowed excitation levels for helium, shown on the diagram as "A", coresponds almost exactly to one of a number of closely spaced excitation levels for the neon atom. This level is shown on the diagram as "B".

Because of this level equivalence between the two different atoms, a collision between an excited helium atom and an unexcited neon atom almost inevitably results in a total transfer of energy between the two. After such a collision, the helium atom reverts back to the ground state, while the neon atom will have an energy excitation level equivalent to that represented on the diagram as level B.

Actually, there is a very high probability that this type of collision will occur. This is because level "A" of the helium atom is metastable; once having become excited to this level, it cannot spontaneously expel a photon to relax. Hence, there tends to be a high proportion of excited helium atoms in the discharge, and accordingly a high probability that collisions between helium and neon atoms will occur frequently.

The task of the helium atoms, then, is to pump large numbers of neon atoms to the level of excitation represented by line "B". However, unlike the helium atoms, neon atoms which possess this excitation level have a strong tendency to relax, either spontaneously or by stimulation, to a lower excitation level as represented on the diagram by "C". From here, they may then revert to the ground state at a later stage.

The energy difference between levels "B" and "C" corresponds to a photon with a wavelength of 0.6328um—the output wavelength of the laser.

As can be seen from the circuit, the KED-1 plasma tube forms the heart of our experimental laser unit. The remaining components together form a fairly simple high-voltage power supply circuit to provide the correct operating voltages for the tube.

The simplest method of arriving at a stable plasma discharge is to apply a large positive voltage spike to the plasma tube for ignition. In the case of the KED-1 tube a starting pulse of around 10kV is required to ensure reliable ignition. Once the tube has ignited, the discharge is maintained with a 1,550V ± 100V "maintain voltage" applied to the tube via a large ballast resistance. The ballast resistance functions to swamp the negative resistance characteristic of the plasma discharge.

The laser unit is designed to operate from a 9.5–12V DC power supply, capable of delivering 2A continuously. In order to do this, and provide correct operating voltages for the tube, the circuit employs a high voltage inverter (to produce the tube maintaining voltage) and a Cockcroft-Walton multiplier circuit to produce the necessary starting pulse.

The inverter circuit configuration is that of a basic "ringing-choke" type inverter which is used in low power applications because of its simplicity and economy. It uses a one transistor blocking oscillator transformer coupled to a halfwave doubler circuit and multiplier stages on the transformer secondary. The multiplier stages add to the output of the basic halfwave doubler to produce the 10kV to fire the tube.

However, once the tube has fired and is drawing current, the last two multiplier stages have no effect due to the fact that their associated reservoir capacitors are too small to hold charge under the load current of the laser tube. The total output voltage then drops to a value determined by the halfwave doubler.

So how does one go about getting it all together?

The first step is to buy the Model KED-1 Educational Laser Kit from Laser Electronics Pty Ltd, PO Box 359, Southport, Queensland 4215 (telephone 075 32 1699). Besides the plasma tube, Laser Electronics include in the kit an etched (but undrilled) fibreglass PC board; all necessary electronic components, including the ballast resistors and a prewound inverter transformer; several lengths of heavy duty hookup wire; and an assembly manual. The cost is $180.00 plus sales tax where applicable.

Included in the fairly brief assembly manual are the relevant circuit diagrams, specifications, and abridged assembly notes. A full size PC board component layout diagram is also supplied.

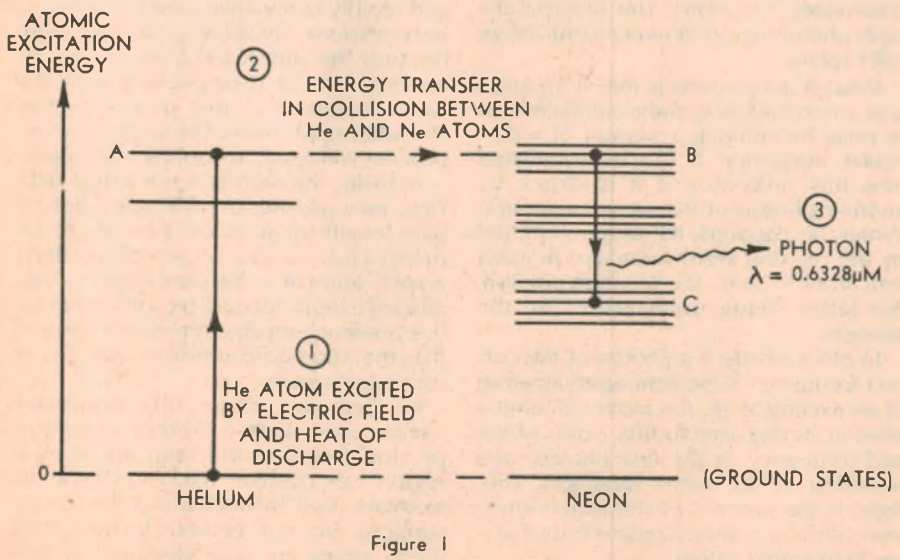
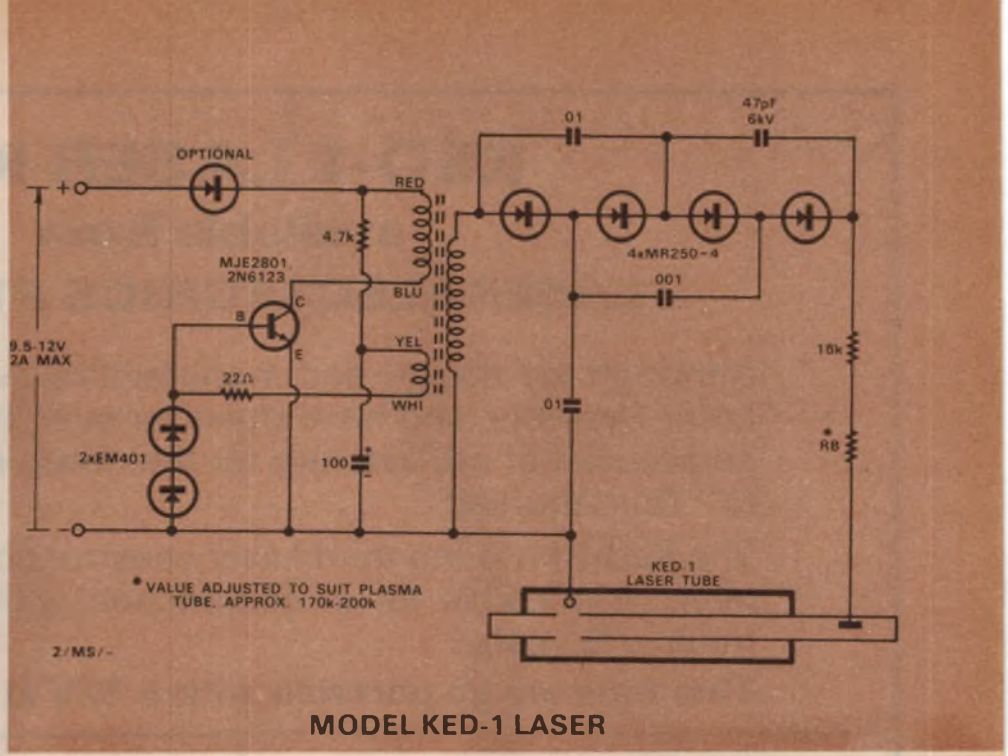


Figure 1

Fig. 1: Energy excitation diagram for helium and neon atoms. Solid horizontal lines represent allowed energy excitation levels.



MODEL KED-1 LASER

That's it though! Apart from making a few suggestions, Laser Electronics leave you to figure out the rest—mounting details for the tube and accommodation of the unit as a whole into some sort of suitable case. Fair enough too; most of us appreciate a bit of a challenge.

Construction can commence by drilling and assembling the PC board. As well as drilling holes to accept the component leads, you will also have to drill four holes to accept the inverter transformer mounting lugs. The transformer should be carefully oriented so that its secondary winding terminations align with the appropriate terminating holes on the PC board, as shown in the photographs.

With the low profile components fitted to the board, the inverter transformer can then be dropped into place on the board and its mounting lugs splayed outwards to secure it in position. Now identify and terminate the colour coded primary and feedback windings, as shown on the PCB layout diagram. The secondary winding can be terminated using PCB pins soldered to the board and bent to meet the terminations.

PCB pins should also be used to facilitate external connections to the board. Solder them into position ready to accept the leads at a later stage.

The first major problem that faced us was providing the unit with a suitable case. After a little headscratching, we finally hit upon the solution shown in the photographs.

What we did was to obtain two A & R-Soanar PC1 instrument cases of the same colour, and combine them to make one. These instrument cases are of moulded plastic "clamshell" construction and feature detachable front and back panels, one of plastic and one of metal.

Two such cases can be combined to make one by simply strapping them together using brackets made of scrap aluminium. Strap the two bases together first, orienting them so that the two integral plastic feet on each will be at either end of the finished case. Note that you will need to file slots in the lip surround of the case pieces to accommodate the brackets.

The case lids can now be strapped together in like fashion. The result, after the two halves are fitted together and the eight securing bolts tightened, will be a sturdy plastic case similar to the one shown in the photographs.

The PC board should be mounted on 25 mm plastic spacers, with the inverter end of the board as near to the back panel as possible. Reference to the photographs will show the positions we chose for the three spacers used. Do not use metal spacers, particularly at the high voltage end of the board, and make sure that all high voltage connections are well clear of metal brackets and mounting screws.

Immediately in front of the PC board are two 10-way miniature tagstrips which accommodate the ballast resistors. Before mounting the tagstrips though, they should be modified by removing every second lug. This is intended as a precautionary measure against high voltage "flashover" between lugs.

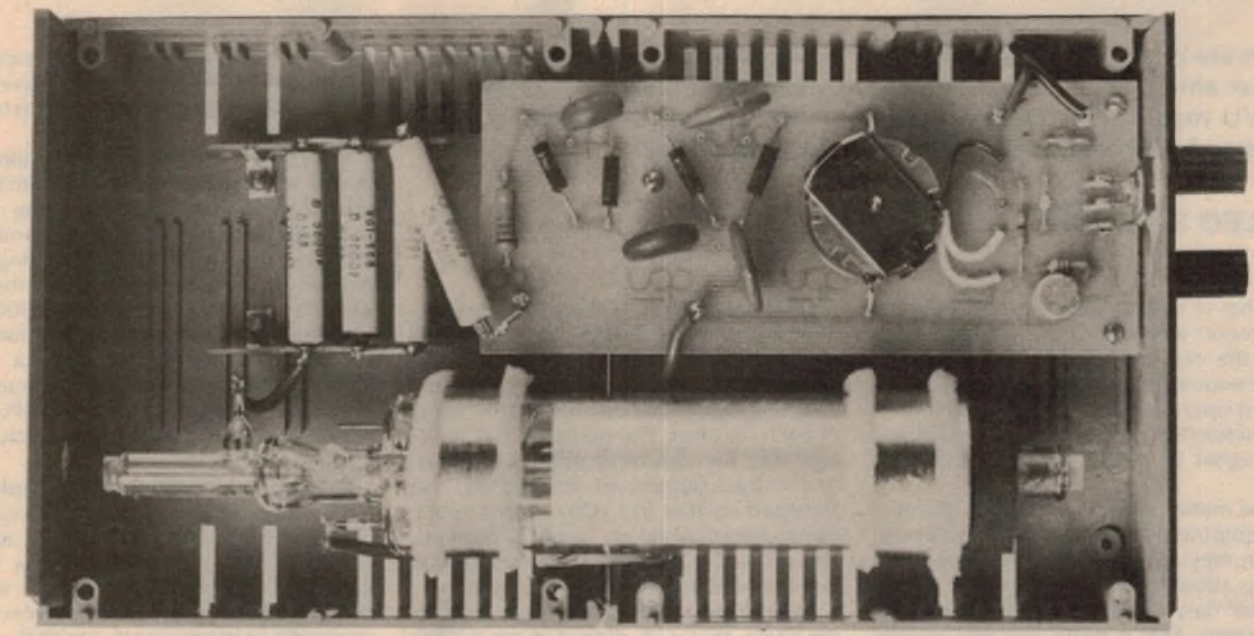
An adequate heatsink is required for the inverter transistor, and this can be provided by using a metal back panel. We actually used both metal panels, combined as one, as we found that this would give a better fit into the end slots provided for the normally thicker plastic panels.

Use an insulating mica washer when mounting the inverter transistor, and a smear of silicon grease to ensure good heat transformer. The power supply terminals are also mounted on the back panel, immediately behind the PC board.

Our second major problem was to figure out some way of mounting the tube. We solved this by employing two 37 mm diameter capacitor clamps which in turn are bolted to two small L-shaped brackets attached to the bottom of the case. Before fitting the clamps, trim off

Two A & R-Soanar PC1 instrument cases were used to house the laser tube and supporting electronics. Cases are strapped together using aluminium brackets.

Build your own laser



This internal view shows the prototype laser with wiring completed.

any excess appendages using a hacksaw, and file smooth. Insert a strip of foam rubber (the tube comes wrapped in it) between the metal clamp and the glass, to protect the tube from undue strain as the clamp is tightened.

Be very careful when handling the laser tube. Apart from being the single most important item in the kit, it is also the most fragile and the most expensive. Take care also never to touch the mirror ends of the tube with your fingers. If the external surface of the output mirror does need cleaning (due to dust accumulation etc), then this should be done carefully using a soft rag and methylated spirit.

In no circumstances should you solder direct to the anode and cathode pins of the tube, as this could result in damage to the pin seals. Use the pin connectors provided instead, attaching them only when they've cooled after soldering.

You will need to drill a hole in the front (plastic) panel adjacent to the output end of the plasma tube. This should be large enough to provide adequate clearance for the output beam without causing interference. You will probably want to make yours a little larger than the one shown for the prototype to enable cleaning of the external surface of the plasma tube mirror without removing the case top.

With the tube now mounted in position and all external connections to the PC board made good, you are now in a position to test your laser. Connect up a suitable 12V 2A power supply, aim the business end of the tube at a suitable screen, and switch on. You should be rewarded with a pinkish-orange glow from the plasma tube, and an intense red spot where the laser beam strikes the screen.

If not, you're in for a spot of troubleshooting. For what it's worth, our unit functioned as expected from switch on.

Here might be a good place to insert a word of caution. The voltages produced by the inverter supply are potentially lethal. Exercise extreme care when operating the laser with the cover removed, and ensure that all connections to the tube and ballast resistors are well insulated.

On a similar theme, do not assume that the circuit is safe just because the power is switched off. The two .01uF capacitors are capable of storing quite a hefty charge for some time after switch off, as staff member David Edwards (and those who heard his scream of pain) can testify.

Although Laser Electronics provide a circuit of a suitable 12V 2A mains power supply for the laser unit, we elected not to build it up. Instead, we used a CB power supply to power our unit and this proved to be quite satisfactory in spite of a slightly higher than specified DC voltage output. A 12V car battery could also be used to power the unit.

Lack of space prevents us from going into too much detail on the experiments that can be performed with the laser. However, a brief description of just some of the things that can be done will serve to highlight the potential applications.

As mentioned at the beginning of the article, the laser could be used as the basis of an experimental light beam communications link. This can be done by modulating the output of the laser, and detecting this modulation with a suitable photo-detector arrangement. Although we haven't tried it, the laser modulator circuit described in the October 1969 issue should also be suitable for use with this laser. Just insert the output winding of the coupling transformer between the tube cathode and earth.

Since the output beam of the new laser is polarised, you may care to experiment to find the plane of polarisation. Insert a piece of polaroid film (or polaroid sunglasses) in front of the beam. By rotating the polaroid, the plane of polarisation of the laser can be easily found.

Again, the laser may be used in the laboratory to verify some of the laws of geometric optics, including reflection and refraction. Or you can pass the output beam through various apertures to produce all sorts of diffraction patterns. The most common diffraction patterns are produced by passing the beam through a narrow vertical slit (eg. two razor blade edges placed very close together), and through a very small hole (eg. a pinhole in aluminium foil).

We'll leave it to you to determine the results of these experiments, and to think up other experiments for yourself.

Stereo Level Indicator

LEDs are often used as signal level indicators on cassette recorders and power amplifiers. They can be used as an adjunct to, or a replacement for VU meters. The circuit presented here uses eight LEDs to provide a stereo level meter with a total range of about 30dB.

by LEO SIMPSON

What is wrong with the conventional VU meter anyway? There is little wrong with the expensive VU meters found on professional equipment, and an experienced operator who is familiar with their characteristics can tell a great deal about the signal dynamics from their indications.

The meters found on cheaper domestic equipment are not so good, however. Often they are either underdamped and swing about wildly, or are overdamped so that they do not respond to most of the peaks. This is partly the reason why light-emitting diodes are so often used as peak indicators. LEDs respond very fast, so that only the briefest of signal peaks are likely to go unnoticed.

One big factor against VU meters (or those that are passed off as VU meters) is the cost. Even the cheapest signal level meters can cost about $10 for a stereo system and added to that is the cost of the meter driving circuitry. LEDs, on the other hand, are reasonably cheap.

Actually, the reason for developing this circuit was to provide level metering for a stereo cassette recorder which we intend to feature in the near future. The deck mechanism is supplied with an attached PC board which provides most of the necessary circuitry and requires a regulated power supply of nine volts DC.

Our problem was the low supply voltage. We wished to run all circuitry from the 9V rail. With this limitation we could find no easy way of designing the metering circuitry to measure the 0dB output level of 1 volt RMS and also provide an effective meter range of about 25dB.

The easy way out turned out to be negative. Do away with conventional metering circuitry, and rely on LEDs instead. But driving a minimum of eight LEDs, each indicating a logarithmic increase in signal level could be a little complicated too. The answer is to use two LM3900 quad op-amp ICs, one for each channel.

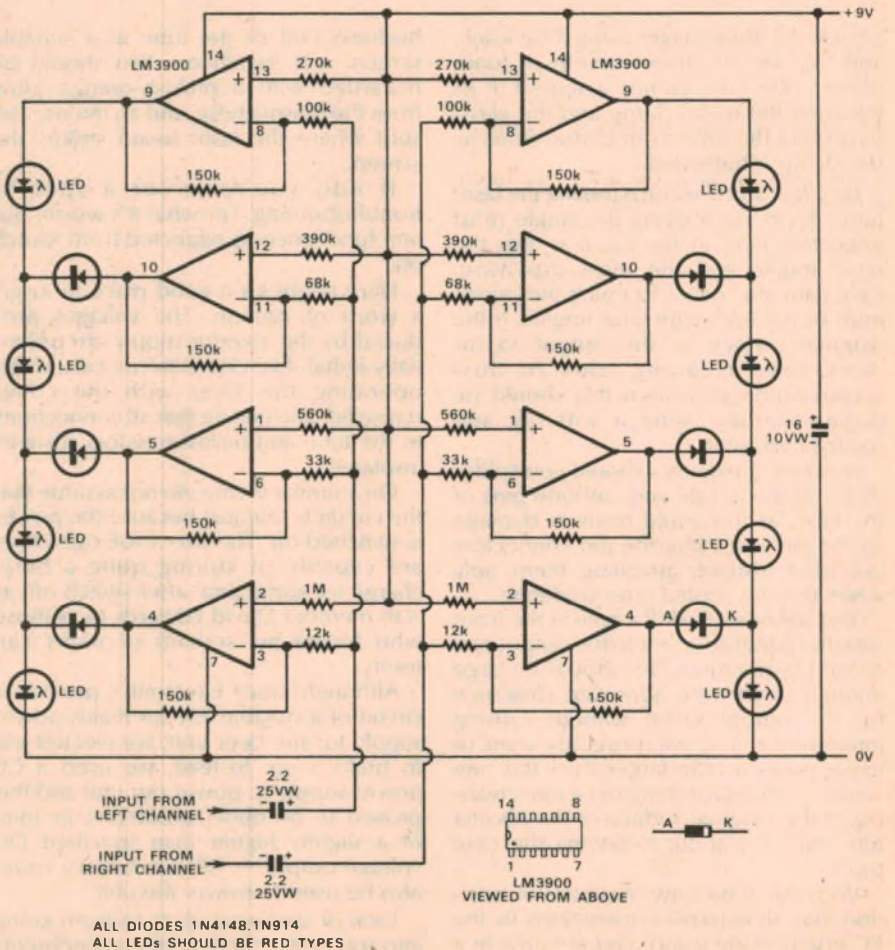
The circuit may look a little weird but is in fact quite simple. Each of the LM3900 op amps is connected as an inverting amplifier, with a negative feedback resistor connected from the output to the inverting input (marked with a minus sign).

Each amplifier is biased to provide a different quiescent output voltage. This is arranged by the resistor connected from the 9V supply rail to the non-inverting input (marked with a plus sign) of each op amp. The quiescent DC voltages and the diodes in series with three of the four outputs of the LM3900 are arranged so that the LEDs are normally extinguished when no signal is applied. The series diodes also have an additional function which we will discuss later.

Now consider the lowest op amp in the chain, that with output at pin 4. This amplifier has the highest gain of the four and so, as the signal level rises from below 50 millivolts RMS, its associated LED is the first to glow. What happens is that the LED is fed with half-wave rectified current which is proportional to the signal level.

Notice that there is no current limiting resistor in series with the LED. With most normal amplifiers a current limiting resistor would be required to protect both the LED and the amplifier. In omitting the resistor we are making use of an interesting characteristic of the LM3900 op amp—when loaded with low values of resistance it becomes virtually a constant-current source. Thus the current pulses fed to the LED are internally and automatically limited to a safe value of about 20 milliamps.

To keep the circuit concept simple we could have merely repeated with circuit just described eight (for stereo) times. But this would have resulted in a fairly high total current drain at high signal levels, with a resultant relatively high power dissipation in each LM3900 package. The alternative approach is to "stack" the op amp circuits so that, at high signal levels the top op amp drives



ALL DIODES 1N4148,1N914
ALL LEDs SHOULD BE RED TYPES

EA STEREO LEVEL INDICATOR

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all four LEDs in series with a consequent saving in current drain and power dissipation.

The circuit is relatively critical in a number of respects. First, it depends on using red LEDS with forward bias range of about 1.5 to 1.8 volts and also uniform brightness for a given value of current. This latter parameter can be checked and allowed for, during circuit assembly. Second, the resistor tolerance should be no more than 5% and preferably 2%. Third, the supply voltage must not exceed 9 volts by more than 100 millivolts, otherwise the LEDs will begin to glimmer.

Of course the circuit can be adapted to other supply rails, up to 36 volts, provided the op amps are correctly biased and account is taken of power dissipation.

For a supply rail of 9V, the calculated quiescent (no-signal) output voltages are as follows:
pin 4 1.77V
pin 5 2.77V
pin 10 3.77V
pin 9 5.2V

No, they do not go up in even steps.

Each op amp, with the exception of the one at the top of the stack, has an associated series diode. The prime purpose of the diode is to prevent the associated LED from turning on too early. But in case of an op amp with incorrect biasing it can also stop current flowing through a LED and into the op amp immediately below it. The effect of this is to make one of the LEDs glow while the others are extinguished, with no signal applied.

The gain of each op amp has been chosen so that its associated LED does not begin to glow until the one below it is fully illuminated. In practice, this means that each LED is changed from off to fully on for a signal level increase of about 7dB. The total signal range for the four LEDs is about 30dB. This is more than most VU meters (on the majority of cassette decks anyhow) can handle and the overall cost, for a stereo set-up, is considerably, cheaper.

All LEDs are fully illuminated for an input signal of 1 volt RMS. The frequency response of the system is more than adequate, extending from below 20Hz to beyond 25kHz. The system may be adapted to higher signal levels by changing the individual op amp gains or by merely inserting a suitable resistor in series with the 4.7uF input coupling capacitor, in each channel.

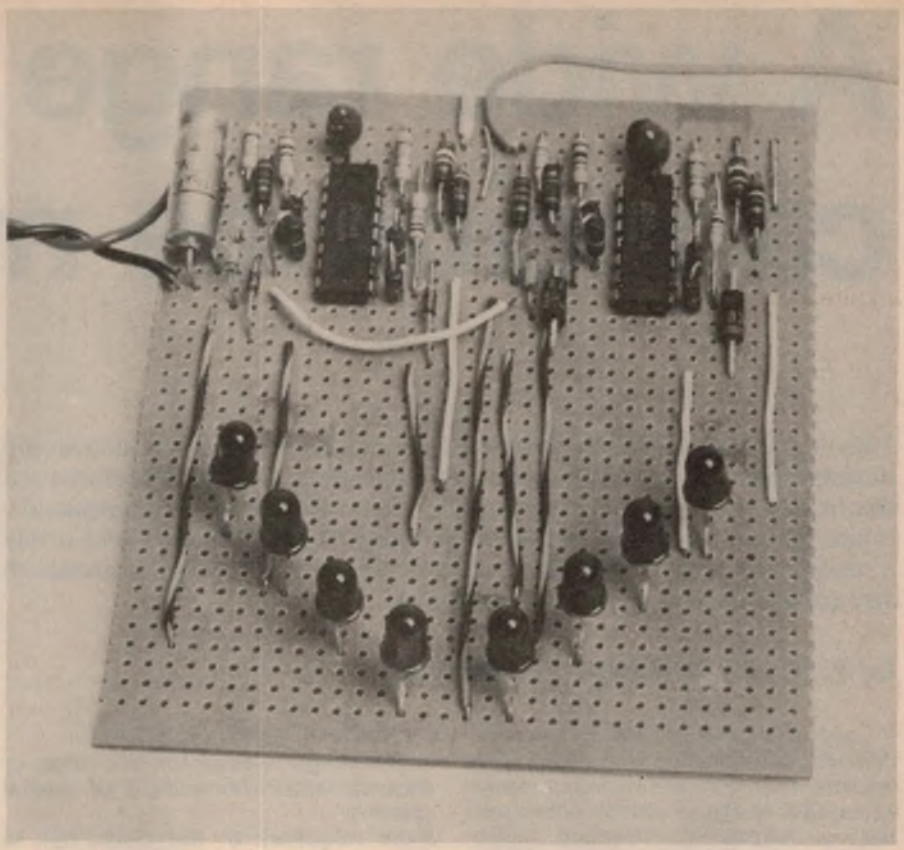
Input impedance of the circuit is about 7.4k in each channel. If the circuit is to be driven from the output of a preamplifier, a buffer circuit may be required.

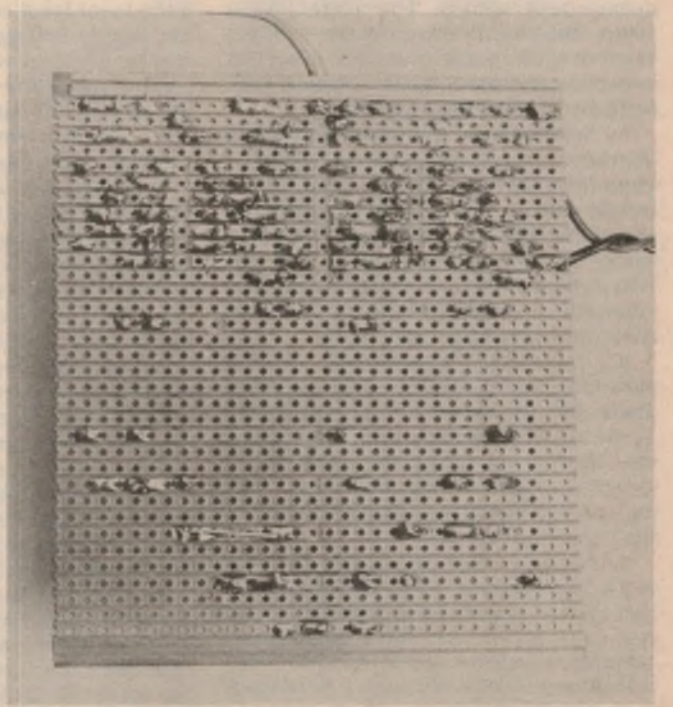
Construction is easy and straightforward using Veroboard with 0.1in conductor spacing. This suits the pin spacing on the integrated circuits. The photographs give the general concept.

We mounted the LEDs in a V-display which seems to have good visual effect. We mounted the display on the same piece of Veroboard as the circuit but some constructors may wish to separate the display board from the circuit board. No problem, as layout is not critical.

Check the LEDs for brightness before installation. This can be done by connecting four LEDs and a 150 ohm resistor in series across a 9V supply. Some will be brighter than others. Install the bright guys at the bottom and the dull fellows at the top. This may not sound equitable, but it gives a better display.

As it stands, the circuit is suitable for red LEDs only. If other colours are desired, the op amps will have to be biassed differently to take into account the higher forward voltages of non-red LEDs. Note too, that the supply voltage of 9V may have to be increased if other LEDs are used.





These two photos show how the Level Meter circuitry can be easily assembled onto a piece of Veroboard with 0.1in conductor spacing.

A wide range capacitance meter

This instrument combines three modes of capacitor testing into a single portable unit, using a minimum of components. Desirable features are that it applies a polarised voltage of a few volts to the test capacitor, it can be run from a single 9V unregulated power supply, and it has a readout scale that is inherently linear. Build it and you can measure any capacitor up to 2,500uF in seconds.

by P. H. MATHIESON, M.I.E. Aust.*

Capacitor markings can quite often be difficult to read and understand, particularly when they are in code. In some cases, too, markings can be either partially or completely obliterated, further adding to the problems of identifying component values. The capacitance meter described here provides a direct readout of the value of an unknown test capacitor, and should prove popular with hobbyist and professional alike.

As mentioned in the introduction, the instrument incorporates three modes of capacitor testing: a low capacitance mode (mode A), a high capacitance mode (mode B), and a leakage test mode (mode C). We will commence description of the circuit by considering the low capacitance mode (mode A), involving measurements up to 1uF.

IC1, an NE555, operates as a clock providing brief negative going pulses at about 350 per second to trigger IC2, also an NE555. This unclamps the test capacitor, allowing it to charge through a switch selected resistor to half the supply voltage. At that point, IC2 resets, discharging the capacitor via pin 7.

During this charging period, pin 3 of IC2 is high (approx. 8V). The duration of this high is directly proportional to the test capacitance, and the resulting rectangular waveform can be used to drive a 1mA meter direct through a 5k trimpot for a simplified unit.

However, in the circuit presented here the high signal is attenuated to 0.6V across silicon diode D1 at the non-inverting input of IC3, a CA3140 op amp with MOS input. IC3 operates as a unity gain buffer feeding the meter through calibrating trimpot R6. The meter deflection is proportional to the average value of the rectangular wave output from IC3, and therefore to the capacitance.

The supply voltage for this mode of measurement is non-critical for several reasons:

- the frequency of the clock, IC1, is almost independent of voltage;
- the reset level of IC2 (pin 6) is at half the supply voltage, which compensates for the effect of voltage changes on the charge rate of the test capacitor through the switched resistors; and
- D1 acts as a simple regulator, limiting the high signal input to IC3 to 0.6V.

With no test capacitor connected, there is still about 30pF of internal capacitance between pins 6 and 7 of IC2, plus additional stray capacitance. To compensate for this effect, and prevent it causing a substantial reading on the lower ranges, a negative capacitance must be employed to cancel it. This unlikely device is simulated by 100pF capacitor C3 which is connected to the output of amplifier Q1Q2, this amplifier having a small positive voltage gain and low output impedance. The current through C2 is then adjusted by R1, as detailed below, to be equal and opposite that through the 30pF.

To calibrate, use a known accurate capacitor to give a high deflection on the .01uF or 0.1uF ranges. First adjust the negative capacitance trimpot R1 so that the source of Q1 is at the top end of R1. Then calibrate by adjusting R6. There may be a small residual zero error, caused by the miniumum pulse width from IC2, which can be offset by the addition of R7, 470k in my unit.

Now switch to the 100pF range with a known capacitor of 10-20pF connected, and adjust the negative capacitance trimpot R1 until the meter reads the correct value. Readings will then be accurate down to a few pF.

The high capacitance mode (mode B), up to 2,500uF, uses a "single shot" method. IC1 is not required for this mode, and is switched out of circuit by S1.

When the +9V is switched on, IC2 is triggered by the momentary low on pins 2 and 4 applied by the uncharged capacitor C2. As in the previous mode, a high of 0.6V is applied to the non-inverting input of IC3 until the capacitor under test is charged to half the supply voltage. During this period, IC3 behaves as an accurate integrator, using low leakage capacitor C4 in the feedback loop. At the end of the high input period the output voltage of IC3 will be proportional to the duration of that period, and therefore to the test capacitance.

Accurate high value capacitors are difficult to find, so calibration using trimpot R5 is best done with values around 1uF. (The leakage resistance of high value capacitors extends the charging time, causing false high readings.)

After the integrating period, the meter should remain stationary while the reading is taken. If drift is a problem (assuming that feedback capacitor C4 is not leaky) it may be minimised by correcting the offset in the input stage of IC3. Try a 10k resistor (R3) from IC3 pin 1 or 5 to ground, and adjust for minimum drift.

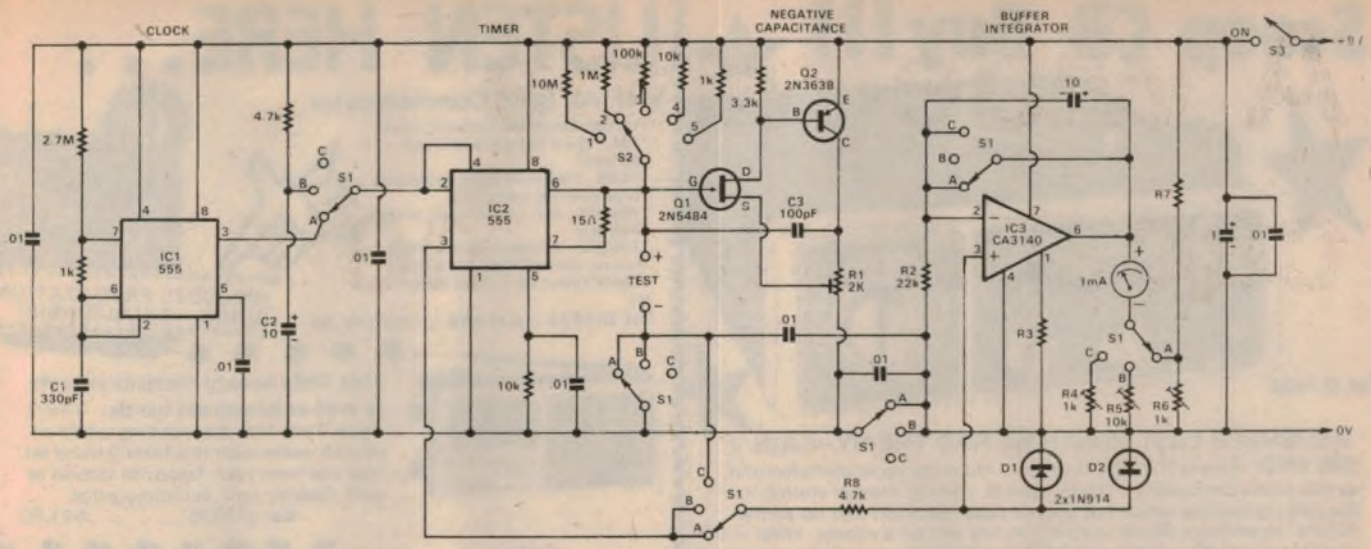
IC2 discharges the test capacitor through pin 7. Before taking another reading switch the +9V off, then discharge C4 by momentarily switching to another mode. Switching on the +9V will then initiate a new reading.

The third testing mode (mode C) produces a logarithmic indication of the test capacitor leakage current with up to 8V applied. In this mode, the lower end of the capacitor is disconnected from ground, and the leakage current caused to flow through limiting resistor R8 and diode D1.

The voltage across D1 bears an approximate logarithmic relationship to the current flowing through it. IC3 is again used as a unity gain buffer, and trimpot R4 is set to produce full scale deflection with a short circuit across the test terminals. IC1, IC2 and the negative capacitance amplifier (Q1Q2) are all disconnected from ground by switch S1.

Electrolytic capacitors which have remained unused for some time can be

*J.A.A.R.S., Box 248 Waxhaw, North Carolina, USA.



WIDE RANGE CAPACITANCE METER

reformed in the leakage test mode before their capacitance is measured. The logarithmic readout can be interpreted by observing the reading obtained with known resistors across the test terminals. Resistor values can range from a few kilohms to hundreds of megohms.

The capacitance ranges are in steps of 10:1. These are set out in the following table.

Switch S2	Mode A	Mode B	Mode C
Position 1	100pF	0.25uF	
Position 2	1000pF	2.5uF	
Position 3	0.01uF	25uF	
Position 4	0.1uF	250uF	
Position 5	1.0uF	2,500uF	Leakage

If intermediate ranges additional to these are required these may be obtained most economically as follows: in mode A, switching the clock timing capacitor C1 to a higher value will permit larger capacitances to be read on scale; in mode B, switching R2 to a higher value slows the integrating rate, and capacitor readings will be moved up scale. 10,000uF is probably the practical upper measurement limit due to the effects of leakage above this figure.

The CA3140 op amp was chosen for its high input impedance, and because both inputs and the output can be swung down to the negative supply line. This eliminates the need for a separate negative supply. The positive supply may be varied from +6V to +12V with little effect on calibration. Current drain is 20-30mA for capacitance measurements, and a few mA for leakage measurements.

The prototype was built on matrix board, the layout approximately following the schematic. Other recognised construction techniques could, of course, be used. Because fast risetimes are involved, several .01uF supply bypass capacitors are included on the board, and leads should be kept short and neat.

Note that the CA3140 op amp is a CMOS device, and the usual soldering precautions should be observed. If a shorting type wafer switch is used for S1, a 470 ohm current limiting resistor should be inserted in series with pin 3 of IC2.

The test points can be alligator clips on short flexible leads fed through grommets in the front panel. Take care to minimise stray capacitance to ground from the positive test point.

Never apply reversed power supply voltage to the circuit—at least not unless you're keen to purchase three new ICs. A reverse biased 1A diode across the supply will protect the circuit in the event of reverse polarity connection to the battery should you feel such precaution necessary.

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by GREG SWAIN

The average home handyman prides himself in being able to fix everything from a light bulb to the family car. And with the high cost of car ownership these days, many motorists are doing their own servicing work whenever possible to save a few of those hard earned dollars.

The Heathkit Model CM-1073 Automotive Tune-up Meter will therefore find immediate appeal with many would-be Saturday afternoon mechanics. Combine it with an ignition timing light, and you will be able to accurately tune your car's engine for top performance and reduced fuel consumption. What's more, you will be able to make regular checks to ensure that the engine stays in peak tune.

In fact, it seems highly likely that the CM-1073 would pay for itself in a very short time. You will be doing your bit for the environment too. A badly tuned engine not only "guzzles gasoline"—it also causes more air pollution.

As with all Heath projects, the aim is that the purchaser has some fun in building up the kit, and on completion be rewarded with a worthwhile piece of test gear. We obtained our kit from the local Heath agent, Warburton Franki Pty Ltd, assembled it, and were suitably impressed with the result.

Actually, we've been very impressed with all the Heathkit projects we've assembled so far. The standard of presentation of the kits has been of a very high order indeed, and all have functioned first time. Considering the number of units we've assembled, that must be some kind of record!

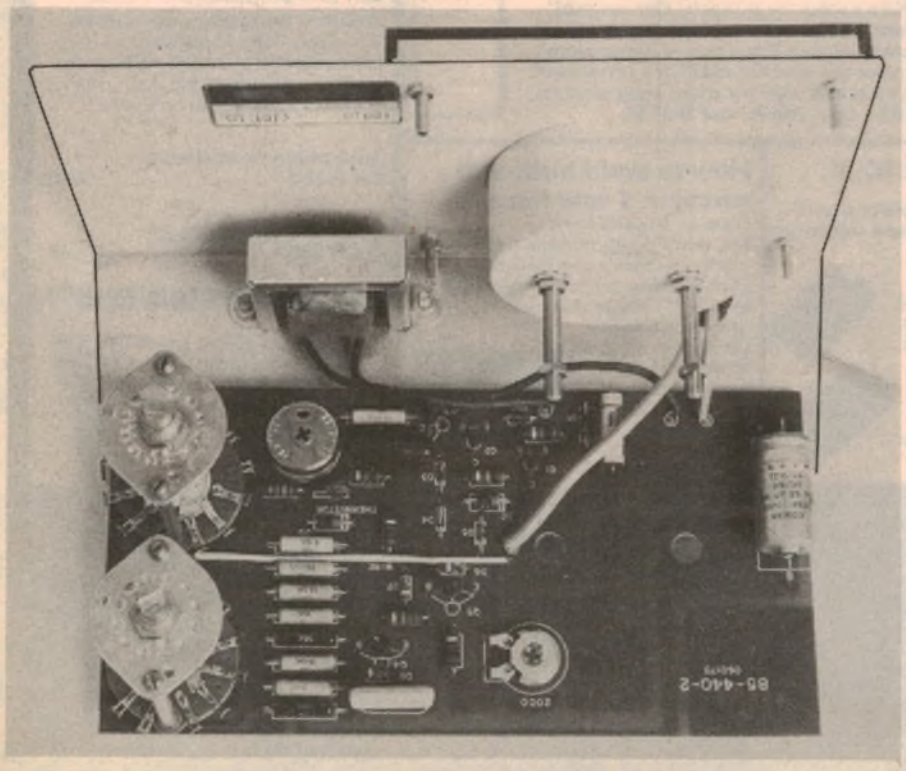
The most pleasing feature of the CM-1073 is the large, easy-to-read meter. Facilities offered include high and low tacho ranges (1500 and 4500RPM), three dwell meter scales (one each for 4, 3 & 6, and 8 cylinder engines), and a 0-20V voltmeter range. The instrument may be used on any 4-cycle engine of 3, 4, 6 or 8 cylinders that employs a standard automotive type of ignition system.

Note that the CM-1073 is not recommended for use on cars having accessory solid-state ignition systems. Cars fitted with these systems should be changed back to the original system for tuning.

More about the kit itself later on. Let's concern ourselves first with how a tacho/dwell meter is used to tune an automobile engine for best performance. Make sure though that all engine adjustments (timing, carburettor etc) are carried out according to the manufacturer's specifications. Invest in a workshop manual if you don't have one.

Most frequently, engine tuning involves little more than making adjustments to the ignition system. Assuming that the spark plugs and high tension leads are in good order, the first step is to set the points dwell to the manufacturer's specifications. On Holden 6-cylinder engines, for example, this will be somewhere between 30 and 35°.

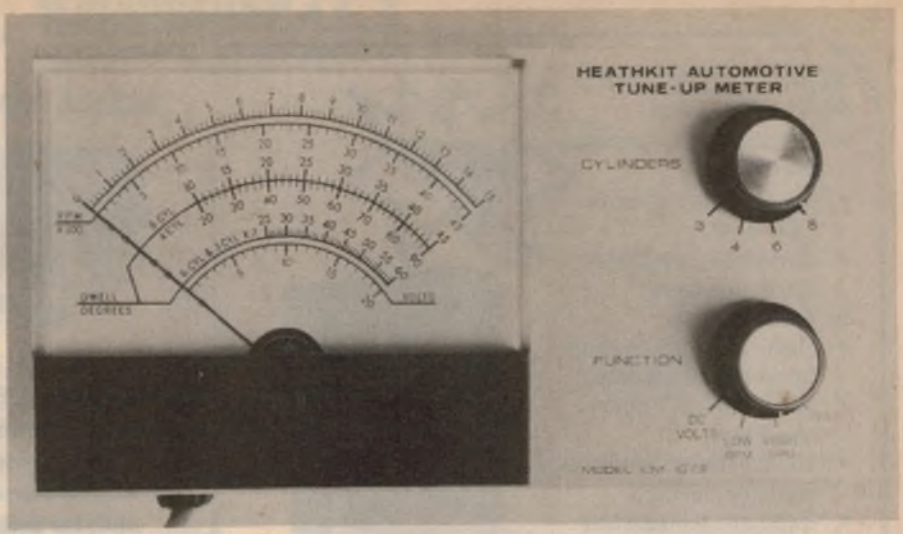
For those who are not familiar with the term "dwell", we will explain further. Simply stated, dwell is the number of

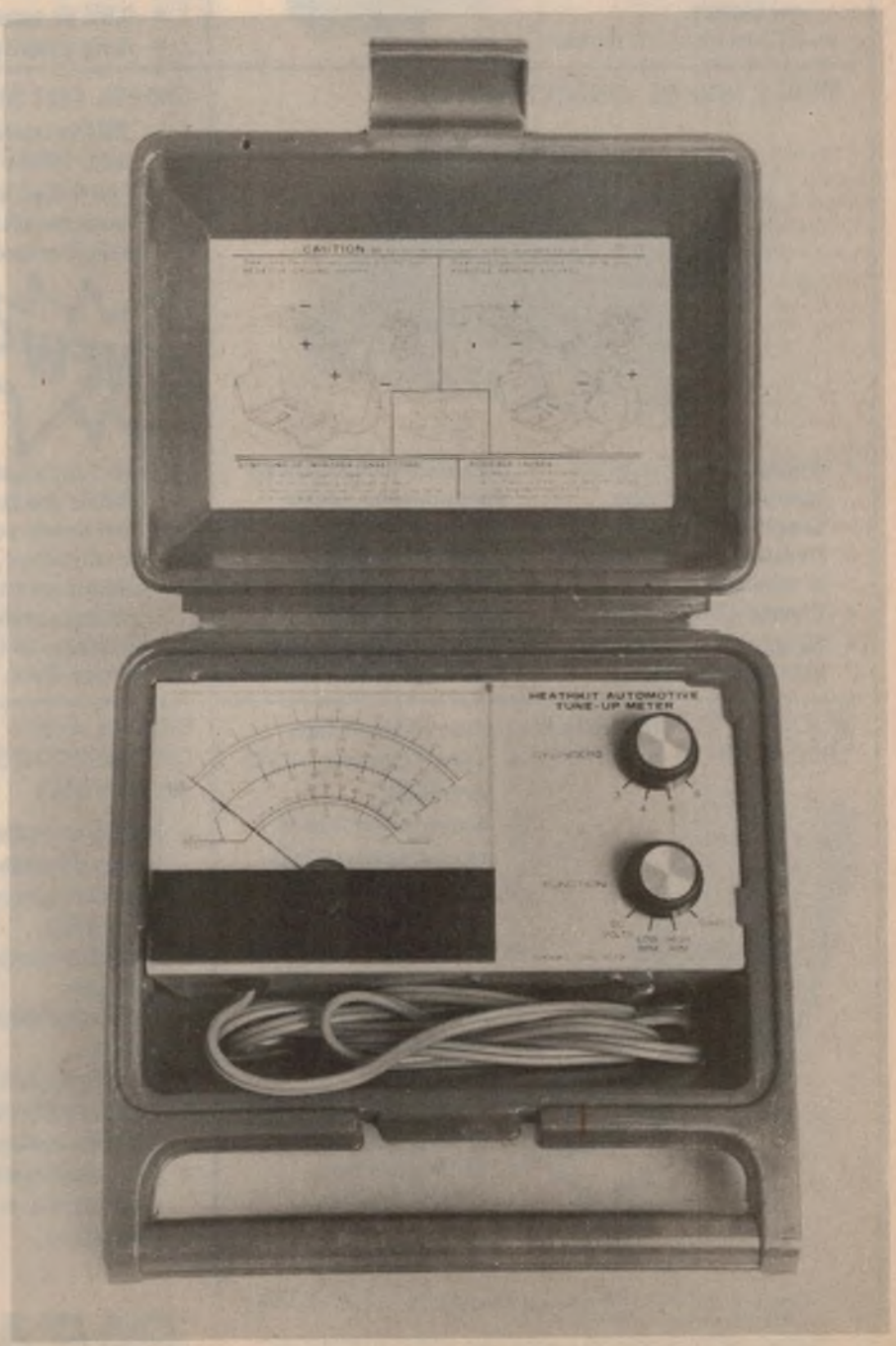


View at left shows the completed board before final installation on the chassis. Board is held in place by meter terminals and switches.

Right: main feature of the instrument is the large, easy-to-read meter. Unit can be used on 3, 4, 6 and 8-cylinder, 4-cycle engines with standard ignition system.

Below right: the completed instrument, fitted to its plastic carrying case. A diagram on the case lid shows tach/dwell wiring hookup.





degrees the distributor cam rotates while the points are closed during each ignition cycle. All one has to do is adjust the points gap until the correct reading is obtained on the meter. If the reading is too high, the points gap must be increased; if it is too low, the points gap must be decreased.

In practice, this means stopping the engine, removing the distributor cap, and resetting the points gap in the direction indicated by the dwell meter. The distributor is then reassembled and the engine restarted so that the new dwell angle may be read off the meter. This procedure is repeated until the indicated dwell angle is within the manufacturer's specifications.

It is important that the dwell angle be correctly set. Too small a dwell angle, for example, will result in the coil not reaching magnetic saturation at high rpm, with consequent poor ignition through loss of spark energy. Note also that it is necessary to set the dwell before making ignition timing adjustments, as dwell affects timing (although the converse is not true).

The tacho ranges are essential for setting the engine idling speed and for ignition timing adjustments. Let's go back to the Holden 3300cc 6-cylinder engine referred to earlier, in this case as fitted to a 1974 LH Torana sedan. The ignition timing advance for this vehicle is specified as 5° BTDC (before top dead centre) at 800 rpm. This engine speed is obtained with the vacuum line to the distributor disconnected and plugged.

Once ignition timing adjustments have been completed, the tacho can be used to accurately reset the engine idling speed. Proper engine idling speed is important, especially on cars with automatic transmission. If the idling speed is too high, the car will tend to creep more than normal, and if it is too low, the engine will run roughly, have a tendency to stall, and have higher than usual bearing wear.

Following through on our Holden 6-cylinder example, the low tacho range of the tune-up meter would be used to adjust the idling speed back to 575 rpm with the transmission in drive.

Note that all of the above adjustments should be carried out with the engine at normal operating temperature.

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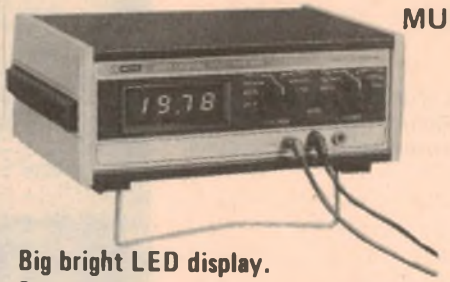

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The tachometer ranges can also be used to make carburettor adjustments, usually to the idling mixture. On modern cars, this is usually set lean to meet anti-pollution requirements. Consult a workshop manual for the procedure and engine speeds appropriate to your car.

About the only feature of the Model CM-1073 that we haven't discussed so far is the voltmeter facility. This would typically be used for checking on battery voltage under load and no-load conditions, and for checking the charging voltage. The voltmeter facility could also be used for general troubleshooting work.

Let's talk now about the circuit of the Model CM-1073 tune-up meter.

Both the tachometer and the dwell circuits utilise the DC voltage pulses produced across the coil by the distributor for the input signal. This signal is applied through a filter network consisting of choke L1 and diode D1 to transistors Q1 and Q2. Capacitor C2 provides additional filtering when the meter is switched to the Dwell mode.

Diodes D1 and D2 are included to provide reverse current protection for transistors Q1 and Q2, in case the test leads are improperly connected. Transistors Q1 and Q2 function as a constant current source for reference stabistor diodes D3 and D4, which provide a clamped voltage of 2.8V at the collector of transistor Q2 for any input voltage between 5 and 15 volts.

In the dwell mode, the dwell signal at the collector of Q2 is applied to diodes D5, D6 and D7. These diodes perform two functions: they clamp the dwell signal at a fixed level, and they provide temperature compensation for the dwell circuit. The dwell signal is then passed through dwell calibrating control R4 to the function switch, and thence to the meter.

By comparison with the dwell circuit, the tacho circuit is somewhat more complicated. When the points close, a voltage pulse is applied to the collector of transistor Q3. At the same time, voltage from the collector of Q2 is applied to the base of Q3 as described previously. Since the base bias voltage is constant, Q3 acts as a variable resistance and keeps the emitter voltage constant, even when the load changes.

The signal from the emitter of Q3 is coupled to the meter through tachometer calibrating control R17 and the temperature compensating network consisting of thermistor R19 and resistor R21. When the function switch is in either tachometer range, the signal from the meter is passed to the common negative return through diode D9 and transistor Q5.

Transistor Q5 began to conduct as soon as the points closed, so that current is initially passed through the meter. At the same time, capacitor C3 begins to charge through one of the timing resistors. Before the points open to end the pulse, C3 becomes charged and transistor Q4 begins to conduct. This in turn biases transistor Q5 off, shutting off the current through the meter.

The meter thus only responds to a small part of the pulse. This measured pulse duration is independent of engine speed, and is changed only by selecting a different timing resistor with the function and cylinders switches.

When the distributor points open, an induced voltage is produced in the primary of the ignition coil. This potential is opposite in polarity to the battery voltage and, "sees" a complete circuit through choke L1, transistor Q3 (conducting in the reverse mode), the function switch, the cylinders switch and one of the timing capacitors, to one side of capacitor C3. Diode D8 completes this circuit and also provides a consistent starting potential across C3 for the next pulse.

The current pulses seen by the meter are always at a constant amplitude. Different meter readings are determined by the duration and frequency of these pulses, which are in turn dependent on the number of engine cylinders and the engine rpm.

The voltmeter circuitry is simplicity itself. With the function switch in the DC Volts position, the meter is coupled directly to the test leads through calibrating resistor R18 and choke L1. Note that the voltmeter was designed for making automotive electrical measurements only, and should not be used to measure voltages in high impedance electronic circuits. Also, DC voltages above 37V may cause zener diode D10 to conduct heavily, causing possible damage to other components.

As to the kit itself, what more can we say than that it is presented with typical Heath thoroughness. It arrived carefully packaged, accompanied by the customary step-by-step assembly manual, and was literally complete to the last nut and bolt. Heath even supply you with the solder!

The only trouble is that the experienced kit constructor might find the assembly procedure rather boring, so detailed are the instructions in the assembly manual. It's true—if you can solder you can build a Heathkit (unless you're a complete moron!).

From a physical standpoint, the unit is designed around a simple L-shaped chassis which is fitted to a rugged, high-

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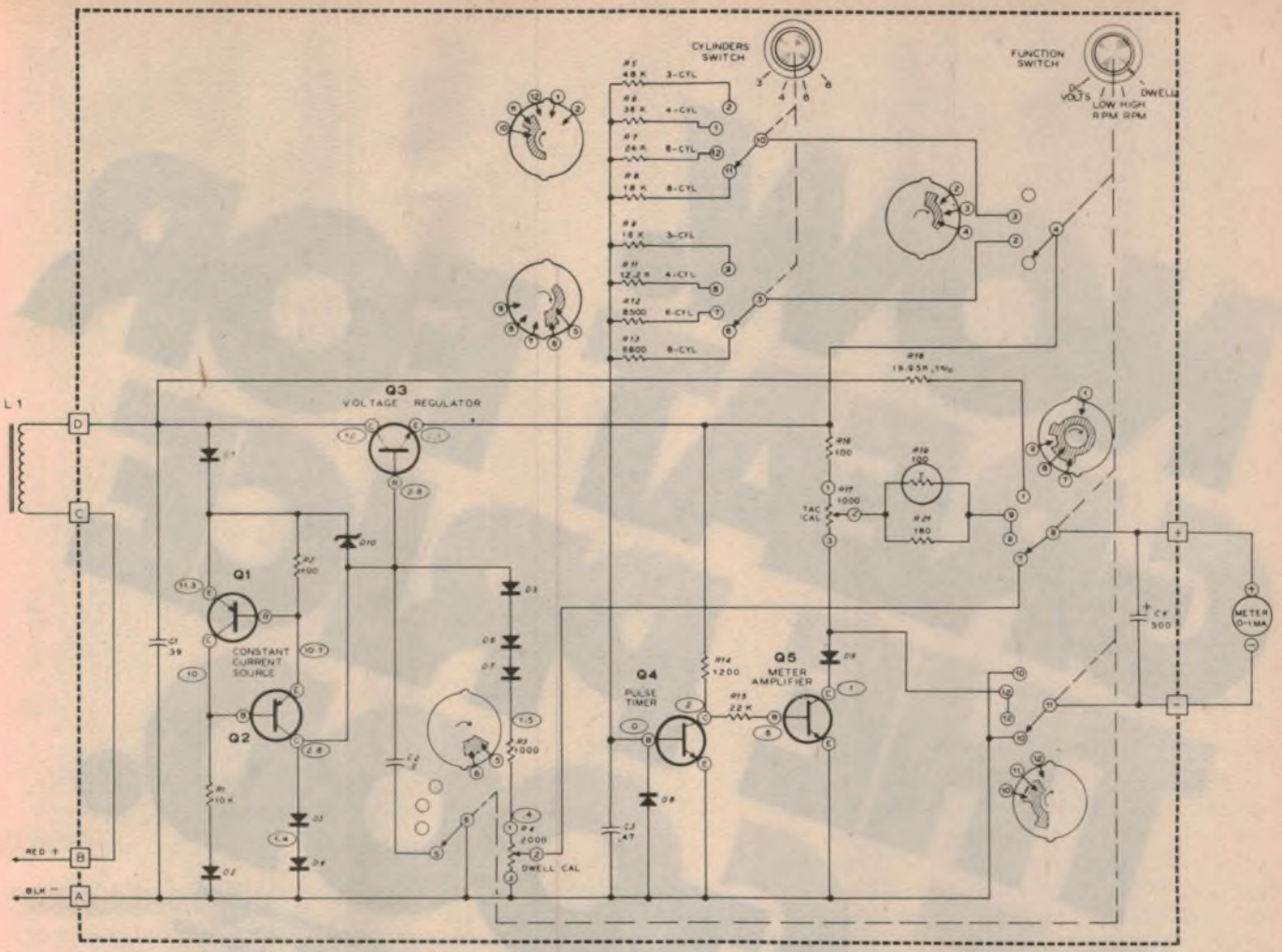

Schematic diagram of the Model CM-1073 Automotive Tune-up Meter, as published in the assembly manual.

impact plastic case. The electronics (with the exception of the input choke) are contained on a single PC board, which is mounted parallel to the front panel and held in place by the switches and the meter terminals. The two rotary switches solder directly to the board pattern.

In our case, the unit took only about 3½ hours of actual work from unpacking to completion. It functioned normally right from the word go and, in keeping with the job it was designed for, was rugged and attractive in finished form. It's easy to use, too—just clip the two test clips across the coil for tach or dwell tests, or across the battery for voltage checks.

Calibration of the tachometer is achieved by using the mains as a frequency reference, and it was here that we encountered our only hassle with the kit. The problem is that the procedure laid down in the assembly manual assumes a mains voltage of 120VAC 60Hz, and no provision is made for other voltages.

Fortunately, there is a simple way out of the problem. Supplied as part of the kit is a calibration cable with a 2-pin mains plug and a 10k resistor in series with one of the leads. All we did to adapt this cable for 240VAC operation was to solder a second 10k resistor in series with the first.

The TAC CAL control is then adjusted so that the meter reads 1000RPM (instead of 1200RPM) with the function switch set to low RPM and the cylinders switch set to 6. Calibration readings for the other three test positions should then be 750RPM (instead of 900RPM), 1500RPM (instead of 1800RPM), and 2000RPM (instead of 2400RPM). These revised readings are necessary because of the 50Hz line frequency used in Australia.

Note: Warburton Franki has advised that a revised calibration procedure is now attached to the kits sold in Australia. This new procedure involves the substitution of a 47K 5W resistor in place of the original 10k ½W resistor used in the calibration cable, together with revised calibration test readings.

Exercise extreme caution when carrying out the calibration procedure, to ensure personal safety. If you feel at all unsure of yourself, wind some insulation tape around the connections between the test leads and the calibration cable.

For those unlucky enough not to get the instrument going first try, the assembly manual contains a detailed trouble-shooting section. As a last resort, the constructor can take advantage of the technical back-up and factory repair service offered by the Heath Company. A 90 day warranty applies in the case of defective parts or workmanship, and full spare parts back-up is available.

In summary, full marks to the Heath Company for its Model CM-1073 Automotive Tune-up Meter. Even its cost of $48.00 seems reasonable. One thing you can be sure of—there was no shortage of staff members wanting to take the unit home for a Saturday-afternoon tune-up.

As for my own "set of wheels"—they never ran better!

The Heath Company is represented in Australia by Warburton Franki Pty Ltd, who have branches in all state capitals and in Wellington, NZ. Readers should either write to The Heath Centre, 220 Park St, South Melbourne, Vic 3205, or ring one of the following numbers: Melbourne 699 4999, Sydney 648 1711, Brisbane 52 7255, Adelaide 356 7333, Perth 65 7000, Hobart 23 1841, Wellington (NZ) 69 8272.

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Simple signal generator for RF and audio work

By connecting two complementary junction FETs together, you can make a negative-resistance device similar in many ways to a tunnel diode. Like a tunnel diode, it can be used to make a simple RF or audio oscillator, but with somewhat higher output.

by J.BRIAN DANCE, M.SC

One of the simplest circuits which will provide radio frequency, audio frequency or modulated radio frequency signals involves the use of a pair of complementary junction field effect transistors. These transistors are connected as shown in the circuit of Fig. 1, the complete circuit being equivalent to a negative resistance device. The biasing voltage must be applied with the correct polarity, or the negative resistance effect will not occur.

In Fig. 1, the drain of the N-channel junction FET is connected to the gate of the P-channel device to form the positive electrode of the complete circuit. Similarly, the drain of the P-channel device is connected to the gate to the N-channel FET to form the negative electrode of the circuit. The sources of the two devices are connected together.

The variation of the current flowing through this type of circuit with the applied voltage is shown in Fig. 2. As the applied voltage increases from zero, the current passing through the series connected channels of the two devices increases until the applied voltage becomes equal to the pinch-off voltage of one of the FETs.

A further increase in the applied voltage will then cause the current to decrease in the negative resistance region until the applied voltage equals the sum of the two pinch-off voltages of the FETs. The current is then very small indeed--usually less than 1nA at room temperature, but increases somewhat with temperature. This low current region is known as the valley region and extends over a relatively wide voltage range.

As the applied voltage is increased still further, the gate to channel junction of one of the devices eventually breaks down and the current then increases very rapidly indeed with any further increase of the applied voltage.

As with all negative resistance circuits, it is only the incremental or differential resistance which is negative, as shown by the negative value of the gradient in Fig. 2. Both the voltage and the current are positive in all regions of the characteristic and therefore the resistance must be positive. Indeed, this must be so, since if a device which had a negative resistance could exist, it would be able to deliver power continuously into an external circuit and this would violate the principle of conservation of energy. However, the fall of current with increasing voltage means that the AC resistance is negative, and this effect can be used to generate oscillations or switching.

The characteristic curve shown in Fig. 2 is rather like the characteristic of a tunnel diode, except that the valley region of a tunnel diode characteristic never falls to such a low value as that of the circuit of Fig. 1. However, the tunnel diode can oscillate at very high frequencies (up to some GHz with suitable devices) whereas the circuit of Fig. 1 is limited in frequency to some tens of MHz.

In order to ascertain whether the type of junction FETs are at all critical, the writer tried the FETs shown in Table 1 in the circuit of Fig. 1. The values of the peak current and the peak voltage are shown in the table together with an estimate of

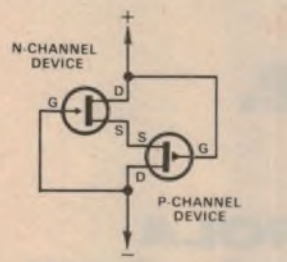

FIG. 1

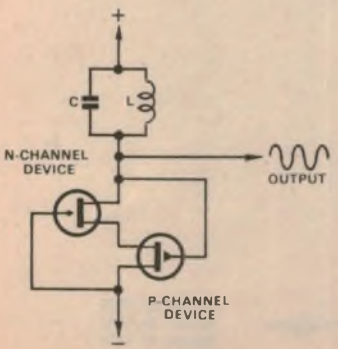

FIG. 3

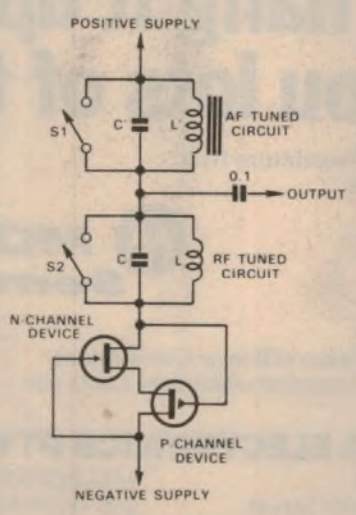

FIG. 4

Fig. 4: shows the final circuit, in which both audio frequency (AF) and radio frequency (RF) circuits are included in series with one another. Output can be either AF, RF or modulated RF.

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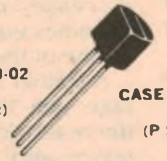

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the valley voltage. This latter value can only be an estimate, since its value depends on how far the current must fall before one considers that one is in the valley region. In all cases valley currents were of the order of 0.5nA to 2nA. Three 2N2386 devices were tried and two BFW61 devices, as indicated in the table.

A negative resistance oscillator was then made using two complementary FETs, connected in the circuit of Fig. 3. The resonant LC circuit determines the frequency of oscillation, and a sine wave output can be obtained over a wide range of frequencies. Initially frequencies in the range 50kHz to 10MHz were tried. The voltage across the tuned circuit under no load conditions has a peak to peak amplitude equal to twice the applied voltage. The circuit is especially useful when one requires an output amplitude accurately related to the power supply voltage. The valley current is so small that it imposes a negligible load on the tuned circuit.

The devices need not be matched or selected in any way, almost any pair of complementary junction FETs being suitable.

The inductance L was then replaced with an iron cored coke and the parallel capacitor was increased to 0.02uF. The circuit then gave an output at an audio frequency, the value of which could be selected by changing the value of C or L.

The circuit was then modified to the form shown in Fig. 4, in which both audio frequency and radio frequency resonant circuits are included in series with one another. The resultant output consisted of a radio frequency oscillation amplitude modulated at the audio frequency. Either the radio frequency or the audio frequency tuned circuit could be shorted out by one of the switches so that an unmodulated audio or radio frequency output could be obtained.

This type of circuit is very simple and convenient for use when servicing radio receivers. A short length of wire connected to the output of the circuit will provide adequate coupling to a radio receiver which is situated fairly near to the wire. Audio signals must be directly coupled to the audio section of the receiver, however. If used for IF alignment, it may also be necessary to place the output lead from the circuit very close to the IF stages of the receiver to ensure the coupling is adequate, but when the IF stages are nearly aligned, the wire connected to the output of the Fig. 4 circuit can be moved somewhat farther away from the IF stages.

The writer formed the opinion that the output from the Fig. 4 circuit was fairly pure, the harmonic responses appearing no larger than those from a typical commercial signal generator. However, this was only my general impression, and no harmonic measurements were carried out to check this.

TABLE 1:

P-channel device	N-channel device	Peak Current (uA)	Peak Voltage	Valley Voltage (approx.)
2N2386 (1)	BFW61 (1)	1050	1.4	7.5
2N2386 (2)	BFW61 (1)	1100	1.9	6.6
2N2386 (3)	BFW61 (1)	940	1.55	7.5
2N3820	BFW61 (1)	1410	1.5	6.2
2N3330	BFW61 (1)	1170	1.4	7.6
2N2386 (1)	UC734	1040	2.15	9.0
2N2386 (1)	E304	1650	1.9	7.9
2N2386 (1)	BFW61 (2)	1250	1.7	7.4
2N2386 (1)	2N3685	725	1.6	7.3
2N2386 (1)	2N3823	1060	1.55	7.3

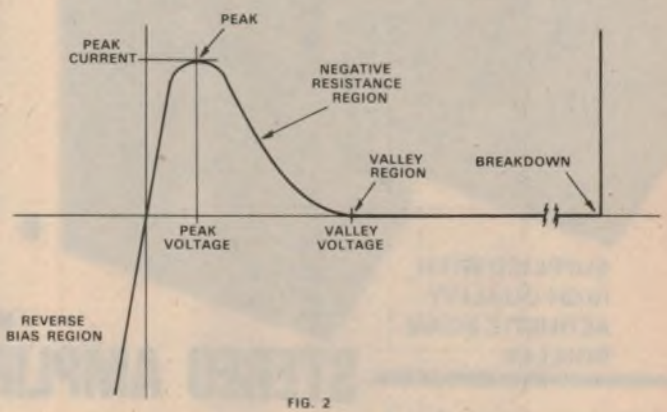

Fig. 2: diagram showing current through circuit of Fig. 1 as a function of applied voltage.

Integrated devices containing the circuit of Fig. 1 in a miniature two terminal package are available from the Matsushita Electric Company of Japan under the name 'Lambda diodes'. This name is derived from the fact that the characteristic curve of Fig. 2 is in the shape of the capital Greek letter lambda.

It seems to the writer that the main difference between the Matsushita device and the discrete component circuit of Fig. 1 is in the somewhat lower currents of the former type. Valley currents as low as 30pA were found for some of the Matsushita devices, although a valley current of the order of ten times this value was found more frequently. Peak currents of the order of 300uA are typical for the Matsushita devices, depending on type. Peak voltages of 0.8V to 4V or more can be obtained.

In conclusion, I believe the simple practical circuit described has a perfectly satisfactory performance for use as a signal generator. One should avoid attaching an aerial of appreciable length to the output or one may cause interference over a considerable area, since the output voltage is greater than that from most signal generators. Indeed, the circuit could probably be used for radio control over a reasonable distance, but the frequency of oscillation would have to be set quite accurately for this application.

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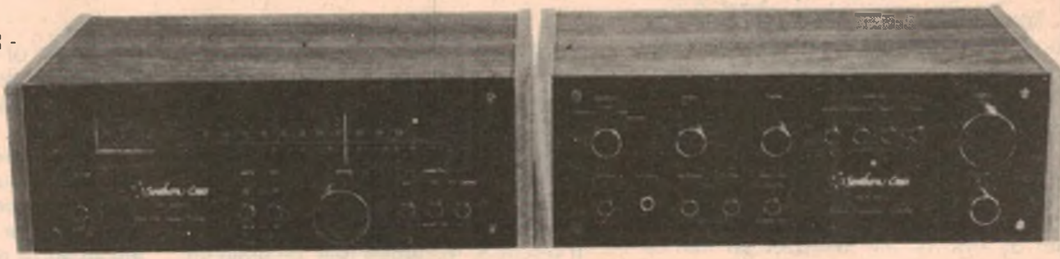

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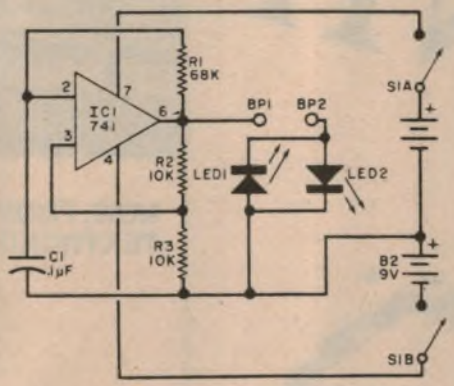
One-touch diode tester

Most of us seem to have plenty of diodes in our junk boxes. However, the problem often is to find out which ones are good, which ones are bad and, in the case of the former, which end is which (cathode or anode). Most diodes can be tested which a conventional ohmmeter. However, a simpler way is to use the diode checker described here.

The op amp IC1 forms a simple square wave oscillator whose output swings from almost full positive to full negative levels with respect to ground. If a good diode is connected between BP1 and BP2 with its cathode toward BP1, LED1 is forward biased and glows. If the diode is reversed so that its anode is at BP1, LED2 glows and LED1 is dark. With the LEDs properly identified and placed close to BP1, an unknown diode lead connected to BP1 is easily identified.



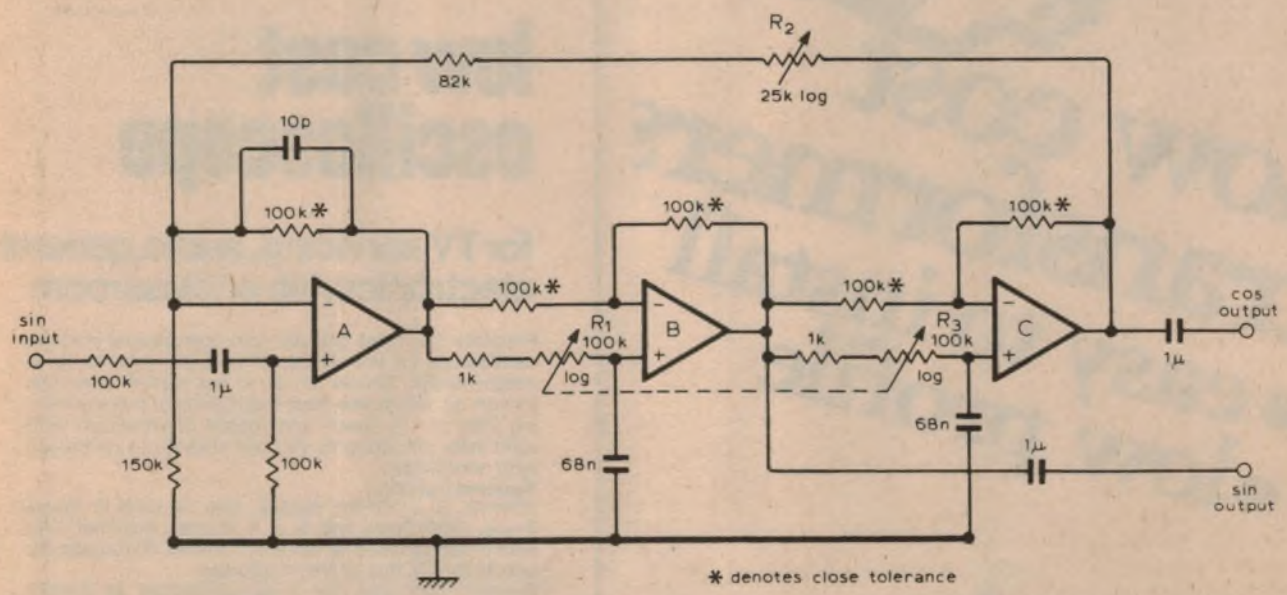
Before installing the LEDs, be sure they are of equal brightness. The values of R1, R2, R3 and C1 can be varied if the specified values are not available, as long as the circuit oscillates.

In use, connect a diode to be tested between the two binding posts. If only one LED glows, the diode is good and the glowing LED will identify the cathode. If both LEDs glow, the diode is shorted. If neither LED glows, the diode is open.

Transistor junctions may be tested by connecting the collector to BP1 and the base to BP2. If LED1 glows and is brighter than LED2, the transistor is NPN. If LED2 glows, or is brighter than LED1, the transistor is PNP.

(By David Markegard, in "Popular Electronics".)

Variable band-pass filter



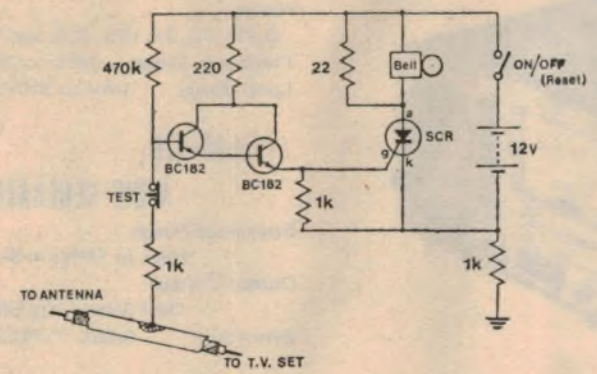
Sometimes it is required to have a high-Q bandpass filter which is adjustable over a wide frequency range without an appreciable change in Q, or more particularly, without the loop-gain becoming greater than unity which causes oscillation. With this circuit the centre frequency can be adjusted over a 100:1 range whilst maintaining Q greater than 100, and over smaller frequency ranges, a Q of up to 10,000. In addition, a two-phase output is available.

The cascaded all-pass networks, B and C, each have a 0° to 180° phase variation, and unity gain at all frequencies. This cascade is driven from a third operational amplifier whose feedback signal is the sum of the input and output of the all-pass network. The sum becomes exactly zero when there is exactly 180° phase shift over the cascade, and thus the overall gain approaches half the open-loop gain of amplifier A. At other frequencies the gain tends towards unity.

Because the frequency determining components only affect the overall phase-shift and not the gain, there is no danger of having a loop-gain greater than unity. If the two-phase output or large frequency range is not required one R can be fixed. The Q is adjusted by R2, and with the values shown gives the circuit a 20Hz to 2kHz range.

(By J. M. Worley, in "Wireless World".)

Colour TV thief trap



Colour TV receiver sets have a good value on the black market and it is not uncommon for a set to disappear while occupiers of premises are asleep. It is also obvious that the same sort of thing could happen when premises are left unoccupied, even for quite short periods. The circuit may be installed to give an alarm when the set is being tampered with by unauthorised persons. Withdrawal of either the TV antenna lead from the set, or the mains plug, will actuate the alarm and the bell will ring.

Component values as shown are approximate as these depend on the transistors being used, but with careful construction a minimum constant current of approximately 20uA can be achieved.

The rated current of the SCR should suit the bell. One "earthy" end of the circuit should be connected to the "outer" of the coaxial cable, or it could be connected to one line of 300 ohm ribbon via a suitable RF choke. The other "earthy" end of the circuit should be connected to a water pipe or other electrical earth.

(By D. H. Johnson, ZL2BHK, in "Break-In")

Editorial note: Such a device could be useful for motels etc, where they may have problems with colour TV sets disappearing from time to time.

Economy suggestion for Mini Scamp

With regard to additional RAM for Mini Scamp, instead of using the additional PCB as shown in June, 1977, page 80, figure 2, may I suggest that the 2112 RAM chips can be piggy-backed. If pin 13 in each case is bent outwards, the remaining 15 pins can be soldered to the chip below. Two vertical stacks of 2112 chips are therefore produced. Pin 13 on each chip can then be joined to its companion in the other stack and from there to one of the pins on the 74LS138 decoder. A 4-chip stack will stand 9/16 in or 15mm clear of the PCB.

This idea may be of use for other types of memory chip where there are several address lines but decoding and I/O buffers (with the 2102 for example) may begin to make it impractical. In some cases it might be possible to build horizontally across a PCB instead of up, then only the 8 legs in the air need be tied to the PCB, since all the others can be bent downwards. This may be done with the 2102 for instance.

(By Mr R. King, 10 Ashfield Street, Sandy Bay, Tasmania 7005.)

Low-cost replacements for input IC on 1973 DVM

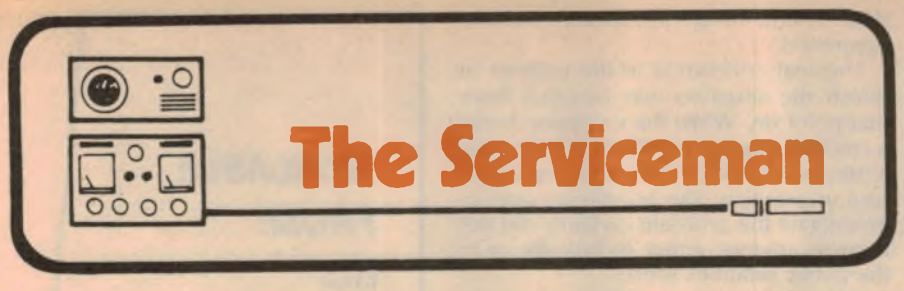
While using my Digital Volt-Ohm Meter described in January and February, 1973, I was unfortunate enough to destroy the 740 input IC in a most unusual way. While making measurements on a TV receiver, I brought the negative lead of the probe within corona distance of the EHT lead on the receiver. There was a sizzle and the inbuilt protection was overloaded, leading to the demise of the 740. On checking up to replace the 740, I found that the cost was very high and so I decided to seek out some type of suitable substitute. The newer type CA314OT made by RCA was found to be suitable, with some minor modifications. The price turned out to be about 10% of that for the former device.

To effect the changeover, I soldered the appropriate leads of the CA314OT into a 14-pin DIL plug, made by McMurdo (now Swann Electronics). This plugs into the existing holes on the PCB. Pin 8 has no connection and is left flying. A 22pF compensating capacitor is soldered from pin 8 on the PCB to the −15V line, which is also pin 4 of the CA314OT. Also, it is necessary to place a 15k resistor in series with the offset potentiometer, to limit the voltage and so prevent overheating of the device.

While making the above change, I decided to make a couple more small modifications at the same time. Much better drive to the LEDs is possible by replacing the type AY1103 or 2N3641 transistors with type BC337s. This gives increased brilliance and improved leading zero blanking.

As I do not care for the use of two LEDs to simulate a "1", I used an FND70 instead. I bent up all the pins against the case and cemented the FND70 to the PCB in the place where the two LEDs were previously. Pin 1 is the cathode and it is connected to the original cathode point. Pins 8 and 9 are the anodes which give the figure "1" and they are connected to the anode points of the original FLV110s. There is a blank spot on the PCB just above the position of the FND70. A hole was drilled through and the leads were then soldered direct to the appropriate points on the copper side of the PCB.

(By Mr E. Noller, 106 Essex Street, Epping, NSW 2121.)



The Serviceman

It doesn't happen often, but . . .

Reputable manufacturers go to a lot of trouble to ensure that a faulty appliance never reaches the customer but, occasionally, one does slip through. When it does the firm concerned needs to act quickly and positively to retrieve the situation. Here is a story which makes the point most effectively.

It is no secret that some funny things (funny peculiar, that is) happen on modern production lines, whether they be for motor cars, washing machines, colour TV sets, or any other mass produced device. Most of them are so obvious that they are picked up further down the line but, occasionally, one slips through. When it does it can cause a lot of red faces.

The story I am about to tell is a typical example. It did not happen to me but I can vouch for its authenticity. For obvious reasons all those involved, including the firm concerned, have to remain anonymous; it happened but it is not a reason to avoid that brand.

The story started with the purchase of a new colour TV set, locally made by a well known manufacturer. It was duly installed by the dealer and, superficially at least, appeared to be performing normally. However, after a couple of days, when the initial enthusiasm had worn off, the customer began to take a more critical look at the picture.

Sure, it moved, it spoke, and it was coloured. But there was something about it which didn't seem right. It wasn't until he watched a football match the next Saturday afternoon that he felt able to describe the effect.

Thus reassured he sought the advice of a friend who, while not directly associated with the TV industry, has a thorough grounding in the subject. And, as you might have guessed, this friend is also known to me; that's how I heard the story.

Anyway, as the customer put it to his friend, "when I saw the footballers in their bright coloured jerseys running around against a background of green grass I realised that the colours on the jerseys did not match up with the outline of the players. They seemed to be smeared and noticeably displaced to the right. Is this normal?"

His friend assured him that it was most definitely not normal but, just to make sure, he arranged to have a look at the picture himself. What he saw only convinced him that the set had a fundamental fault, as well as having poor overall colour balance. He advised the customer to complain in no uncertain terms.

About this time the customer received a form letter, ostensibly from the manufacturers, noting that he had bought one of their sets, congratulating him on his choice etc,—blah blah blah— and asking whether he was satisfied with the set. The customer promptly wrote "NO" in the appropriate place and sent the letter back.

As a result a technician appeared on the doorstep a couple of days later to find out why. After a cursory glance at the picture he picked on three likely causes of the trouble. (1)There was a portable radio sitting on top of the TV cabinet. (2) There was a metal handrail, belonging to an adjacent stairway, which ran alongside the cabinet. (3) It was aggravated by ghosting, caused in turn by a faulty aerial installation.

In fact, the aerial was a well known model which should have been quite adequate for the area and the only abnormal feature of the installation was that the customer had replaced the old ribbon feeder with coax, but had omitted to fit a balan. The technician immediately latched onto this point as a major cause of the trouble.

The customer duly passed this pronouncement along to his technical friend, who promptly dismissed the suggestions with one curt phrase. In greater detail he refused to accept that the tiny speaker in the portable set could have any great effect on the particular set—let alone the effect under discussion—or that the metal handrail could have any effect, either.

Similarly, he was not convinced about the aerial. Granted, the lack of a balan was technically wrong but, as had been pointed out to him by an engineer well versed in antenna design, a balan is a technical nicety rather than a necessity. The really important thing, in any system where the aerial is the generator, is for the load (ie, the set) to match the feedline impedance and present a balanced or unbalanced load as appropriate. A moderate mismatch between the aerial and the feedline is far less important.

Nevertheless, because there was no great effort involved, the customer removed the portable set and even dismantled the handrail. It goes without saying that neither action had any effect whatever. At the same time, more as an exercise than anything else, he rang a well known TV aerial manufacturer and put the problem to them. They went through the motions of asking him where he lived and then, presumably from a district map, proceeded to nominate the disposition of power lines and other landmarks in the vicinity.

Having done that they assured him that the aerial he was using was completely inadequate for his area and that nothing less than their model XYZ123 would be needed to solve his problem. They would be happy to install one for something over $60. In the light of subsequent events, this turned out to be a most revealing exercise.

In the meantime the customer's technical friend had discovered that he, "...knew a bloke what knew a bloke" in the TV company concerned and began stirring from the other end. As a result a second technician appeared on the doorstep.

He roundly denounced the findings of the first technician and set to work on the set itself. The only trouble was, he didn't seem to get very far either. After an hour or so of fiddling he announced that the set would have to go back to the company's service department, and that he would arrange to have it picked up. Which was just as well, because the customer's impression was that, not only had he not achieved anything but the colour balance was even worse than before.

The set was subsequently picked up and returned to the service department where it caused a great deal of head scratching before the trouble was pinpointed. Incidentally, I wonder how many readers have tried to guess what was wrong, from the symptoms so far. In fact, I had been brought up to date on the story at this stage and had nominated—correctly I am happy to say—at least the broad area involved.

I can only guess at some of the things that went on in the service department, based on what eventually emerged as the real culprit. But I must say I sympathise with them; fate played them a trick which I wouldn't even wish on someone I didn't like!

To find the problem the service department eventually had to back track into the production department; a quite separate entity. Here they learned—or confirmed—that a certain component (pardon me if I stretch the mystery out just a little longer) had been changed in the middle of a recent production run.

Apparently there had been a supply problem with this particular component

and one of a different type had had to be substituted. But to accommodate the new version associated circuitry had to be modified, so the new chassis were now suitable only for this type.

Most readers are probably way ahead of me by now in guessing that it was almost inevitable that one (at least) of the old units, which in theory had all been used, should suddenly turn up and be fitted to the modified chassis.

And I wonder if anyone can nominate the component at this stage?

Well, here's another clue. In any colour TV set the luminance(monochrome) and chrominance (colour) signals diverge into separate paths at the video detector and do not meet again until they reach the picture tube or a mixing network immediately prior to it.

The luminance signal is handled by the luminance amplifier which has a broad bandwidth to cope with the fine detail contained in the luminance signal. The chrominance signals are handled by chrominance amplifiers which have a restricted bandwidth appropriate to the relatively limited bandwidth of the chrominance signals.

This restricted bandwidth effectively delays the chrominance signal so that, if not allowed for, it will arrive later than the luminance signal with which it is expected to exactly coincide on the screen. In fact, being later, it would be displaced slightly to the right.

To compensate for this the luminance amplifier is fitted with a delay line (not to be confused with the PAL delay line) which retards the luminance signal by the same amount.

Now can you pick it?

Yes, the changed component was the luminance delay line. I have no way of knowing in exactly what respect(s) it differed from the original type, or what degree of error the difference(s) introduced. Suffice it to say that it was of a magnitude which attracted the attention of a non-technical viewer because he found it visually disturbing.

Incidentally, a delay error of this kind introduces a rather more subtle disturbance than simple lack of register between the two images. Wherever there is a transition between colours or between colour and a neutral tone, involving a change in luminance level, there will also be a change of colour until the chrominance signal catches up. Thus we get not only a displacement of colour but also, possibly, a change of colour.

Little wonder the viewer didn't like it!

Of course it all ended happily. The correct delay line was fitted, the colour balance restored, and the set returned to a now happy customer. But not a story of which the TV industry can be very proud; too many things went wrong.

It was not simply that the wrong delay line found its way into a chassis; that kind of mistake can—and does—happen on all production lines. It is not even the fact that the set was passed by the final test department, though this should not have happened.

The real criticism is in the manner in which the situation was handled from that point on. While the company made a creditable gesture with their follow up letter, this turned out to be an empty gesture in practice. The technician sent to investigate the problem certainly did not impress anyone, either technically or in the public relations sense.

While he cannot be blamed for not diagnosing the fault, he stands condemned for not realising—or admitting—that he was out of his depth and, worse, for nominating quite ridiculous reasons for the trouble.

The simple fact is that anyone charged with this job should not only be technically competent but should also have some public relations sense and ideally, also have the authority to make on-the-spot decisions.

For example, would it be too much to expect that, in a sticky situation like this, such a person could authorise a complete replacement chassis if necessary? This would wipe out the problem as far as the customer was concerned, while the company could then investigate the problem in private rather than in public.

Granted the second technician at least realised that he was out of his depth, and did the right thing as a result. But it must be remembered that he only appeared on the scene because someone was able to make an unofficial approach, on a personal basis, further up the line. It is interesting to speculate on what would have happened had no such approach been possible.

And the organisation which seems to have come out of it with the worst record is the aerial company. Once the basic problem in the set had been corrected all the troubles which they—and others—were so ready to blame on the aerial completely disappeared. In fact, the set delivered a first class picture.

One cannot avoid the suspicion that their supposed assessment of the situation, based on the location, was little more than a gimmick; that the answer would have been the same regardless of the location, or the aerial currently in use.

In view of these rather caustic comments my earlier statement that I sympathised with the service department may seem a little strange. It isn't really. I do sympathise with them; after all it wasn't their fault that things went wrong, but they were saddled with the job of finding a fault which was really outside their province.

To appreciate their difficulties it is necessary to understand the difference between field servicing—the kind we usually talk about—and what might be called production line servicing.

Having once earned my bread and dripping at the end of a production line, charged with the job of finding out why

(Continued on page 106)

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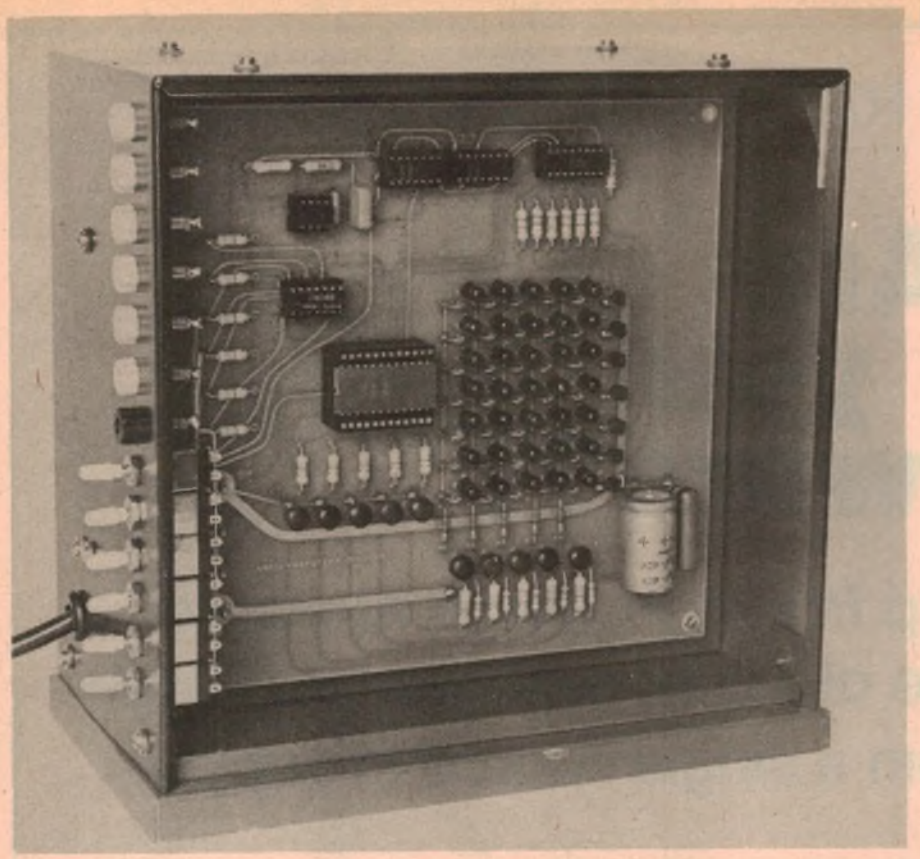


ASCII

At left is a view of the completed prototype, showing the general disposition of the various components. The circuit is shown on the facing page.

This project was developed and produced by staff of the School of Electrical Engineering at North Sydney Technical College, as an educational aid for use in the Electronics and Communications Certificate course.

article by GREG SWAIN

Here is a demonstration device designed to help teach both the fundamentals of the ASCII alphanumeric code, and the way characters are generated for display purposes. It can also be used as a single-character display for data communications experiments.

This ASCII character generator should find immediate appeal with technical institutions conducting data communications courses. In fact, as mentioned in the accompanying credit line, the unit was developed by staff at the School of Electrical Engineering, North Sydney Technical College, as a training aid for the subject "Data Communications", a Stage 4 elective of the Electronics and Communications Certificate.

At the college, students use the character generator to obtain familiarity with the ASCII code, in conjuction with ASR33 teletypes, modems and UART (universal asynchronous receiver transmitter) serial to parallel converters. The student is able to generate data on a keyboard, convert it to serial synchronous form, and then to a modem producing frequency shifted audio tones which are fed into a simulated telephone line. The data then flows via another modem and serial to parallel converter to the character generator, where it is displayed on a 7 x 5 LED matrix.

In the initial stages of student training though, the unit can be used without supporting equipment. On this basis, it can be used simply to demonstrate the fundamentals of ASCII code and character generation by feeding in data via 6 binary input switches. It would seem appropriate here to point out that the unit can only be used to demonstrate 6-bit ASCII, and not the more comprehensive 7-bit ASCII code.

The circuit of the character generator is quite straightforward. Six integrated circuits and 17 transistors are employed in all, together with 35 silicon diodes and the 35 LEDs that go to make up the display matrix. At the heart of the circuit is a Signetics 2513 ASCII character generator (CM2140).

Data input to the unit is by way of 6 banana sockets wired in parallel with the binary input switches, together with a 7th banana socket wired permanently to earth. When the switches are in the normally closed position (connected to earth), the data inputs to the 7404 hex inverter are held low (logical 0) and inputs 17-22 of the character generator will thus be high (logical 1).

Conversely, if the input switches are opened the data inputs to the hex inverter will be pulled high by the 3.3k pull-up resistors and data lows (0) will be applied to the inputs of the character generator.

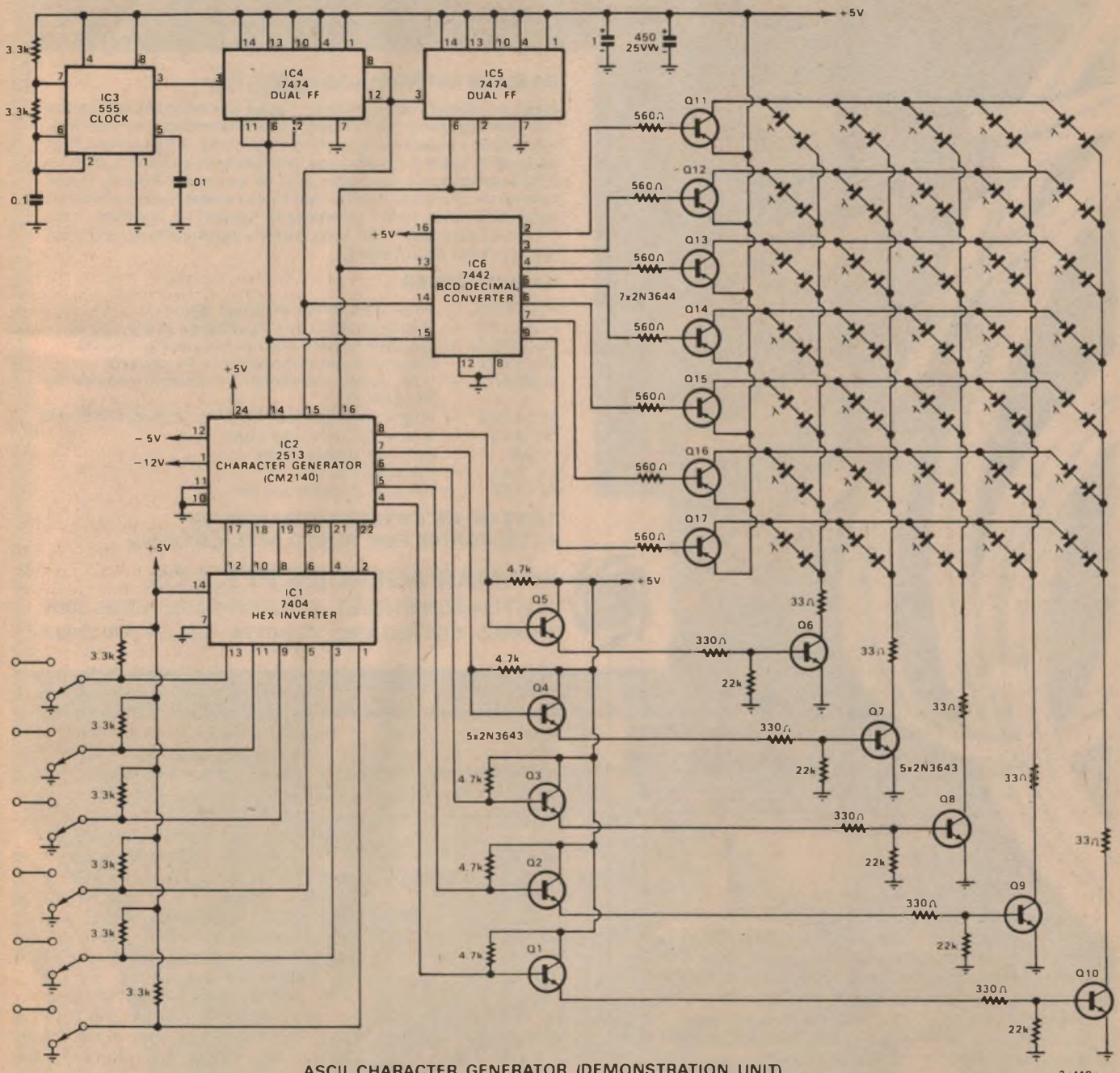
The multiplexing clock is formed by a 555 timer connected in the astable mode and set to oscillate at approximately 1kHz. This drives two 7474 dual D-type flipflops connected as a binary dividing chain. The outputs from the first three flipflops are used to form three row address lines, which are decoded by a 7442 BCD-to-decimal decoder to drive the 7 rows of the LED array via transistors Q11-Q17.

The three row address lines also drive inputs 14-16 of the character generator. This data, together with input data on pins 17-22, is used by the character generator to determine which of its outputs are activated to drive the columns of the character array.

The outputs (pins 4-8) of the character generator are buffered by current buffers Q1-Q5. These in turn control transistors Q6-Q10 which drive the columns of the array.

The power supply circuitry has been kept relatively straightforward, with the positive and negative supply rails derived from two separate 15V secondary windings of a Ferguson type PL30/20VA transformer. The positive side of the supply is simply a bridge rectifier and filter com-

Character Generator

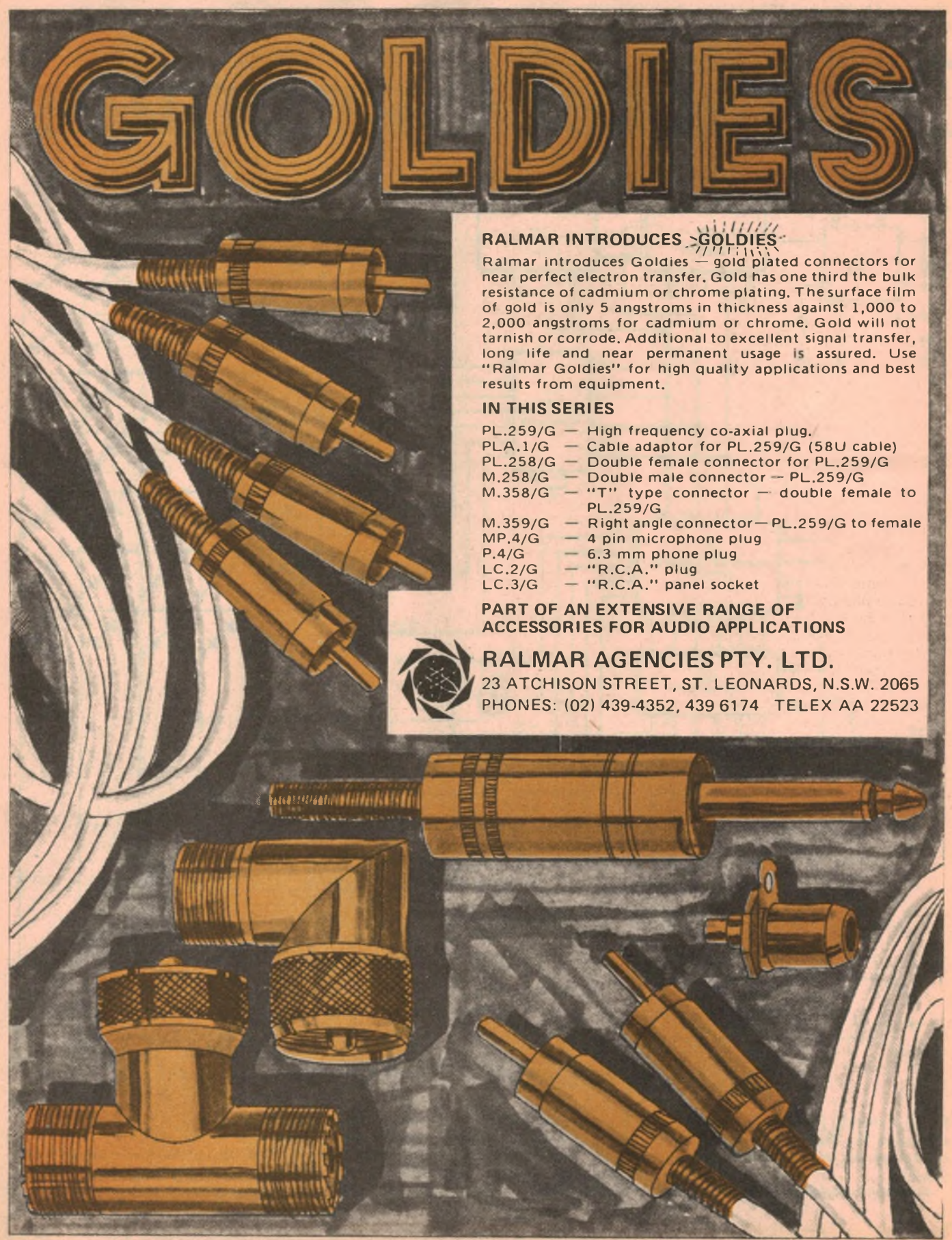


ASCII CHARACTER GENERATOR (DEMONSTRATION UNIT)

bination driving a three terminal 5V/1A regulator. The 1uF capacitor across the output of the regulator is to ensure stability.

Two zener stabilised supplies giving the required −12 and −5V outputs are employed for the negative side of the supply. The 220 ohm and 180 ohm resistors are for current limiting, while the two 1uF capacitors are included to ensure stability as before.

The method of construction of the prototype should be self-evident from the accompanying photographs. Most of the circuit components, including the



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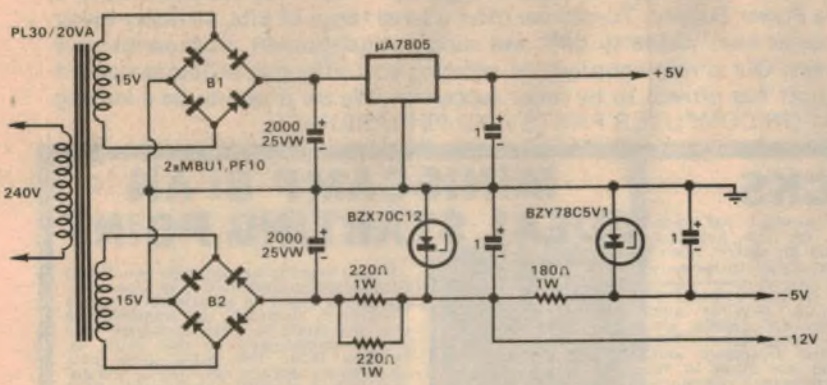
ASCII CHARACTER GENERATOR



The power supply circuit. All components, with the exception of the power transformer, are mounted on a specially designed PC board.

display LEDs, are mounted on one large double-sided PCB, the layout of which is indicated by the lead photograph. The position of each IC is indicated by its type number, etched onto the board as part of the copper pattern. The power supply rails are indicated in a similar manner.

A separate, smaller PCB carries the power supply components. The layout of components on the board may be seen from the photograph. Note the heatsink fitted to the +5V regulator IC.

Because of the specialised nature of this project, and for space reasons, we are not publishing the PCB patterns or the component overlay patterns. It should not be too hard for the individual to place the components on both boards by following the circuit diagram and the photographs.

We are making the PCB patterns available to the various board manufacturers though, and PCBs should be available by the time this article appears in print. PCB patterns will also be available from the Information Service for those readers who normally make their own boards. However, readers who plan to do this should be warned that the double-sided pattern on the main board may present some difficulties.

A metalwork diagram has not been prepared for this project, as we imagine many builders will want to design their own case.

The prototype is housed in an inverted U-shaped aluminium case which is fastened to a baseplate. The front and back panels are of clear plastic. Case dimensions are 220 x 210 x 115mm (W x H x D).

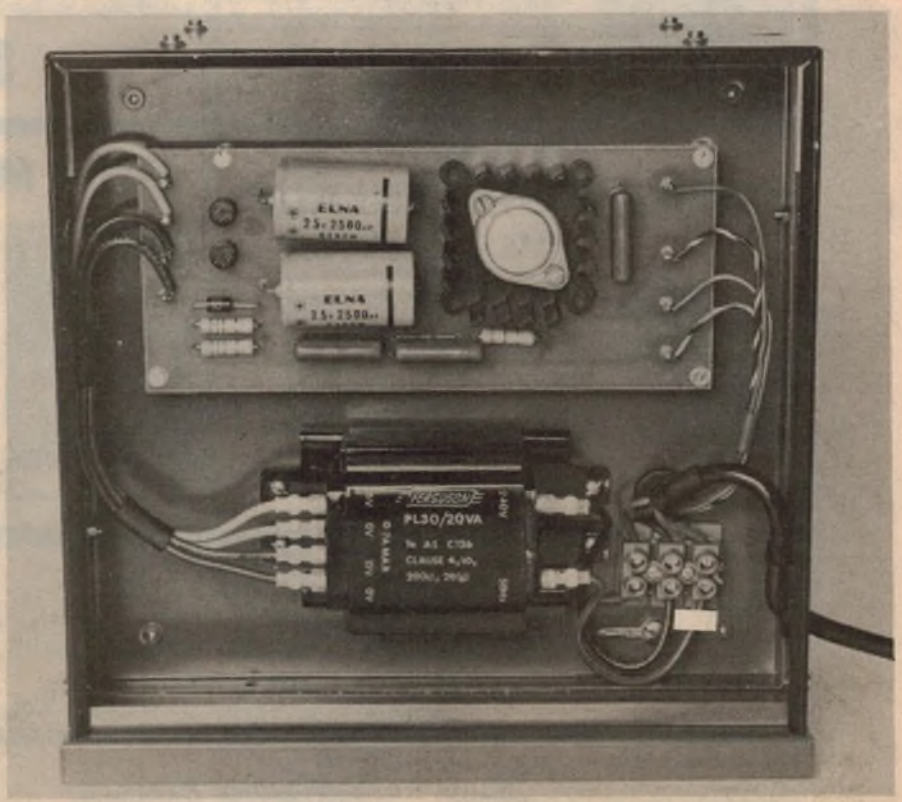
Mounted down the front left-side of the case are the 7 input sockets, together with the 6 binary input switches. Take care when wiring between the board and the input sockets and switches—inputs 1 and 3 on the board (counting from top to bottom) are transposed with respect to the switch/socket order.

The two PCBs are mounted on either side of an internal dividing panel located approx. 70mm behind the front panel. The power transformer also mounts on the rear of the dividing panel and is bolted directly to it below the power supply board, together with a 3-way mains terminal block. Wiring between the two boards is run via a grommeted hole located just above the terminal block.

The mains cord enters through a grommet on the side panel adjacent to the terminal block, and should be securely clamped on entry.

Testing of the unit simply consists of switching it on, feeding in various 6-bit codes via the input switches, and checking to see that the appropriate characters are displayed. If all is well, the unit can be hooked up to an ASCII keyboard, or some other external input device, for further testing.

Finally, we wish to point out that the School of Electrical Engineering, North Sydney Technical College, is not in a position to answer reader questions regarding the ASCII Character Generator. Reader enquiries should instead be directed to "Electronics Australia" through our Information Service, and in accordance with the Information Service rules published each month in the back of the magazine.



View at right shows the general layout of power supply components on the rear of the dividing panel.

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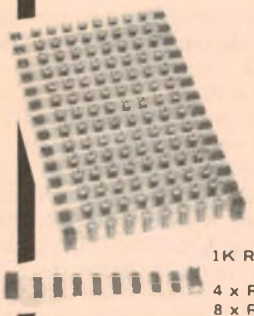

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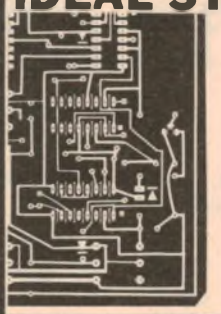

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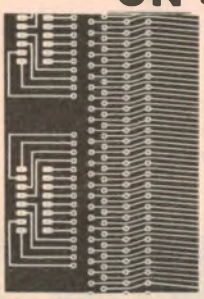

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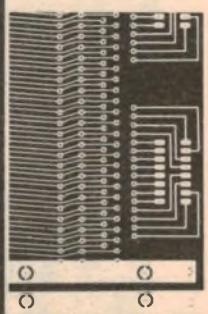

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An Introduction to Digital Electronics—18

ROMs & PROMs

Continuing the discussion of memory devices, this chapter looks at semiconductor memories which are used for permanent or semi-permanent "read-only" storage. It describes the three main types of device in present use: mask programmed ROMs, fusible-link programmable ROMs (PROMs), and reprogrammable PROMs of the electrical and ultra-violet erasable type.

by JAMIESON ROWE

In contrast with RAM devices, which allow information to be written into and read from them with equal ease, ROM devices are designed primarily for read-only operation. They are thus suitable for use in applications where information must be stored permanently and used or referred to from time to time, and also for applications where information must be stored semi-permanently.

An important application of ROM devices is for program storage in microcomputer controllers, where the microcomputer is "dedicated"—i.e., intended to perform the same set or sequence of tasks for a very long period. By having the sequence of instructions which make up the microcomputer's program stored permanently in a ROM, they are immediately accessible whenever required, and do not have to be fed in each time the controller is required to operate.

ROM memory devices also have a place in many general-purpose computer systems, because such systems tend to have many utility programs which are frequently and repetitively used—like loaders, text editors, assemblers, compilers, interpreters and so on. By having these programs stored in ROMs as "firmware", they can be called instantly whenever they are required, obviating the need to load in each time from paper tape, magnetic tape or disc.

There is increasing use of ROMs also within the actual processor or "CPU" section of computers, to store the processor's microprogram algorithms. These are the sequences of internal sub-operations which are used to carry out each of the various instructions in the processor's repertoire. By having a processor micro-programmed with its algorithms stored in a ROM, it becomes possible to change the instruction set relatively easily, for different applications.

ROMs also tend to be used quite widely in both computers and other digital systems for the storage of permanent or semi-permanent reference data—such as logarithm tables, tables of complex mathematical functions and code-conversion tables. The last of these areas is very broad, covering a variety of things from conversion between communication codes (e.g., Baudot or Murray code to ASCII code and vice-versa), to generation of alphanumeric character scanning-row patterns from ASCII code inputs, as required for a video display terminal or line printer.

Yet another application of ROM devices is in programmable logic arrays, as we saw in an earlier chapter, to effectively synthesise complex logic functions. Here the information stored in the ROM is equivalent to the truth table of the complex logic function concerned.

In short, then, ROMs form an important group of semiconductor memory devices, which tend to be found in many digital systems. A knowledge of the various types of ROM and their operation is thus very worthwhile for anyone working with, or seeking to work with such systems.

Broadly speaking, there are three main types of ROM device in current use. One is the mask-programmed ROM, in which the stored information is effectively written in during manufacture. Then there is the fusible-link programmable ROM or "PROM", which is programmed permanently by the user. And finally there is the erasable PROM or "EPROM", which not only may be programmed by the user, but erased and reprogrammed many times.

Mask-programmed ROMs are so named because the information they contain is effectively stored in them during manufacture, from one of the photolithographic masks used in the fabrication process.

There are various types of mask-programmed ROM, which can be made using either bipolar or MOS technology. The former tend to be faster in operation, but also more expensive due to the larger number of fabrication steps involved in bipolar technology.

A mask-programmed ROM using MOS technology is illustrated in Fig. 1. Here the individual memory cells in the storage array are single enhancement-mode N-channel MOS transistors, with the P-type drain and source regions formed by diffusion. The diffusion regions are actually in the form of long strips, which also form the bit sense and earth lines for whole columns of cells in the array.

As with normal MOS transistors, the gates consist of a thin layer of aluminium vacuum deposited on the top of the silicon dioxide passivation. However, in this case the metallisation is in the form of thin strips running across the array, so that they also form the X-address row select lines.

The actual information is "stored" in the MOS transistor cells by controlling the thickness of the silicon dioxide passivation above the channel of each transistor, as shown. To effectively store a zero (0), the passivation is left at its full thickness. This makes the gate almost ineffective in inducing conduction in the transistor's

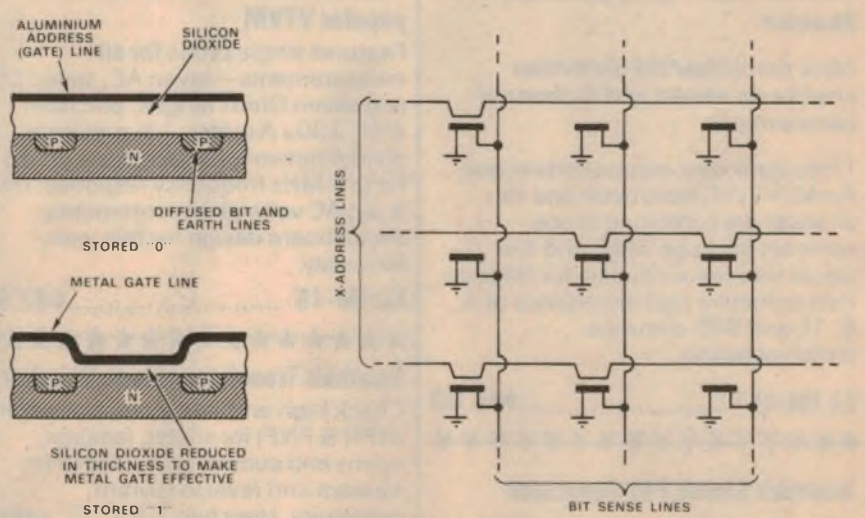

FIG. 1. MASK-PROGRAMMED ROM

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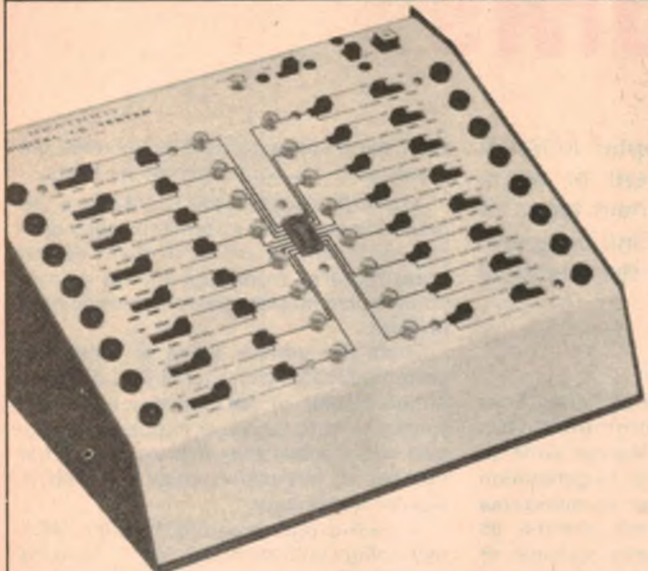

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channel, because of the separation between the two.

To effectively store a one (1), the passivation is etched to a reduced thickness above the channel. This allows the gate to become effective in inducing channel conduction, when the gate line is taken to the high logic level.

All of the cells in the ROM are programmed at the same time during device fabrication, by means of a photolithographic mask which controls etching of the passivation layer. Wherever cells are to be programmed with a "1", the mask has a tiny rectangular hole; thus the etching only takes place in those locations, leaving all other cells with full thickness passivation.

Mask-programmed ROMs made using bipolar technology generally have cells consisting of single NPN transistors, connected as potential emitter-followers. The bases of each row of transistors in the array are driven from the X-address lines, while the collectors are all connected to the positive supply rail.

The emitters of the transistors in each column of the array are potentially capable of being connected to Y-axis bit sense lines, formed by metallisation deposited on the silicon dioxide passivation. The ROM is programmed by using a custom mask to determine which of the emitters in each column have holes etched in the passivation above them, to allow the metal bit sense line to make contact with them.

In other words, the emitter of the transistor in each cell is only connected to the bit sense line for its column if that cell is to effectively store a 1. But if the cell is to store a 0, the emitter is simply left unconnected.

A ROM of this type is typically organised as shown in Fig. 2. As you can see, it is very similar to that of a RAM as given in the last chapter. The main differences are that there is no read / write control line, and the data pins are purely outputs.

Note that Fig. 2 shows a 1024-bit ROM, whose internal array is actually organised as 32 rows by 32 columns. The external organisation is different, however, being 128 x 8—i.e., the ROM is arranged so that it effectively stores 128 bytes each of 8 bits. There are thus seven address bit inputs, to define the 128 nominal memory addresses. Five of the address lines are decoded to produce the 32 X-address or row select lines for the array, while the other two address bits are decoded to select one of four 8-bit groups of column sense lines.

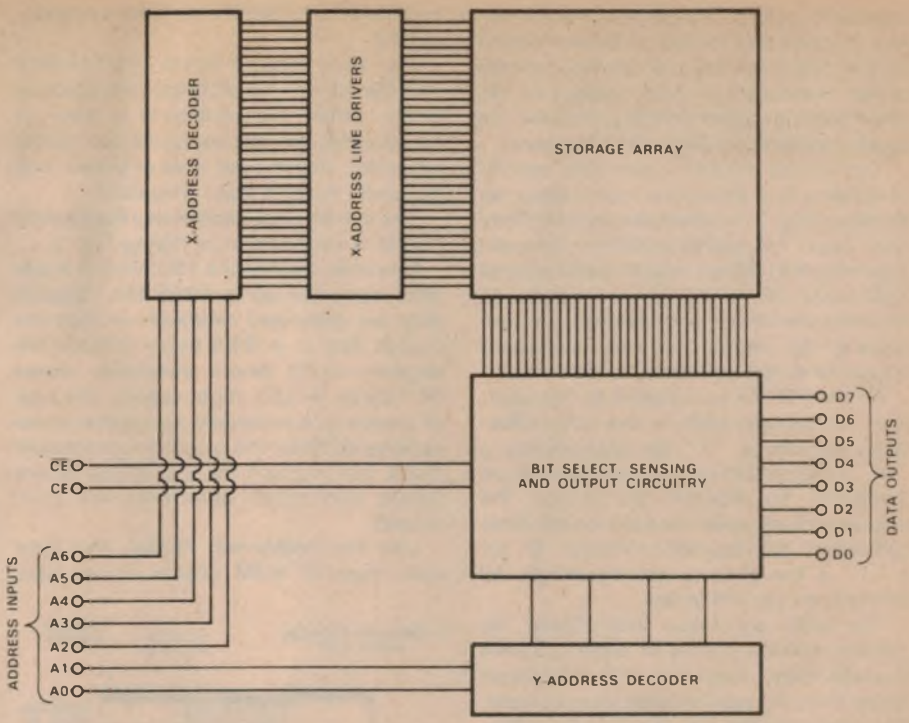

FIG. 2 : 1024-BIT ROM WITH TYPICAL ORGANISATION

Mask-programmed ROMs of the type we have been considering thus far can be made to store quite large amounts of information. At the time of writing, at least one manufacturer is marketing an N-channel MOS device with a capacity of 32768 bits (or "32k"), organised externally as 4096 bytes. It is likely that devices with double or quadruple this capacity will be available before 1980.

Like all of the photolithographic masks used to fabricate an integrated circuit, the mask used to program this type of ROM involves a very high degree of precision. This together with the setting-up required for the various steps in IC fabrication tends to make it uneconomical to produce mask-programmed ROMs in small quantities. But when a large number of identical ROMs are required, this type of ROM is generally far lower in cost than the other types we will consider shortly.

In short, the mask-programmed ROM is not very suitable for applications requiring a single custom-programmed ROM, or even those requiring a small number of identically programmed devices. And being permanently programmed, it is not really suitable for applications where the stored data must be changed from time to time. But where a large number of ROMs must be identically programmed on a permanent basis, this type of ROM turns out to be the most suitable and the lowest in unit cost.

In contrast with the way the mask-programmed ROM is programmed by the IC manufacturer during its fabrication, the two remaining types of ROM are programmable by the user. They are thus known as field-programmable ROMs or "PROMs". As you might imagine, the fact that they are user programmable makes PROM devices more suitable for applications requiring single or small quantities of custom-programmed ROMs.

Perhaps the simplest type of PROM to understand is the fusible-link device. As the name suggests, this is programmed by passing short pulses of relatively high current through small resistive links, so that they "fuse" or break. Generally fusible-link PROMs are made using bipolar technology, because bipolar devices are more suitable than MOS devices where high currents are involved.

The operation of a typical fusible-link PROM is illustrated in Fig. 3. As you can see, the cells in the storage array consist of single NPN transistors, connected as

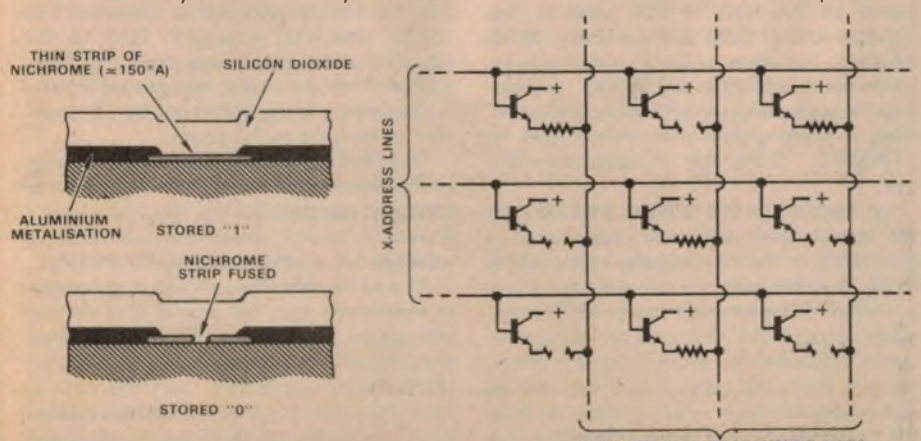

FIG. 3 : FUSIBLE-LINK PROM

emitter followers. The bases of the transistors in each row of the array are driven by the X-address lines, while the emitters of the transistors in each column of the array are connected (initially, at least) via small resistors to Y-axis bit sense lines.

The emitter resistors generally consist of either a thin film of nichrome alloy, as shown in Fig. 3, or alternatively a similarly thin layer of polycrystalline silicon. Typically they have a resistance of around 150 ohms. When the device is made, all resistors are intact and effective in connecting the emitter of their associated transistor to the correct bit sense line.

As the PROM is supplied to the user, then, all storage cells in the array effectively contain a "1" (or alternatively a "0", if the output circuitry contains logic inverters). To program the device, the user must fuse open the links on all those cells which are required to store a "0" (or a "1" if the outputs are inverting). All others links are left intact.

The links are fused individually, by passing current pulses of around 30mA through them. This current level is much larger than the normal operating current. The pulses are fed into the links by activating special current driver transistors connected to the Y-axis bit sense lines, within the PROM. These transistors are held cut off by the normal operating voltages within the PROM, and have no effect on normal bit line sensing.

To fuse a particular link, the normal address code for its byte is first applied to the PROM's address inputs. This activates the X-address row select line driving the base of the link's transistor, and also connects the link's Y-axis bit sense line to the corresponding data bit output of the PROM, via the sensing and programming circuitry. Then a programming pulse is forced into the data bit output, using it as an input.

The programming pulse is not positive-going, but negative-going. In fact it takes the data bit output negative with respect to the normal negative supply rail, by about 6 volts. This has the effect of disabling the normal sensing circuitry, and at the same time enabling a normally inactive current driver transistor. This transistor accordingly conducts, pulling the bit sense line negative by about 4.5 volts and thus forcing a current of about 30mA through the link until it fuses.

The procedure is fairly straightforward, and does not call for complex or elaborate equipment. A fusible-link PROM can in fact be programmed with a very simple manual programmer, with toggle switches to select device addresses and data bits, a press-button to apply programming pulses, and positive and negative power supplies. However, to program a large PROM in this way can be rather tedious and time consuming.

The other main drawback of manually programming a fusible-link PROM is that the programming is permanent, so that mistakes can't be undone. If you fuse the wrong link by mistake, it can't be rejoined, and the entire PROM may have to be discarded.

For this reason most fusible-link PROMs tend to be programmed automatically, under the control of a mini- or microcomputer. The computer can do the job faster, doesn't get tired or bored, and generally doesn't make mistakes!

The overall organisation of a fusible-link PROM is very similar to that of Fig. 2.

Currently fusible-link PROMs are made with capacities up to 4096 bits. Usually they are organised externally so that the output data is in 8-bit bytes, so that the largest current device effectively stores 512 bytes. As you might expect, this type of device is intrinsically somewhat more expensive than the mask-programmed ROM, but is much more practical where single and small quantities are concerned.

Like the fusible-link PROM, the third main type of ROM device is also user programmable. But in contrast with both the fusible-link PROM and mask-programmed ROM, this third type is not confined to permanent programming. Its stored information can in fact be erased, and new information stored in its place. Hence the name erasable-PROM or "EPROM".

There are two different types of EPROM device in current use, the two differing in terms of the type of cell used in the storage array. Both are basically MOS devices, but one uses a metal-nitride-oxide-semiconductor or "MNOS" transistors in each memory cell, while the other uses a floating-gate avalanche-mode or "FAMOS" transistor in each memory cell.

We looked at the MNOS transistor in the last chapter, you may recall, as it is also used in the non-volatile static MOS RAM. It is basically not too different from a normal enhancement-mode MOS transistor, except that there are two dielectric layers between the semiconductor channel and the metal gate. One is the normal silicon dioxide layer, etched down to only 20 Angstroms or so, while the other is a much thicker layer of silicon nitride grown above the dioxide layer, after etching.

Where the two layers meet, crystalline defects known as "traps" are formed. These are capable of capturing charged carriers, and when trapped such charges tend to act like a second gate, controlling the effect of the main gate upon the transistor's channel conduction.

Fig. 4 (a) shows how such an MNOS transistor is used as an EPROM cell, to store either a "1" or a "0". The metal gate is formed by the X-address line, while the source and drain diffusions form Y-axis earth and bit sense lines respectively.

To erase the cell so that it stores a 0, the metal gate line is pulsed positively when the transistor is selected. This causes electrons to be attracted upward from the silicon substrate; they tunnel through the thin dioxide layer, and are captured by the traps. This leaves the traps filled, and substantially uncharged.

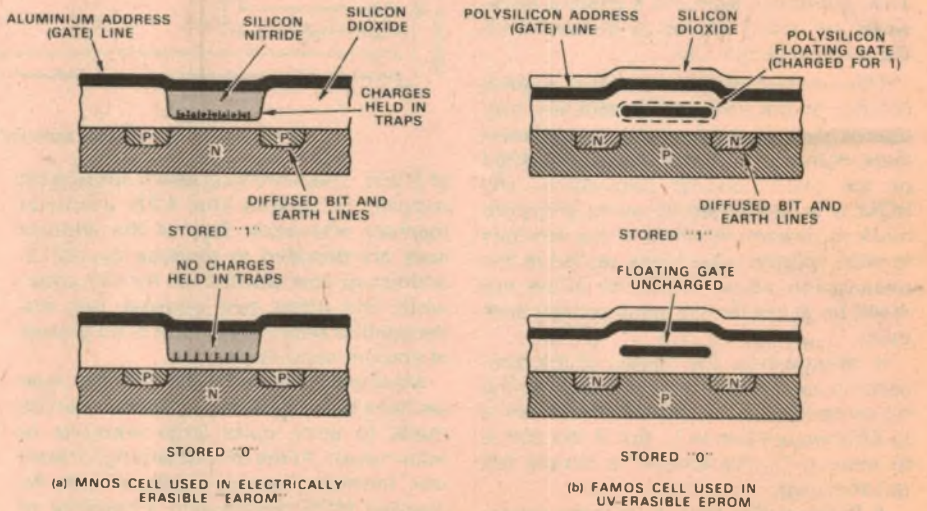

FIG 4 TYPES OF ERASIBLE PROM CELL

In this state they have little effect upon channel conduction, and when the transistor is selected for normal readout its channel remains cut off.

To store a 1 in a cell, the gate line is pulsed negative by about 25-30V when the transistor is selected. This causes electrons to be repelled from the traps in the nitride-dioxide interface, and they tunnel into the silicon substrate to leave the trap region positively charged. Due to the excellent insulating properties of the dioxide and nitride layers, this stored charge is captured almost permanently—in practice for as long as 10 years.

The effect of the stored positive charge in the traps is to assist the metal gate to produce conduction in the transistor's channel, so that when the transistor is selected for normal readout, it conducts.

As you can see, the process is reversible in that a cell may be erased and written into again, if required. And the erasure may be performed electrically, although it takes somewhat longer than the writing time: typically 10 milliseconds compared with 1 millisecond. Both are much longer than the normal read time, which is typi-

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cally less than 1 microsecond.

Because of its ability to be electrically erased as well as programmed, the MNOS-cell EPROM is sometimes called the electrically-alterable ROM or "EAROM".

The second type of EPROM cell is illustrated in Fig.4 (b). Here the cell is again based on an enhancement-mode MOS transistor, but in this case there is a second polysilicon gate between the main X-address line select gate and the silicon channel. The second gate is "floating"—that is, there is no connection to it.

As with the MNOS cell, stored charge on this second gate is used to control the transistor's channel conduction. But the floating gate is charged in a different way—by inducing a controlled avalanche breakdown across the drain-channel junction, at the surface of the silicon. High-energy electrons from the avalanche breakdown are then injected into the floating gate, charging it negatively.

The avalanche breakdown of the drain-channel junction is produced by applying a high-voltage reverse bias pulse—typically around 28V, or as high as 50V with some devices. As this voltage is much higher than the normal PROM operating voltages, there is virtually no loss of stored charge from the floating gate during normal reading. The life of the stored information is thus almost indefinite—typically tens of years.

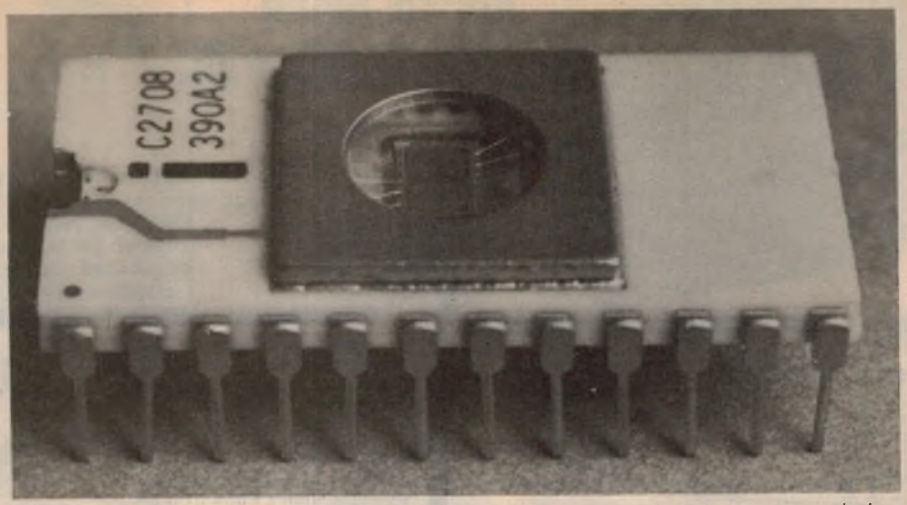
This floating-gate avalanche-mode MOS or "FAMOS" transistor was developed at the US Intel Corporation in 1971, by Dov Frohman-Bentchkowsky.

Unlike the MNOS cell, the FAMOS cell is not easy to erase electrically. The oxide layer between the floating gate and the silicon substrate is relatively thick (around 1000 Angstroms), so that the electrons trapped on the gate must be raised to a high energy level before they can escape.

Because of this the normal method of erasing an EPROM which uses FAMOS cells is to expose it to intense ultra-violet radiation. The high-energy photons impart the necessary energy to the trapped electrons, allowing them to escape to the substrate and leave the floating gate discharged. The radiation required has a wavelength of around 2537 Angstroms, and the exposure required for full erasure is about 10 watt-seconds per square centimetre.

To allow this to be done, EPROMs using FAMOS cells are fitted with a transparent quartz window immediately above the silicon chip. The device is erased by placing the window about 30mm from an ultra-violet lamp, for about 15-20 minutes. Needless to say, all cells in the device are erased simultaneously. This is in contrast with EPROMs using MNOS cells, which can be erased in individual array rows.

EPROMS which use FAMOS cells are often called UV-erasable PROMs or "UV-EPROMs", the "UV" standing for ultra-violet.



EPROM devices which use FAMOS transistor cells are fitted with a quartz window above the IC chip, to allow erasure by ultraviolet irradiation. This is an Intel 2708, with a capacity of 1024 8-bit words.

Fig. 5 shows the way both MNOS and FAMOS cells are typically connected in an EPROM storage array. As you can see the X-address lines are used to form the gate select line for array rows, while the diffused drain lines become the Y-axis bit sense lines. The overall organisation of an EPROM is basically the same as in Fig. 2.

At the time of writing, EPROMs using MNOS cells are being made with capacities of up to 4096 bits. Devices using FAMOS cells are available with somewhat larger capacity, up to 16384 bits (organised externally as 2048 8-bit bytes). Larger devices of both types are predicted before long.

Because of their ability to be programmed and reprogrammed by the user, EPROMS are particularly suited for applications requiring single custom ROMs or small quantities. They are also well suited for development work, where the final contents of a ROM may have to be arrived at by trial and error. An example is program storage for a microcomputer controller, where the program may need to be modified and/or expanded during development.

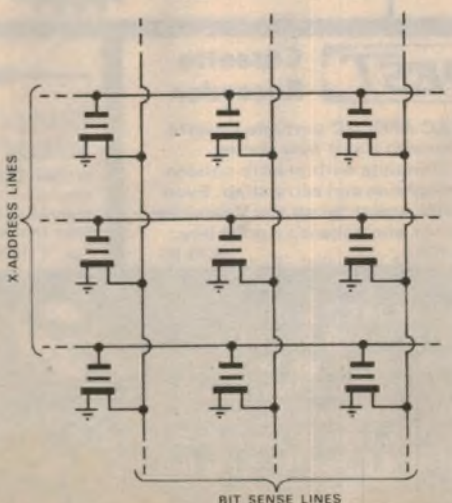


FIG. 5 : ARRAY OF MNOS OR FAMOS CELLS

Once development is complete, the program or data which has been stored in the EPROM can be used to make mask-programmed ROMs if the application is one involving large quantities. This is economically desirable, as EPROMs have a somewhat higher unit cost than mask-programmed devices.

In fact to make it easy to use EPROMs for development and then change over to mask-programmed devices in production, many manufacturers make pin-for-pin equivalent devices of the same capacity, in both types. For example Intel Corporation currently makes a 16384-bit UV erasable EPROM, the 2716, and a pin-compatible mask-programmed device, the 2316E. Similarly National Semiconductor makes a 4096-bit UV erasable EPROM, the MM5204, and a pin compatible mask-programmed device, the MM5214.

Before we leave the subject of ROMs, PROMs, and EPROMS, it might be worthwhile to look briefly at the way a number of devices may be used together in the same system, to provide mores storage capacity than is available from a single device.

Basically, this is done by taking advantage of the "chip select" input involved provided on most of these devices. Two such inputs are shown in Fig. 2, for example, one effective when taken to the high logic level (CE), and the other when taken to the low logic level (CE-bar).

Like RAMs, most ROMs and PROMs are provided with at least one such input, of either type. Some have as many as four, of which some may be active-high and others active-low.

Where a ROM or PROM is provided with more than one chip enable input, they generally act together according to a logical AND function. In other words, all inputs must be taken to their active logic level, whether high or low as the case may be, before the ROM's output circuits are enabled. This can be used to simplify the decoding logic required to

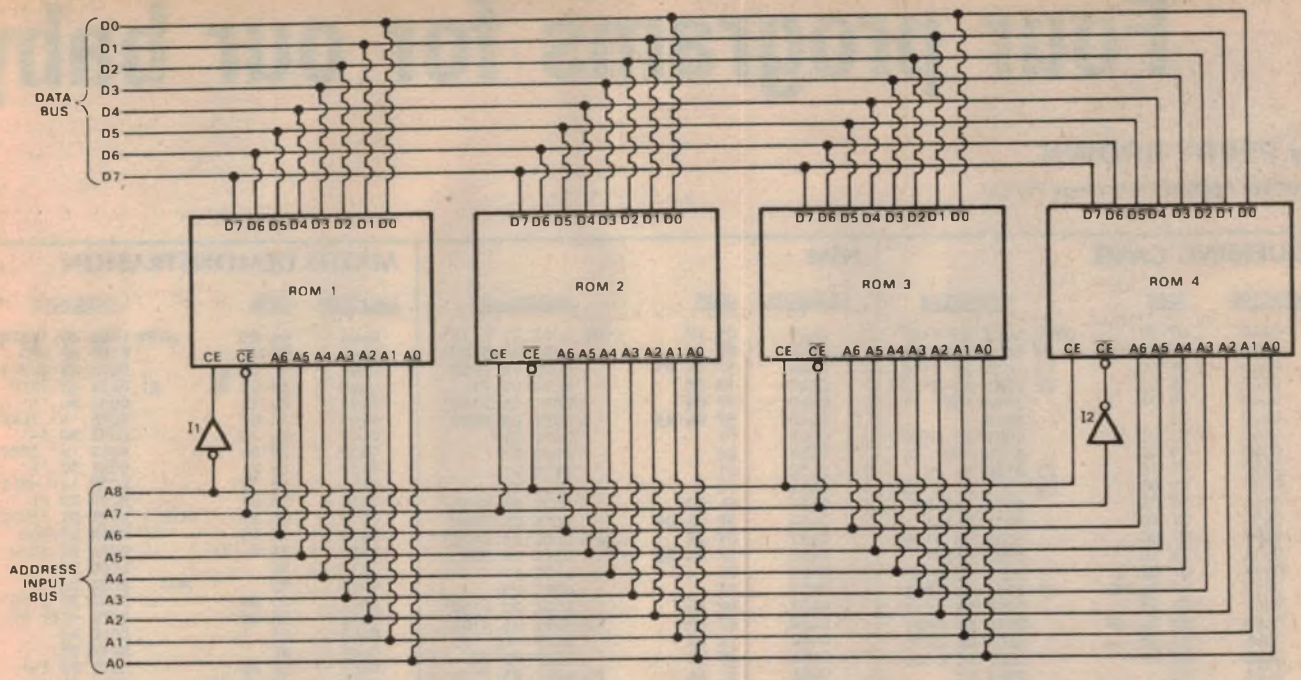


FIG. 6 USING CE AND $\overline{CE}$ INPUTS FOR MULTIPLE DEVICE DECODING

select different devices, when a number are connected into a system.

Fig. 6 shows how this is done. It shows how four of the 128 x 8 ROMs of Fig. 2 may be connected into a system, to form what is effectively a single 512 x 8 or 512-byte ROM.

As you can see, the corresponding data outputs of the individual ROMs are connected together, to form eight common data bus lines (D0-D7). Similarly the seven address inputs of the ROMs are also connected together, forming common address bus lines (A0-A6). Two further address lines A7 and A8 are added to these, to form the total of nine address lines necessary to define 512 effective memory addresses.

The two additional address lines must be effectively decoded in order to select which one of the four devices operates at any particular time. But because each ROM has both a CE and CE-bar input, the actual devices themselves perform most of the decoding internally. All that is required externally is two simple inverters, I1 and I2.

Hence by taking advantage of the two chip enable inputs on each ROM, we can arrange for ROM 1 to operate whenever A7 and A8 are both low, ROM 2 to operate when A7 is high and A8 low, ROM 3 to operate when A7 is low and A8 high, and ROM 4 to operate when A7 and A8 are both high.

ROM 1 therefore effectively provides the binary addresses from 000000000 to 001111111 (or in equivalent hexadecimal, 000 to 07F), ROM 2 the binary addresses from 010000000 to 011111111 (hex 080 to 0FF), ROM 3 the binary addresses from 100000000 to 101111111 (hex 100 to 17F), and ROM 4 the binary addresses from 110000000 to 111111111 (hex 180 to 1FF).

Incidentally, note that the technique used here is basically one of multiplexing. The ROMs are sharing a common set of data bus lines and lower address bus lines, but are effectively multiplexed onto them by means of the chip enable selection performed by the high-order address lines.

The same technique may be used with RAM devices, by the way, and also with a mixture of RAMs, ROMs and other devices fitted with chip enable facilities. We will discuss this further in later chapters.

Four programs for our baby

by PERRY BROWN

Courtesy Applied Technology Pty Ltd

GUESSING GAME

```
LOCATION  CODE          MNEMONICS
0440      07 07     STRT LODI R3 H'07'
0442      3F 04 B6    FZ BSTA UN PRNT
0445      05 00       F1 LODI R1 H'00'
0447      E5 63       F2 COMI R1 H'63'
0449      19 7A          BCTR 'GT' F1
044B      12             SPSU
044C      E4 00          COMI R0 H'00'
044E      19 02          BCTR 'GT' F4
0450      D9 75       F3 BIRR R1 F2
0452      E5 00       F4 COMI R1 H'00'
0454      18 7A          BCTR '=' F3
0456      77 10          PPSL H'10'
0458      07 00          LODI R3 H'00'
045A      75 10          CPSL H'10'
045C      07 36          LODI R3 H'36'
045E      3F 04 B6    F5 BSTA UN PRNT
0461      07 1F          LODI R3 H'1F'
0463      3F 04 B6       BSTA UN PRNT
0466      3B 3B          BSTR UN INPT
0468      07 09          LODI R3 H'09'
046A      C2             STRZ R2
046B      82          F6 ADDZ R2
046C      FB 7D          BDRR R3 F6
046E      C2             STRZ R2
046F      3B 32          BSTR UN INPT
0461      82             ADDZ R2
0462      77 10          PPSL H'10'
0464      87 01          ADDI R3 H'01'
0466      75 10          CPSL H'10'
0468      07 10          LODI R3 H'10'
046A      E1             COMZ R1
046B      19 61          BCTR 'GT' F5
046D      07 18          LODI R3 H'18'
046F      E1             COMZ R1
0470      1A 5C          BCTR 'LT' F5
0472      07 28          LODI R3 H'28'
0474      3B 30          BSTR UN PRNT
0476      77 10          PPSL H'10'
0478      05 30          LODI R1 H'30'
047A      A7 0A       F7 SUBI R3 H'0A'
047C      E7 00          COMI R3 H'00'
047E      1A 02          BCTR 'LT' F8
0480      D9 78          BIRR R1 F7
0482      87 3A       F8 ADDI R3 H'3A'
0484      01             LODZ R1
0485      3F 02 B4       BSTA UN COUT
0488      77 10          PPSU H'10'
048A      03             LODZ R3
048B      3F 02 B4       BSTA UN COUT
048E      07 02          LODI R3 H'02'
0490      1F 04 42       BCTA UN FZ
0493      3F 02 86  INPT BSTA UN CHIN
0496      E4 30          COMI R0 H'30'
0498      1A 79          BCTR 'LT' INPT
049A      E4 39          COMI R0 H'39'
049C      19 75          BCTR 'GT' INPT
049E      C3             STRZ R3
049F      3F 02 B4       BSTA UN COUT
04A2      03             LODZ R3
04A3      44 0F          ANDI R0 H'0F'
04A5      17             RET UN
04A6      0F 24 BF  PRNT LODA+R2 MSAG
04A9      E4 00          COMI R0 H'00'
04AB      14             RETC '='
04AC      3F 02 B4       BSTA UN COUT
04AF      1B 75          BCTR UN PRNT
04B1      00 20 54  MSAG "NUL SP T
04B4      52 59 53 0D     R Y S CR
04B8      0A 52 45 41     LF R E A
04BC      44 59 3F 00     D Y ? NUL
04C0      0D 0A 48 49     CR LF H I
04C4      47 48 21 00     G H ! NUL
04C8      0D 0A 4C 4F     CR LF L O
04CC      57 21 00 0D     W ! NUL CR
04D0      0A 47 55 45     LF G U E
04D4      53 53 2D 00     S S - NUL
04D8      0D 0A 59 45     CR LF Y E
04DC      53 21 20 41     S ! SP A
04E0      46 54 45 52     F T E R
04E4      20 00 0D 0A     SP NUL CR LF
04E8      4F 4B 20 31     O K SP 1
04EC      2D 39 39 00     - 9 9 NUL
```

When called, the program will wait until you enter any character. It will then generate a random number between 1 and 99, which you must guess. Starting address is 0440.

NIM

```
LOCATION  CODE          MNEMONICS
0440      05 17     STRT LODI R1 H'17'
0442      07 29          LODI R3 H'29'
0444      3F 04 B3       BSTA UN PRNT
0447      1B 0E          BCTR UN F1
0449      07 09          LODI R3 H'09'
044B      3F 04 B3       BSTA UN PRNT
044E      01             LODZ R1
044F      A2             SUBZ R2
0450      C1             STRZ R1
0451      02             LODZ R2
0452      64 30          IORI R0 H'30'
0454      3F 02 B4       BSTA UN COUT
0457      07 1E       F1 LODI R3 H'1E'
0459      3F 04 B3       BSTA UN PRNT
045C      01             LODZ R1
045D      C3             STRZ R3
045E      04 30          LODI R0 H'30'
0460      A7 0A       F2 SUBI R3 H'0A'
0462      1A 02          BCTR 'LT' F3
0464      B6 7A          BIRR R0 F2
0466      87 3A       F3 ADDI R3 H'3A'
0468      3F 02 B4       BSTA UN COUT
046B      03             LODZ R3
046C      3F 02 B4       BSTA UN COUT
046F      E5 01          COMI R1 H'01'
0471      19 07          BCTR 'GT' F4
0473      07 00          LODI R3 H'00'
0475      3B 3C          BSTR UN PRNT
0477      1F 04 40       BCTA UN STRT
047A      07 16       F4 LODI R3 H'16'
047C      3B 35          BSTR UN PRNT
047E      3F 02 86    F5 BSTA UN CHIN
0481      E4 31          COMI R0 H'31'
0483      1A 79          BCTR 'LT' F5
0485      E4 33          COMI R0 H'33'
0487      19 75          BCTR 'GT' F5
0489      C3             STRZ R3
048A      47 0F          ANDI R3 H'0F'
048C      3F 02 B4       BSTA UN COUT
048F      01             LODZ R1
0490      A3             SUBZ R3
0491      C1             STRZ R1
0492      E5 01          COMI R1 H'01'
0494      19 07          BCTR 'GT' F6
0496      07 3B          LODI R3 H'3B'
0498      3B 19          BSTR UN PRNT
049A      1F 04 40    F6 BCTA UN STRT
049D      A4 05          SUBI R0 H'05'
049F      1A 0E          BCTR 'LT' F7
04A1      A4 03       F8 SUBI R0 H'03'
04A3      19 7C          BCTR 'GT' F8
04A5      84 03          ADDI R0 H'03'
04A7      C2          FA STRZ R2
04A8      98 02          BCFR '=' F9
04AA      86 01          ADDI R2 H'01'
04AC      1F 04 49    F9 BCTA UN FA
04AF      84 04       F8 ADDI R0 H'04'
04B1      1B 74          BCTR UN FA
04B3      0F 24 BA  PRNT LODA+R3 MSGE
04B6      14             RETC '='
04B7      3F 02 B4       BSTA UN COUT
04BA      1B 77          BCTR UN PRNT
04BC      0D 0A 49  MSGE "CR LF I
04BF      20 57 49 4E     SP W I N
04C3      00 0D 0A 49     NUL CR LF I
04C7      27 4C 4C 20     ' L L SP
04CB      54 41 4B 45     T A K E
04CF      20 00 0D 0A     SP NUL CR LF
04D3      4D 4F 56 45     M O V E
04D7      2D 00 0D 0A     - NUL CR LF
04DB      4E 4F 20 4C     N O SP L
04DF      45 46 54 3D     E F T =
04E3      00 0D 0A 0A     NUL CR LF LF
04E7      4C 45 41 56     L E A V
04EB      45 20 31 20     E SP 1 SP
04EF      54 4F 20 57     T O SP W
04F3      49 4E 00 0D     I N NUL CR
04F7      0A 59 4F 55     LF Y O U
04FB      20 57 49 4E     SP W I N
04FF      00              NUL
```

The game of Nim: starting with 23 you and the program take turns at subtracting a number from 1 to 3. The one that leaves 1 after their move wins. Starting address is 0440.

MATHS DEMONSTRATION

```
LOCATION  CODE          MNEMONICS
0440      04 83     STRT LODI R0 'ADDZ R3'
0442      C8 1C          STRR R0 MOD
0444      3F 04 B4       BSTA UN SUB 1
0447      3F 02 86    F1 BSTA UN CHIN
044A      E4 2B          COMI R0 '+'
044C      18 0E          BCTR '=' PLUS
044E      E4 2D          COMI R0 '-'
0450      18 06          BCTR '=' SUBT
0452      E4 2A          COMI R0 '*'
0454      18 38          BCTR '=' MULT
0456      1B 6F          BCTR UN F1
0458      05 A3    SUBT  LODI R1 'SUBZ R3'
045A      C9 04          STRR R1 MOD
045C      3F 04 AF       BSTA UN SUB2
045F      02             LODZ R2
0460      83        MOD  ADDZ R3
0461      20 00          COMI R0 H'00'
0463      9A 09          BCFR 'LT' F2
0465      03             LODZ R3
0466      A2             SUBZ R3
0467      07 2D          LODI R3 '-'
0469      CF 04 DE       STRA R3 A1
046C      1B 0B          BCTR UN F3
046E      E4 0A       F2 COMI R0 H'0A'
0470      1A 0F          BCTR 'LT' F3
0472      06 31          LODI R2 H'01'
0474      CE 04 DE       STRA R2 A1
0477      A4 0A          SUBI R0 H'0A'
0479      64 30          IORI R0 H'30'
047B      CC 04 DF       STRA R0 A2
047E      1F 04 C9       BCTA UN END
0481      64 30       F3 IORI R0 H'30'
0483      CC 04 DE       STRA R0 A1
0486      04 00          LODI R0 H'00'
0488      CC 04 DF       STRA R0 A2
048B      1F 04 C9       BCTA UN END
048E      3B 1F          BSTR UN  SUB2
0490      04 00          LODI R0 H'00'
0492      E6 00       F5 COMI R2 H'00'
0494      18 03          BCTR '=' F4
0496      83             ADDZ R3
0497      FA 79          BDRR2 R2 F5
0499      06 00       F4 LODI R2 H'00'
049B      E4 0A       F6 COMI R0 H'0A'
049D      1A 06          BCTR 'LT' F7
049F      86 01          ADDI R2 H'01'
04A1      A4 0A          SUBI R0 H'0A'
04A3      1B 76          BCTR UN F6
04A5      66 30       F7 IORI R2 H'30'
04A7      CA 35          STRR R2 A1
04A9      64 30          IORI R0 H'30'
04AB      C8 32          STRR R0 A2
04AD      1B 1A          BCTR UN END
04AF      3F 02 B4  SUB2 BSTA UN COUT
04B2      03             LODZ R3
04B3      C2             STRZ R2
04B4      3F 02 86  SUB1 BSTA UN CHIN
04B7      75 0A          CPSL H'0A'
04B9      E4 30          COMI R0 H'30'
04BB      3A 77          BCTR 'LT' SUB1
04BD      E4 39          COMI R0 H'39'
04BF      39 73          BCTR 'GT' SUB1
04C1      C3             STRZ R3
04C2      3F 02 B4       BSTA UN COUT
04C5      47 0F          ANDI R3 H'0F'
04C7      C0             STRZ R3
04C8      17             RETC UN
04C9      05 00     END  LODI R1 H'00'
04CB      0D 24 DC  F8   LODA R1+ MSAG
04CE      E4 00          COMI R0 H'00'
04D0      18 05          BCTR '=' FA
04D2      3F 02 B4       BSTA UN COUT
04D5      1B 74          BCTR UN F8
04D7      3F 00 8A  FA   BSTA UN CRLF
04DA      1F 04 40       BCTA UN STRT
04DD      3D        MSAG '='
04DE      00             A1
04DF      00             A2
04E0      00             A3
```

This program provides the functions of a simple 3-function calculator. It will multiply, add or subtract two single digit decimal numbers. Normal plus, minus and equals signs are used, with an asterisk symbol for multiplication. Starts at 0440.

2650

MESSAGE EDITOR

```
LOCATION  CODE          MNEMONICS
0440      3F 00 8A      F1 BSTA UN CRLF
0443      04 3E            LODI R0 'GT'
0445      3F 02 B4         BSTA UN COUT
0448      3F 02 86         BSTA UN CHIN
044B      C1               STRZ R1
044C      3F 02 B4         BSTA UN COUT
044F      3F 00 8A         BSTA UN CRLF
0452      E5 54            COMI R1 'T'
0454      18 0A            BCTR '=' FT
0456      E5 52            COMI R1 'R'
0458      18 39            BCTR '=' FR
045A      E5 43            COMI R1 'C'
045C      18 2D            BCTR '=' FC
045E      1B 60            BCTR UN F1
0460      05 00         FT LODI R1 H'00'
0462      3F 02 86      FZ BSTA UN CHIN
0465      CD 64 B4         STRA (REL)R1 TEXT
0468      E4 1B            COMI R0 'ESC'
046A      18 54            BCTR '=' F1
046C      E4 7F            COMI R0 'DEL'
046E      98 06            BCFR '=' FP
0470      A5 02            SUBI R1 H'02'
0472      07 00            LODI R3 M1
0474      3B 17            BSTR UN PRNT
0476      3F 02 B4      FP BSTA UN COUT
0479      E5 4*            COMI R1 LIMIT *
047B      1A 0C            BCTR 'LT' F2
047D      07 04            LODI R3 M2
047F      3B 0C            BCTR UN PRNT
0481      04 1E            LODI R0 'ESC'
0483      CD 64 B4         STRA (REL)R1 TEXT
0486      1F 04 40         BCTA UN F1
0489      D9 57         F2 BIRR R1 FZ
048B      07 0A         FC LODI R3 H'0A'
048D      06 00      PRNT LODI R2 H'00'
048F      CA 17            STRR R2 F3
0491      1B 06            BCTR UN F4
0493      06 70         FR LODI R2 H'70'
0495      07 0A            LODI R3 H'0A'
0497      CA 0F            STRR R2 F3
0499      0F 24 A9      F4 LODA *R3
049C      E4 1B            COMI R0 'ESC'
049E      18 05            BCTR '=' F5
04A0      3F 02 B4         BSTA UN COUT
04A3      1B 74            BCFR UN F4
04A5      07 0A            LODI R3 H'0A'
04A7      1B 00            BCTR UN F4 **
04A9      17               RETC UN
04AA      08             M1 'BS'
04AB      20                'SP'
04AC      08                'BS'
04AD      1B                'ESC'
04AE      0D             M2 'CR'
04AF      0A                'LF'
04B0      5B                '('
04B1      46                'F'
04B2      5D                ')'
04B3      1B                'ESC'
04B4      00          TEXT
```

*THIS SETS MAX TEXT LENGTH
**F3 IS SECOND BYTE OF INSTR.

Upon being called, this program will give a prompt character, and await a command character. Command T allows a message to be entered, C allows a stored message to be checked, and R allows it to be repeated until the CPU is reset. In text input mode, the Del character acts as a destructive backspace for correcting errors. To return to command mode, type an ESC.

If the message being stored is too long for the buffer, an F will be displayed. Starts at 0440.

National's low cost PACE development system

Following on from the considerable success of its Low Cost Development System for the 8-bit SC/MP microprocessor, National Semiconductor has developed a similar LCDS for its 16-bit PACE microprocessor. It offers both an integral hex keyboard/LED display console and video terminal/teleprinter interfacing, like the SC/MP system, together with 1k x 16 bits of user RAM and a powerful debug-monitor resident in ROM.

by JAMIESON ROWE

Although the new PACE low cost development system or "LCDS" has only just been released by National Semiconductor, I believe it was planned at about the same time as the now well-known and very popular SC/MP system. In fact both systems were very likely the outcome of some suggestions sent to NS in 1974 by Edwin Schoell, the microcomputer engineer at NS Electronics here in Australia.

As you can see from the photographs, the PACE LCDS is very similar to the SC/MP system in construction, being based on a single heavy duty printed circuit board. The PCB measures 255 x 308mm, and is mounted on a 77mm deep metal chassis fitted with rubber feet.

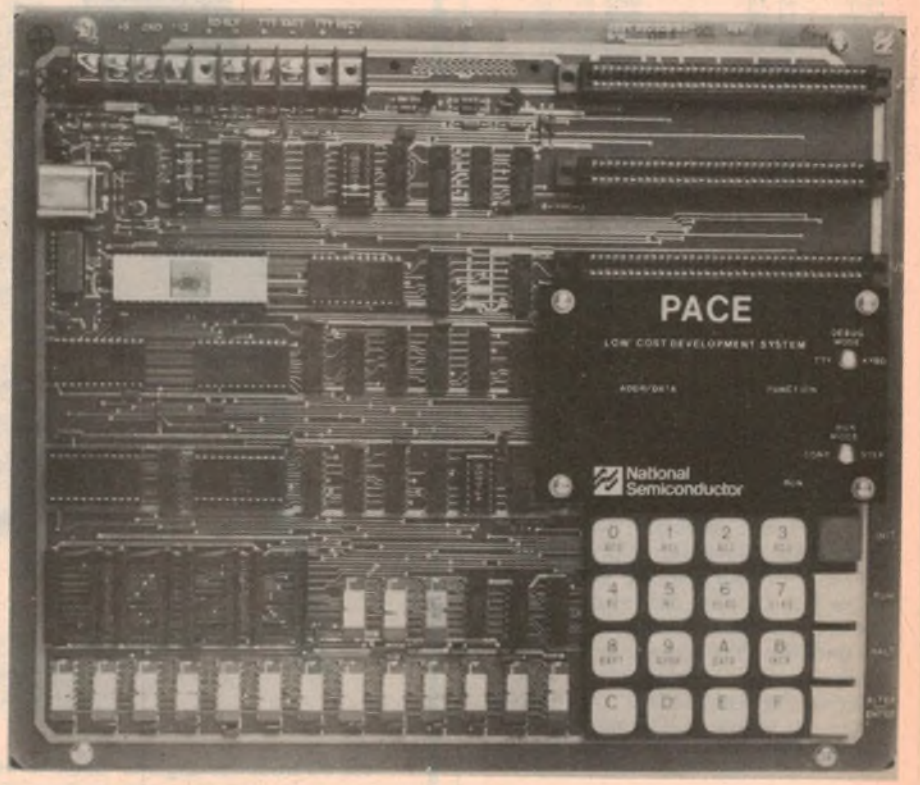
The board is double sided, with all of the ICs and other components for the basic system mounted on its upper surface. This includes a 20-key keyboard and a 6-digit hex LED display, which allow the system to be used without an external terminal.

Mounted on the PCB are the PACE CPU chip with its crystal clock generator and buffering chips; 1k x 16 bits of ROM, with the resident "LCDBUG" monitor; 1k x 16 bits of static RAM, for user programs; sockets for 1k x 16 bits of user-programmable PROMs; a software driven serial interface with either 20mA or RS-232 options, and with a choice of four data rates (110, 150, 300 and 1200 baud); and three 72-way edge connector sockets for memory extension and custom I/O interfacing. National currently provides two types of card capable of being used for LCDS expansion: a 1k x 16 bit static RAM card and a 2k x 16 bit ROM/PROM. Both are available as optional extras.

The operating mode of the LCDS is controlled by two small toggle switches mounted on the red-tinted plastic bezel covering the LED displays. One switch selects the input-output mode assumed by the debug program: either the on-board keyboard and display, or an external terminal. The other switch selects the mode of operation when user programs are executed: continuous or single step.

The resident LCDBUG monitor program offers many useful facilities for program development and debugging. For example, using the on-board keyboard and display it can be used to enter a user program into memory, examine it, modify it, display and alter any of the PACE registers, initiate execution at any address, set a breakpoint, continue from a breakpoint, single step, halt without losing status information, and reset.

Using a separate video terminal or teleprinter, even more facilities are available. You can print the contents of the PACE registers, and alter them if desired; print the contents of any memory location, or a range of locations; alter the contents of a location or range of locations; dump a program in binary "load module" format; load such a program; initiate execution of a user program; set a breakpoint; execute



Here is a top view of the new PACE development system. The four DIL sockets at lower left are for user PROMs, while the edge connector sockets at upper right are for additional RAM or ROM cards.

programs with "trace" printout of PACE registers after each instruction is executed; halt program execution without losing status; and punch a program in complemented binary form for PROM programming.

In short, the LCDS and its debug program provide facilities for very efficient development of user application programs. Such programs can also make use of many of the utility routines in LCDBUG, by calling them as subroutines. These include the routines for keyboard and display servicing, and for external terminal input and output servicing.

Of course much of the interest in the system will be due to the fact that it is based on a 16-bit microprocessor, rather than an 8-bit device. Inevitably a 16-bit processor like PACE tends to offer advantages, when it comes to applications involving manipulation of larger numbers.

PACE was virtually the first single chip 16-bit microprocessor on the market. It is essentially a single chip P-channel version of National's multi-chip IMP-16 microprogrammed processor, with an

A closeup of the keyboard and display. Note also the data rate link, at left.

architecture and instruction set rather like that of a minicomputer. As such it is well suited for both data processing and dedicated controller applications.

Within the PACE chip itself there are six user-accessible 16-bit registers: the program counter, a status and control flags register, and four general purpose accumulators. There is also a 10-word LIFO (last in, first out) register stack, for subroutine and interrupt address storage, and data storage.

Within the 16-bit status and control flags register there are four flag bits which are connected to device pins, for external control and serial output. Five other bits are used in conjunction with four further device pins and internal logic, to implement a vectored interrupt system with 6 priority levels. A further bit in the status register controls the data word length implied for logic instructions—8 bits or 16 bits.

```
                ; ANSWER-BACK PRGM FOR PACE LCDS.
                ; J.ROWE, ELECTRONICS AUSTRALIA 30/7/77
                ;
0040 52F3               LI      AC2,X'F3        ;SET A2 AS DEBUG PTR
0041 2A10               SHL     2,8,0
0042 1602       LOOP:   JSR     RECV            ;FETCH CHAR
0043 5D00               RCPY    AC0,AC1         ;COPY INTO A1
0044 1619               JSR     SEND            ;ECHO
0045 F50C               SKNE    RETN            ;SKIP IF NOT RETURN
0046 1901               JMP     .+2
0047 19FA               JMP     LOOP
0048 5054               LI      AC0,X'54        ;SET UP BUFF PTR
0049 D109               ST      BUFA
004A A108       ANSR:   LD      AC0,@BUFA       ;FETCH ANSWER CHAR
004B 41F6               BOC     LOOP,AC0=0      ;LEAVE IF ZERO
004C 1619               JSR     SEND            ;SEND FIRST BYTE
004D 2C10               SHR     AC0,8           ;SHIFT SECOND BYTE DOWN
004E 1619               JSR     SEND            ;AND SEND ALSO
004F 8D03               ISZ     BUFA            ;INCREMENT PTR
0050 19F9               JMP     ANSR            ;CONTINUE
0051 19F8               JMP     ANSR            ;JUST IN CASE IT SKIPS
0052 008D       RETN:   .WORD X'8D              ;CARR.RTN WITH PARITY
0053 0000       BUFA:   .=.+1                   ;ANSWER PTR
0054 470A               .WORD X'470A            ;START OF ANSWER
0055 204F               .WORD X'204F
0056 5741               .WORD X'5741
0057 5941               .WORD X'5941
0058 492C               .WORD X'492C
0059 4D27               .WORD X'4D27
005A 4220               .WORD X'4220
005B 5355               .WORD X'5355
005C 2159               .WORD X'2159
005D 0A0D               .WORD X'0A0D
005E 0000               .WORD 0
```

Here is our novelty answer-back program as written for the PACE system. It could be improved by using an AISZ instruction at 0045.

A 16-bit branch condition multiplexer is used to perform the logic for conditional branching. Four of the multiplexer inputs are connected to device pins, three of these forming what are effectively "sense" inputs, and the fourth a "continue" input. The remaining multiplexer inputs connect to internal status signals such as the link, carry, overflow, stack full, AC0 sign bit, AC0 equal to zero, and so on.

PACE comes in a standard 40-pin package, and in order to provide pins for the various control signals, flag outputs and sense inputs, the designers have had to multiplex the 16-bit data and address information on a common bidirectional bus. This means that address information must be latched externally, and National provide suitable devices for this.

Memory and peripherals occupy a common 65,536 word address space. This means that all of the memory reference instructions may be used to manipulate data in I/O transfers.

The PACE instruction set is a powerful one, with 45 different basic instructions. Many of these have variations for tests and conditions, giving a total of some 337 individual instructions. The main memory addressing modes available are direct and indirect, both having four mode variations: base page, PC relative, and indexed using either AC2 or AC3 as the index register.

There are also three instructions which use immediate addressing, including a useful "add immediate and skip if zero" instruction (AISZ).

NS Electronics very kindly loaned us the PACE LCDS pictured, to try out while this article was being written. I was thus able to use it to become a little more familiar with PACE programming.

After having used a number of 8-bit chips and systems, I found PACE's fixed length 16-bit instructions initially a little hard to get used to. But soon its convenience and flexibility started to become evident.

For the exercise, I tried re-writing our little novelty "answer-back" program for PACE. It turned out as shown above, although this is by no means the most efficient way of doing the job with PACE. At least one instruction could have been saved by using an AISZ instruction in place of the SKNE instruction at 0045, to test for a carriage return.

Still, it should give you a rough idea of the way PACE is programmed.

Getting the program up and running on the LCDS proved very straightforward, thanks to the facilities it offers.

Price of the PACE LCDS is quoted as $585, plus tax where applicable. It comes complete with a large ring binder housing comprehensive user manuals and data. It is available from NS distributors and dealers in each state.

Classical Recordings

Reviewed by Julian Russell

Franck, Prokofieff: "a rare issue"

FRANCK—Sonata for Flute and Piano in A Major.
PROKOFIEFF—Sonata for Flute and Piano in D Major. James Galway (flute) and Martha Argerich (piano). RCA Red Seal Stereo. LRL1 5095.

Last month I mentioned my surprise at hearing part of the first movement of Franck's Violin Sonata played by James Galway on the flute. Now a pressing of the complete work has been sent to me for review.

For good reasons Galway has become something of a cult both among concert goers and record buyers. This is not surprising because in addition to his lovely tone, brilliant technique and often deeply involved musicianship he is also quite an entertainer to watch. There is something I can only think of describing as Irish about Galway's choice of the work with which the Franck is coupled. It is the Prokofieff Violin and Piano Sonata in D Major, just about as strange a pair of bedfellows as you'd find in the whole of the works composed for the same combination.

The Franck, which was originally composed for the violin, is played here on the flute and the Prokofieff, written originally for the flute is more often played on the violin. Having previously heard a few bars of the Franck on the flute I had no surprise in hearing it in this form when it turned up on my desk.

Now it should not be necessary to point out to readers of this column that there are many differences in tone and other alien factors between flute and violin. Before continuing with this review, however, I must point out that I prefer the Franck played in its original form yet state my surprise at how comparatively well it comes off under Galway's magic fingers, breath control and musical intelligence. The adjustments made in the flute transcriptions are surprisingly few and could, it seems to me, in no way outrage even the most conservative listeners.

Importantly I felt that so much of the original remains in Martha Argerich's superb contribution in the piano part that I couldn't believe anything bizarre was going on. In a bar here and there, the flute, however magnificently played, failed to reach the emotional intensity of a violin. But I must confess that this didn't worry me unduly.

On the other hand the Prokofieff presents no such problems—or perhaps eccentricities would be a better word—since it is given here in its original form. Those used to this composer's spiky and often percussive style may well be surprised (what, again?) at the smoothness and lyrical content of this really lovely sonata. Galway's performance is peerless in every way. To say more would leave me open to a charge of gushing.

Ms Argerich plays with matching skill, emerging majestically at the right moments, at others toned down to a perfect balance in the more sensitive and delicate passages in this attractive score. The sound, too, is faultless in its fidelity in both pieces. This whole disc is a rare issue for the many reasons I have stated here.

★ ★ ★

VIVALDI—La Stravaganza. 12 concertos for solo violin and strings. Piero Toso and Juan Carlos Rybin (violins), supported by the Solisti Veneti. Conducted by Claudio Scimone. RCA/Erato Stereo STU70955 956.

Despite the very great merits to be found among these concertos one would need to be a complete baroque buff to listen to more than three of these concertos at a sitting without losing one's sense of concentration. On the other hand if you have the stamina to achieve this feat you will hear some very exhilarating sound.

But unless you are a dedicated baroquenik you will inevitably find a great many dull patches—a fault I feel due to the uninspired contributions of the continuo parts of the scores—this despite the addition of lutenists to this section in order to stiffen the harpsichord part. Otherwise you will hear all you might expect of this distinguished body of musicians—excellent balance, clean intonation, stimulating rhythms and no lack of vigour.

I must also make a special mention of the principal soloist, Piero Toso, who has a beguiling tone and the instinct to unfailingly find the cusp of every phrase.

Inevitably a committed listener must compare this production with the now two-year-old Marriner set of the concertos and a choice between the relative merits of the two performances will not be easy to make. For reasons often slight and too numerous to mention, I myself lean towards the English group. But to me anyone who listens even to six of the concertos in any one day is likely to emerge from the ordeal a little stunned.

One feature stands out in the Marriner readings—they are much more in keeping with the title La Stravaganza than are the Solisti Veneti's. Despite Marriner's pedagogic attention to what is now—with dubious proof—regarded as true baroque style, and which to me always sounds a little mannered, Marriner's accounts are much more unbuttoned than those of its rivals. But I must again stress that the elegantly presented Erato disc will probably have as many admirers as the competing set.

★ ★ ★

TCHAIKOVSKY—Onegin. Complete ballet by John Cranko on pieces arranged by Kurt-Heinze Stoltze. Sydney Symphony Orchestra conducted by John Lanchbery and recorded by the ABC. EMI Stereo OASD7600.

This, of course, is the music that accompanied the Australian Ballet's successful production of Tchaikovsky's opera Eugene Onegin. The notes, by the arranger Kurt-Heinz Stolze, contain the interesting facts that while all the music is by Tchaikovsky none is taken from the opera itself. Stoltze has used other, and for the most part lesser known, pieces by the same composer to suit the stage action. I saw the ballet when it was performed in Sydney earlier this year and completely approved Stoltze's choice of items, both lyrical and dramatic.

It is played very well by the Sydney Symphony Orchestra—not the orchestra used in the ballet in the Sydney Opera House—and the engineering under the supervision of the ABC's very useful handy man Eric Clapham, who produced and mastered the disc, is always admirable.

It won't matter a bit if you didn't see the ballet, for here you have a collection of some delightful little pieces by Tchaikovsky, expertly scored and put together. It may be significant that Clapham/Lanchbery use the Sydney Symphony Orchestra in preference to the Ballet Orchestra. You don't have to be specially well informed to guess why.

★ ★ ★

LISZT—Tryptych. Ten pieces for solo piano played by Loretta Goldberg. EMI Stereo OASD 7599.

Although I have been on the musical scene in Australia for nigh on 40 years this is the first time I have heard Ms Goldberg play. She has chosen a novel program, a Liszt Tryptych, which includes

a world first recording of his "From the Cradle to the Grave."

According to the sleeve notes Ms Goldberg is Australian born but is nowadays New York domiciled. She won various competitions here before leaving and recently has played in concerts on radio and television in South-East Asia. One of her concerts at the National Gallery of Melbourne was filmed by the Commonwealth Film Board and shown commercially at a Melbourne film festival and on television. Some may question whether exposure at a film festival can be described as commercial.

Altogether on this disc she plays 10 items starting with Chasse Neige (Snow Drift) and finishing with the three pieces that make up the Cradle to the Grave suite. I must say that under her fingers the snow is the heaviest I have ever heard fall. All through this recital her playing varies between delicacy of touch and heavily emotional—not very well organised splashing. Her pedalling is often badly blurred.

Briefly her playing might be described as very soulful if not well disciplined. One seeks in vain for some significant meaning. I realise that is not a very enthusiastic review but at least the recital does record some very rarely heard pieces from the output of this illustrious composer.

★ ★ ★

SCHUBERT—Symphony No. 8 in B Minor. (The Unfinished.) Symphony No. 5 in B Flat Major. London Philharmonic Orchestra conducted by John Pritchard. EMI Masterpiece Stereo Series SMP0023.

There is nothing sentimental about this reading. It is certainly not for those who like sugar added to their already sweet Schubert. This is not to say that Pritchard's performance is either dead pan or monotonous. There are many subtle changes of dynamics, and the phrasing, though fittingly elastic, is never out of shape. His tempo in the first movement is just right though to some it might sound a little pressed.

Pritchard's account is not without drama either, though this is always kept in proportion to his whole conception of the movement. What I like so much about it is the complete absence of Viennese schmaltz. Pritchard is content to just let the music speak for itself. The playing and recording are first rate. The solo flute sounds a little breathy in the beginning of the first movement, but only there.

The second movement has just the right change of tempo and mood. Indeed I can recommend this production to all those who don't like their Schubert drooled over. And there is the added inducement of its issue at a budget price.

It is coupled with the enchanting little B flat symphony which is never overplayed, but preserves its charming innocence from beginning to end—innocence achieved by the composer only by the superb quality of his writing. The first movement sparkles with good humour and Pritchard wastes no time over the second, taking it briskly but without any sacrifice of its moments of passion.

The final two movements are just as good. All through both symphonies, I admired greatly the internal balance of the orchestra, with all the instruments getting their fair share and no spotlighting of the showy bits.

★ ★ ★

COUPERIN LE GRAND – Motets for One and Two Voices. Anna Maria Bondi and Nicole Fallien (sopranos) with Les Solistes de Paris conducted by Henri-Claude Fantapie. Two discs. SFP Stereo 71033 and 91041.

THREE ROMANTIC SONATAS for Flute and Harp by NADERMANN, KRUMPHOLZ and BOCHSA FILS. Jacques Castagner (flute) and Elizabeth Fontan-Binoche (harp). SFP Stereo 31013.

These three discs are from a label hitherto unknown to me—SFP (Societe Francaise de Productions Phonographque, Paris). For that reason, should you feel like acquiring one and your local or city dealer is similarly ignorant, the Australian distributors are Sound and Film Enterprises Pty Ltd, 122 Chapel Street, St Kilda, Vic. 3182. Telephone 91 3238.

Two of the three discs are devoted to church music by Francois Couperin le Grand in the form of motets for one or two voices. In get-up, the discs are very much in the manner of those put out by the Erato label and as such are very elegant indeed.

Couperin (1666-1773) was a great composer whose music has never had a very great appeal to English-speaking audiences; just as the plays by the great French dramatist Racine (1639-1699) are seldom seen on English-speaking stages. I cannot understand this because Couperin's music is still, if a little dry, eminently listenable, though Racine's plays do sound a bit grandiose to our ears. Another odd fact is that Couperin's music is well represented in the English Gramophone catalogue.

The works presented here are all from his great output of religious music and are in the form of motets for one of the two female voices supported by the Soloists de Paris conducted by Henri-Claude Fantapie. The latter play the music on instruments of the period—flute a bec, viola and so on. All are sung in Latin but no copy of the texts in any language accompanied my pressings. The singers are two robust sopranos, Anna Maria Bondi and Nicole Fallien.

Both possess voices that could be heard without effort in any large church or cathedral. Although neither could be described as beguiling in quality, their sense of pitch is always unwavering and the accompanying instruments provide sound that could well be authentic reproduction of the period. The techniques of all concerned are all admirable and the engineering faultless in its fidelity and clarity.

There are five motets on the first disc and six on the second. Some of the motets are for one voice, others for two.

The records should have a very real appeal to scholars of French music and perhaps a few outsiders, too, among which I can be included. But I feel that their general appeal is not likely to be great. Still, I urge readers to get at least one and persevere with it. It will yield up many rewards.

The Third disc features Three Romantic Sonatas played by the Flute and Harp Duo of Paris, all three by different composers. These are Jean-Francois Nadermann (1773-1835), Jean Baptiste Krumpholz (1745-1790), and Robert-Nicholas Charles Bochsa Fils (1789-1856). The instrumentalists are Jacques Castagner (flute) and Elizabeth Fontan-Binoche (harp). The Nadermann sonata pays considerable allegiance to Haydn, not surprisingly when you read that he was a pupil of the Czech composer Krumpholz who was himself a pupil of Haydn. This sonata has great charm and is presented without affectation and complete accuracy by both players.

The Krumpholz sonata, although pleasing, hasn't the same attractive innocence as the Nadermann. Krumpholz's style is rather more Mozartian than Haydnesque.

The Bochsa is a longer work than either of the other two. Bochsa, by the way, was also of Czech origin. His music has considerable beauty of melody and his style approximates to the very early works of Beethoven. All three sonatas are presented with true French refinement. This is a very attractive issue, especially for those looking for novelty.

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Lighter Side

Reviews of other recordings

Devotional Records

PRAISE STRINGS. Stereo, Maranatha Music HS-029. (From S. John Bacon Publishing Co., 12-13 Windsor Ave, Mt. Waverley, Vic. 2149.)

Because the pictures on front and back are the same, I confused this album initially with "Praise II" reviewed recently, but I take it that "Praise Strings" would actually be the earlier one of the two.

As the title suggests, it features a traditional string orchestra, although neither orchestra nor players are identified. In a program which will be enjoyed by those seeking a respite from guitars and percussion, they play a program of gentle, middle-of-the-road Gospel music: Praise You Father – Sing To The Father – Father I Adore You – Praise The Lord – Unto Thee O Lord – Sing Hallelujah – Open Our Eyes – Light Our Way – My Peace – Seek Ye First.

Produced in California, the disc is free from surface or other noise and while the hypercritical may feel that the massed strings are a trifle on the hard side, overall balance is excellent and the piano and solo string tone is very clean. As I mentioned earlier, many will welcome it as a pleasant change from the all-pervading mod Gospel sound. (W.N.W.)

★ ★ ★

EVIE: MIRROR. Stereo, Word WSB-8735. (From Sacred Productions Aust, 181 Clarence St, Sydney and other capitals.)

Perhaps it's not so surprising to find Evie an attractive young Nordic blonde singer, when one realises that this album was recorded at the Europafilm Studios in Stockholm, Sweden. Backing is by local group musicians, plus the strings of the Swedish Radio Symphony Orchestra. The "Mirror" part of the title relates to the theme of the opening number "But 'til you find Him in the mirror, you've got a long way to go".

Most of the songs may be unfamiliar but not to worry: the full lyrics are set out inside the double-fold jacket: Mirror – Lord, Send That Morning – If Heaven Never Was Promised To Me – Jesus Was There All The Time – Now Is The Time – He Loves Me – Four Feet Eleven – Praise You Just The Same – Born Again – Just Because I Asked.

Evie's style is that of a typical popular modern vocalist working, for much of the time, against a driving beat. Interestingly, she not only does the lead vocals all the way through but, according to the notes, is one of two people who provide the backing "chorus". Unfortunately, the multi-recording has bequeathed a touch of coarseness to some of the over-dubbed sounds but not enough to spoil your enjoyment if you have an ear for a pleasant and accomplished popular Gospel vocalist, identified only as Evie. (W.N.W.)

FIVE ROWS BACK. Johnny Hall. Stereo, Singcord ZLP-959S. (From S. John Bacon Publishing Co., 12-13 Windsor Ave, Mt. Windsor, Vic. 3149.)

The jacket photo and notes introduce Johnny Hall as a very pleasant young man, who professes to an old-fashioned conversion as a result of a sermon on the radio. And his voice too, emerges as a very pleasant baritone, used in mainly a conventional way but embellished with an occasional key change, falsetto phrase, or exaggerated vibrato. Much of the time, the whole sound–voice and orchestral and choral backing–is that of a romantic stage musical. The selections are a mix of old and new with an occasional up-tempo number for variation: My Tribute – Moment by Moment – Show A Little Bit Of Love And Kindness – The Healer – Whatever He Wants For Me – Five Rows Back – He Turned The Water Into Wine – Lead Me, Oh Lead Me – Worthy Is The Lamb.

You've probably gathered from this that this album has something for different age groups and that would be true. Neither conservative nor way-out, it should make for good family Gospel listening. Technically, the quality is excellent. Recommended. (W.N.W.)

Instrumental, Vocal and Humour

THE BEATLES AT THE HOLLYWOOD BOWL. The Beatles. Stereo. EMI Records PCSO 7577.

The days of the Beatles have long since passed, and it seems that all we have left is memories. This album will certainly stir up a lot of memories for those who were fortunate enough to see the Beatles live, and probably even for those who wanted to and couldn't. If you play it really loud, the background screaming will probably evoke some feeling of the atmosphere.

In order, the tracks featured are: Twist And Shout – She's A Woman – Dizzy Miss Lizzy – Ticket To Ride – Can't Buy Me Love – Things We Said Today – Roll Over Beethoven – Boys – A Hard Day's Night – Help – All My Loving – She Loves You – Long Tall Sally.

As one would expect, the recording quality ranges from adequate to absolutely woeful. However, it doesn't seem to matter; the magic still comes through. But, because of the reservations, I would recommend this record only for ardent fans, or for use at parties. (D.W.E.)

★ ★ ★

WORKING MAN. Dutch Tilders. Eureka stereo E104. (Eureka Records, P.O. Box 113, North Ryde, NSW 2113.)

Dutch Tilders is an Australian blues singer who has received some good reviews in the Melbourne press and is apparently appreciated by local blues fans. The album notes state that when Brownie McGee is in Australia, they "usually blow together on stage and privately". Good for him. As for me, I couldn't be less enthusiastic.

And I do like Brownie McGee! (L.D.S.)

Reviews in this section are by Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.) and David Edwards (D.W.E.)

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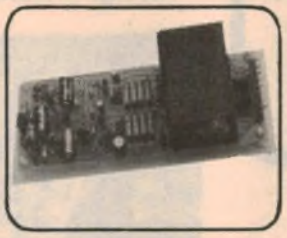

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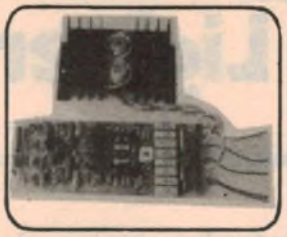

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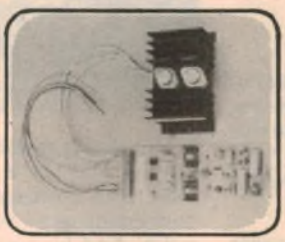

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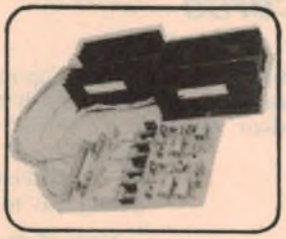
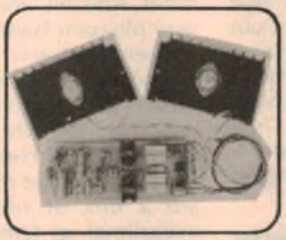
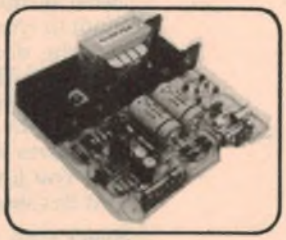


027 250 Watts R.M.S. power amplifier module @ less than 0.2% T.H.D. Fully short-circuit protected. 8 OHM balanced output. $113.28



009 120 Watts R.M.S @ less than 0.1% T.H.D. Fully short-circuit protected $60.38



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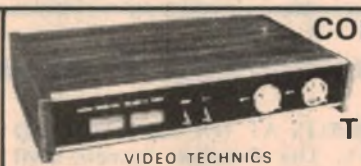

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THE LIGHTER SIDE

RAINBOWS AND TEARS. Ray Price. Dot Records L35980. Festival Records release.

One of the best albums to come my way for some time, this excellently recorded release makes for enjoyable C & W listening from start to finish. Of course, Ray Price will be no stranger to most readers. Remember such hits as "Heartaches By The Number" and "Make The World Go Away"?

There are eleven tracks in all: That's All She Wrote – I Won't Get Over Losing You – Mamas Don't Let Your Babies Grow Up To Be Cowboys – Windsong – Made For Loving You – We're Getting There – Here You Come (And There You Go) – To Make A Long Story Short – That's How Close We Are – I Don't Feel Nothing.

In summary, an album that should find ready acceptance with most C & W fans. Recommended. (G.S.)

★ ★ ★

THE JACK PLEIS BAND. I Play The Song The Whole World Sings. Interfusion L25289. Festival release.

Here is another enjoyable record for the easy-listening set to play as a background for social activities, with such titles as: I'll Always Be In Love With You – On Top Of Old Smokey – You Are My Only Love – Musetta's Waltz – Feelings – Trustful One – Be Mine, Be Mine – I Write The Songs.

Jack Pleis was at one time stage arranger and pianist for Benny Goodman and has worked for such stars as Theresa Brewer, Al Hibbler, Lawrence Welk and Harry Belafonte, and the experience shows.

The quality is good except for some odd buzzing synthesiser sounds on a few tracks. (N.J.M.)

★ ★ ★

ARMSTRONG HIGH SCHOOL CHOIR, directed by Richard Edstrom. Stereo, 2-record set. ARK No. 5195-S. (From M.R. Acoustics, P.O. Box 110, Albion, Brisbane 4010.)

This double album would not be everyone's cup of tea but, if you happen to be one who likes choral singing, mainly unaccompanied, then the accomplished choirs and the varied program presented here would bring a good deal of pleasure.

Side A opens with "Three Festival Anthems" (Johannes Brahms) followed by "The Creation" (Scott), mainly narrative, with vocal harmony.

Side B is different again, with a vocal/instrumental group "Now & Then" presenting a bracket of popular hits. This is followed by "Ascensions" (Davis) involving the full choir and a pre-recorded tape which combine to produce a science fiction space atmosphere.

Side C opens with the choir again—"Plorate Filii Israel" (Carissimi)—followed by the Chamber Singers presenting five tracks of what the notes describe as madrigals and chanson.

The fourth side has "Trotz Dem Alten Drachen" and "Ich Aber Seid Nicht Fleischlich" (J. S. Bach); the Madrigal Singers then present "You Defy Me, Beloved Foe" (Giovanelli) and "Spring Returns" (Marenzio). The final track is "The Lordly Hudson" (Rorem/Eaton) by the full choir.

Recorded in Minneapolis using the techniques developed by R. W. Fulton, the sound quality is very clean, if a little on the "dry" side. In fact, I "sinned" by invoking 4-channel decoding for "Ascensions" and it added quite markedly to the space effect. An interesting recording for those who like the program. (W.N.W.)

★ ★ ★

THE CHIEFTAINS (1) AND THE CHIEFTAINS (2). The Chieftains. Interfusion L 35993 and L 35994. Festival release.

For the serious lover of traditional Irish music, these two albums are collector's items. The range of melodies played is excellent: jigs, reels, hornpipes and the beautiful slow airs. Both albums are entirely instrumental and arranged as you would hear it in a country kitchen or a village pub.

The musicians use the traditional instruments of Irish folk-music: the pipes, the tin whistle, the flute, the fiddle and the Irish drum called the bodhran. The result is anything but bare of variety, for the instruments themselves seem to be able to suggest melancholy or rollicking joy, as reflected by the mood of the song.

To get the atmosphere conveyed by these albums, I would recommend listening to the following tracks: "See Fath mo Bhuartha" and "The Boy in the Gap", from the first album; and "Planxty George Brabazon" and "Brian Boru's March" from the second. Both my copies offered a very high standard of recording, with the individual instruments able to be enjoyed without any background noise. (D.W.E.)

★ ★ ★

GREAT TENORS OF TODAY. Stereo, HMV OASD-3302.

Notable because it's so unusual in the fact that the jacket notes by W. A. Chislett make no attempt whatever to "sell" this album. He lists the twelve tracks in terms of work, composer, artists, orchestra and conductor. Elsewhere he summarises briefly the setting of each excerpt, for the sake of those whose memory needs to be refreshed.

The fact is, I guess, that such a record does not need to be "sold" to those who appreciate operatic tenors and operatic excerpts when the names are: Carlo Bergonzi, Franco Corelli, Placido Domingo, Nicolai Gedda, James McCracken, Luciano Pavarotti and John Vickers.

Or when the selections are from operas like Aida, The Pearl Fishers, Andrea Chenier, Carmen, Tosca, Otello, Turandot, L'Amico Fritz, Faust, Manon Lescaut, La Forza Del Destino, and Samson Et Dalila.

The excerpts are all from EMI recordings, with a couple from EMI Pathe Marconi, dating from between 1959 and 1974. There is some variation in sound with orchestra, venue and age but certainly not enough to compromise your enjoyment of this generous collection of great tenor solos—provided, of course, that you like operatic tenors. That much is up to you. (W.N.W.)

★ ★ ★

IZITSO. Cat Stevens. Island L 36121. Festival release.

This album comes across as an effort of a more mature entertainer than, for instance, "Teaser and the Firecat". Not that this album is unsuccessful; just that it lacks some of the emotional appeal of earlier ones.

There are eight tracks altogether, two of which are instrumentals. Cat writes his own words and music and the style is the same, even if the pace is slower. An interesting effect is his combination of instruments. For example, he uses several electronic synthesizers and manages to combine these with the traditional Greek bouzouki.

Noteworthy tracks include "Old Schoolyard", (despite all the current airplay), "Bonfire", and a very attractive melody called "Kypros" on side one. Well-known for unusual titles, Cat calls one track "Was Dog a Doughnut?". As this is one of the instrumentals, the question remains unanswered. The recording quality of the album is good. (D.W.E.)

LIGHTER SIDE

A LITTLE BIT OF IRISH. Hal Carter and his Dance Band. Festival 35843.

Hal Carter and his band have been a part of the local music scene for some considerable time and have ensured a loyal following for themselves amongst those who enjoy the old style dance music. There are the usual twelve tracks with the following titles: That Tumbledown Shack In Athlone – Beautiful Isle Of Somewhere – Is Your Mother Molly Malone? – If You're Irish Come Into The Parlour – With My Shillelagh Under My Arm – Bridgett O'Flynn – Mickey – Peg O'My Heart – Harrigan – It's A Great Day For The Irish – I'm Looking Over A Four Leaf Clover – When The Rose Of Tralee Meets Danny Boy.

Quality is excellent. (N.J.M.)

★ ★ ★

COMPUTERISED BEATLES. The T-Tone Synthesizer. Interfusions stereo L-25273. Distributed by Festival Records Pty Ltd.

These synthesized Beatles numbers are but pale shadows of the originals. It seems the Japanese gentlemen who produced the disc need to tweak up their machine or to put it another way, to liven up their arrangements. Record quality is okay.

Twelve tracks are featured: A Hard Day's Night – Ob-La-di, Ob-La-Da – Get Back – And I Love Her – Something – Penny Lane – She's A Woman – Yesterday – Ticket To Ride – I'll Follow The Sun – Help! – Because. (L.D.S.)

★ ★ ★

A RETROSPECTIVE LINDA RONSTADT. Linda Ronstadt. Stereo. 2 record set. Capitol Records SIJ 11629. EMI release.

Linda Ronstadt has been making good records since about 1967, and this double album proves that conclusively. The 22 tracks featured range from the very early "Different Drum" days to her late 1974 sessions at the L.A. Sound Factory.

Even before I played it, I could tell that this record was going to be good, simply by reading the cover notes. There are songs by Phil Everly, Neil Young, Hank Williams, Mike Nesmith, Bob Dylan, Jackson Browne, Paul Anka and the Carol King/Gerry Goffin combination. And when I finally got the first record onto my turntable it proved to be even better than I thought it would be.

Linda's very expressive and totally exceptional voice comes across very clearly, and is never obscured by the instrumental backing. There are too many tracks for me to list them all, and they are all of such a high calibre that I

find it difficult to select any in particular.

On side 1, my favourite would have to be Hank Williams' "I Can't Help It If I'm Still In Love With You", while on side 2, you just can't go past "Different Drum". On side 3, I couldn't really pick out any tracks in particular, while on side 4, I stopped at "Will You Love Me Tomorrow".

In conclusion, a very fine record, which I would go so far as to say should be mandatory in any modern rock collection. Considering the age of some of the recordings, the quality is excellent, with very clean bass. (D.W.E.)

★ ★ ★

MUSIC MAESTRO PLEASE. Love Unlimited Orchestra. 20th Century Records L 35772. Festival release.

Love Unlimited is a well-known female pop group, produced by Barry White. They do not appear on this record, which is, as its name suggests, an instrumental one only. Apparently the orchestra featured is the one used to back them on their records.

The sound is very pleasant, and quite melodious. Tracks featured are as follows: Bring It On Up – Makin' Believe That It's You – I Wanna Stay – Give Up Your Love Girl – You're All I Want – It's Only What I Feel – Midnight Groove – Forever In Love.

Barry White is listed as the composer of most of the songs, as well as being credited with producing, arranging and conducting. I found the record quality to be adequate, and would recommend it as light background music. (D.W.E.)

★ ★ ★

20 GOLDEN HITS. Webb Pierce. SSS L 35895. Festival release.

No doubt died-in-the-wool C&W fans will see a bonanza in this collection of twenty country standards, sung and played by Webb Pierce. Personally, I've heard other more pleasant sounding country singers!

Some of the titles are: Wondering – More And More – I'm Walking The Dog – That's Me Without You – Walking The Streets – Why Baby Why – Sparkling Brown Eyes – Cowtown – Fool, Fool, Fool. Judging by the huge guitar shaped pool on the cover, Mr Pierce must be fairly successful. Quality average. (N.J.M.)

RED RIVER VALLEY. Slim Whitman. United Artists Records L-36.149. Festival Records release.

If you fancy the distinctive "cowboy" style of Slim Whitman, then this album would be hard to go past. On it, Slim Whitman, on steel guitar sings twelve familiar songs ranging from Glen Campbell's "Rhinestone Cowboy" through to "Lara's Theme from Dr Zhivago".

The other track titles are: Mr Ting-A-Ling (Steel Guitar Man) – Too Young – Let Me Call You Sweetheart – (It's A) Small World – Una Paloma Blanca – Red River Valley – My Elusive Dreams – Cara Mia – When The Moon Comes Over The Mountain – Now Is The Hour.

All tracks are treated in real country style as one would expect from Slim Whitman, although interestingly none were written by Slim himself. An unamed female vocalist gives Slim a hand with "Red River Valley", the second track on side 2.

Have no fear of technical quality – it's excellent. (G.S.)

★ ★ ★

MIKE AND BERNIE WINTERS. For Mums and Dads Of All Ages. M7. MLF176.

Anyone who has seen such English TV shows as The Cilla Black Show will recognise the two engaging characters on the sleeve of this record. Mainly known for their comedy, on this disc we see the musical side of their talents, with twelve titles including two medleys. Some of the tracks are: Mums And Dads – How Lucky You Are – Ballin' The Jack – The Darktown Strutters Ball – Mister Sandman – Music Maestro, Please – Somebody Stole My Gal.

The musical backing is arranged and directed by Brian Rogers and the overall quality is excellent; a record to enjoy. (N.J.M.)

★ ★ ★

NORTH PARK ELEMENTARY CHOIRS. Stereo. ARK 4185-S. (From M. R. Acoustics, PO Box 110, Albion, Brisbane 4010.)

A product of the Ark Recording Division of Fulton Electronics, this is another in a series of releases featuring the use of Fulton's special stereo microphone and their "purest" approach to recording procedures. And, for sure, the recording quality is very good and of possible interest to anyone who might be involved in recording local choirs, etc.

But therein lies a point: these are local school choirs, probably from the Minneapolis area in the USA, the home of the Fulton company. While their performance is commendable, and of undoubted interest to their families and friends, their efforts are not likely to interest people elsewhere other than those who are involved with similar activities. The items on side 1 are a mix of classical, traditional and religious; those on side 2 are predominantly from the musicals.

In other words, the technical quality is fine but the program content would have very limited appeal. (W.N.W.)

★ ★ ★

THE SPIRIT OF VAUDEVILLE. Eric Rogers and the Vaudeville Orchestra and Chorus. Master of Ceremonies, Al Mancini. Decca Phase 4 stereo.

Here's a thoroughly enjoyable record which very effectively recaptures the spirit of old-time vaudeville, complete with orchestra, acts, and a responsive audience. It just so happens that all three are more accomplished in their roles than the genuine article but that merely counterbalances modern expectations.

On the eleven tracks you hear the inevitable Light Cavalry Overture, the flappers and their boyfriends, a barbershop quartet, minstrels, a Frankie & Johnny melodrama, some singalong, an abortive attempt to include some culture (with a capital "K") and so on—all very happy, all very nostalgic. It caused one member of my family to lament that we miss out on so much fun, these days.

But there's one other aspect that warrants special mention. The record owes much of its success to the excellent quality of the recording and the degree to which the recordists have substituted the stereo sound stage for the visual.

If you have the slightest suggestion of rapport with the old minstrel shows, you should make yourself a present of this one. (W.N.W.)

★ ★ ★

THE WORLD OF WILLIE NELSON. RCA Victor, stereo APL1-1234.

Willie Nelson is an American C&W singer with an unusually penetrating voice and C&W fans should sample a few tracks before buying. Recording quality is good. The album was produced by Chet Atkins and Felton Jarvis.

Ten songs are presented: I'm A Memory – What Can You Do To Me Now? – Fire And Rain – Once More With Feeling – I've Seen That Look On Me A Thousand Times – Wake Me When It's Over – My Own Peculiar Way – Permanently Lonely – I Gotta Get Drunk – You Left A Long, Long Time Ago. (L.D.S.)

New Products

Moore-O-matic Door Opener

Garage door openers are probably regarded by many people as luxury items for the indolent rich. A few days of wet weather can quickly change this opinion—especially with regard to a unit you can instal yourself at lower cost. Many readers will thus be interested in this Moore-O-matic Navajo 600 Garage Door Opener.

The scene is a Sydney suburb on a wet summer night. The wind is howling, the trees thrashing about and the rain pelting down the driveway at an angle of 30 degrees—right into the garage door. And you have to get out of your cosy heated and demisted automobile to open the door. Oh! What you would do for an automatic garage door opener?

The answer is to instal one yourself, at a considerable saving over a commercially installed unit!

The subject of these ramblings is an import from the USA, the Moore-O-matic Navajo 600 garage door opener. It is a ruggedly built unit, employing a ⅓HP motor with worm reduction gear driving a roller chain.

The roller chain drives a trolley along a boom and in doing so, pulls the door up or drives it down. Claimed to be suitable for one-piece overhead (tilting type) and sectional doors up to 5.5 metres wide and 2.15 metres high, the unit has a rated pull of 334 Newtons (75 lbs) and will take about 20 seconds to fully open or close the average door.

Housed in a streamlined case, the motor and mechanism appear to be well up to the job. We did not make an actual installation, but ran the unit through its paces on the bench to check the operation of transmitter, control unit and mechanism.

The compact split-phase capacitor-start motor is intermittently rated at ⅓HP. Running it continuously rapidly raises the motor temperature until a safety cutout operates. Normally this would not happen but if one of the limit switches failed or the unit was operated more or less continuously by mischievous children, the motor would otherwise heat up and burn out.

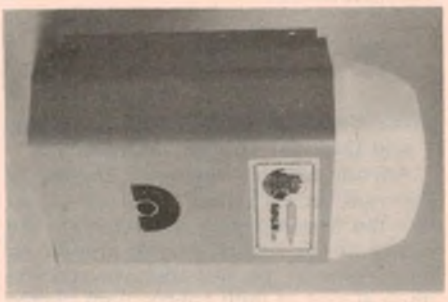
The main worm gear is made of aluminium alloy while the other gears are made of nylon or a similar material. Also housed in the case is a 24VAC contactor with changeover contacts for motor reversal, and a thermal delay switch (using a heated bimetallic strip) to turn on the integral garage light for about two minutes after initial operation of the control.

The mechanism has a spanner-adjustable clutch and a pair of contacts which operate the contactor and reverse the motor in the event of the door hitting an obstruction. This prevents damage to the door opener mechanism, but does not prevent the possibility of some damage to the obstruction, which could be a person or a car. If desired this possibility could be taken care of by a light-beam relay system monitoring the door opening.

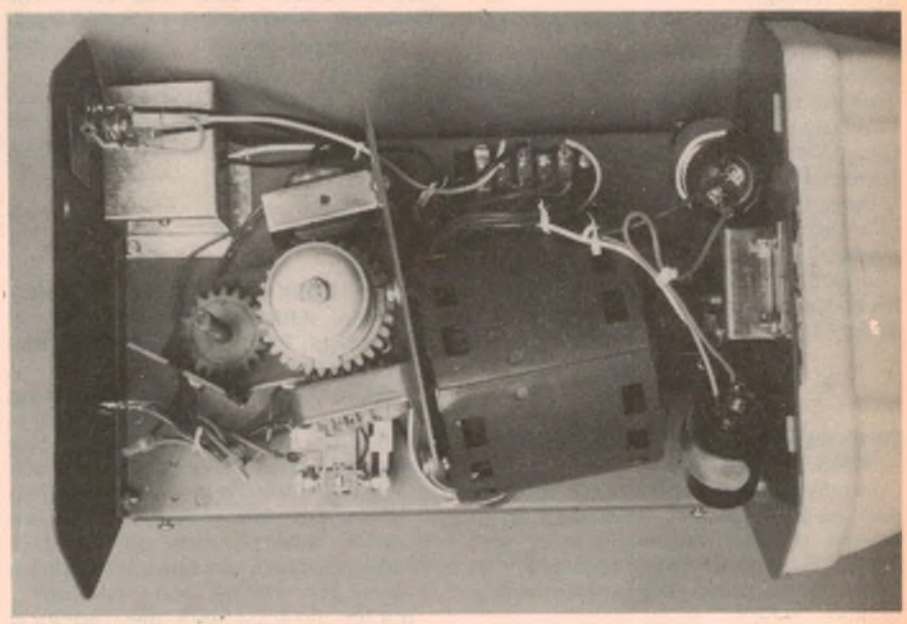
The remote control transmitter, which is usually kept in the car, looks like an electric shaver. The transmitter operates on the 27MHz band with tone modulation and is claimed to have a range of approximately 30 metres with the companion receiver. Our tests indicate that this is a reasonable claim. We also tried to operate the unit with a CB transceiver set to the same frequency, but the tone control system seems quite effective in preventing such unauthorized use.

In addition to the remote control transmitter and receiver, the garage door opener may also be actuated by a push-button or keyswitch. In case of a power failure the door may be operated manually, from inside the garage, as the drive trolley can be easily decoupled from the door. However, power failures could present a problem if the garage door provided the only access—this is often the case with home unit garages.

Apart from this minor reservation our impressions of this garage door opener were very favourable. Installation should be quite straightforward for the experienced handyman.



Above is a normal operator's view of the unit while below is the mechanism.



Price of the garage door opener, including the transmitter and control receiver, is $360 including sales tax. The transmitter and receiver are also available separately. Further information can be obtained from the importers, Raydoor, 35 Tait Street, Five Dock, NSW 2040.

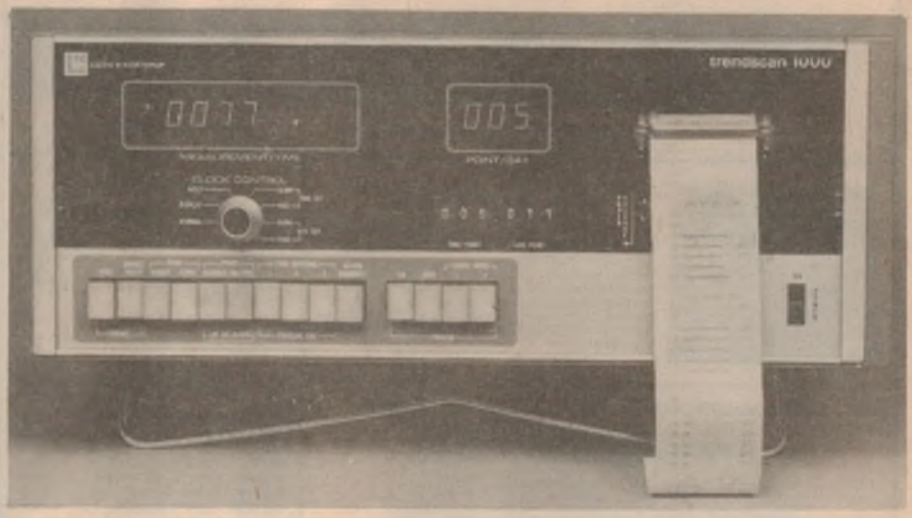
Data acquisition system prints bar graphs

Rapid evaluation of trends in data logging and process monitoring situations is made easy by the new Trendscan 1000 Data Acquisition System from Leeds and Northrup. The unit provides a bar-graph printout in addition to the normal alphanumeric presentation of values.

In the "trend mode" of operation, the most significant digits are printed as numbers, with the remaining digits presented in bar graph or histogram form. This allows very rapid and convenient detection of emerging patterns and trends.

The Trendscan 1000 can log, show trends and provide alarms for up to 1000 different points, with input switching as far as 3200 feet away. It accepts both linear and non-linear inputs, including volts, millivolts, milliamps, thermocouple, and contact closures. It will print out data on all points, on selected points only, or on a single point, and either continuously, on demand, or on a timed basis.

It is also possible to have the unit print out only those points in the alarm condition, or all points when any alarm occurs.



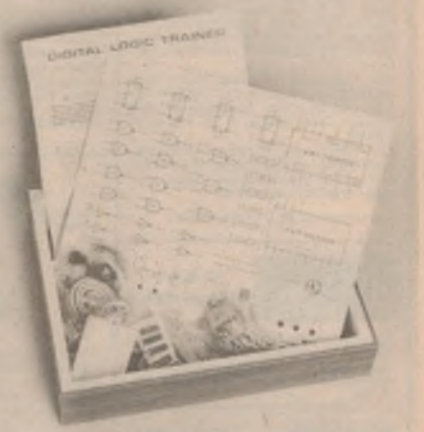
The Trendscan 1000 contains an internal mains-derived digital clock, with a quartz derived clock available as an option. The printer is a 21 column ribbonless type, using conductive coated paper. Printing rate is 6 lines per second, with 2 lines per cm. Input power is 100-240V AC.

The unit can be expanded into a very extensive system by adding an external alarm processor and additional input switching card frames.

Further information may be obtained from Leeds & Northrup Australia Pty Ltd, 298 Botany Rd, Alexandria, NSW 2015.

Kit for our Mk3 Logic Trainer

Those readers wishing to construct the Digital Logic Trainer Mark III described in the July 1977 issue will be pleased to learn that the Dick Smith Electronics Group has produced a complete kit of parts for this project, which is available for the attractive price of $69.00.



The kit arrives neatly and sturdily packed in a cardboard carton, with the components grouped with regard to type, and packed in see-through plastic bags. An attractive veneered wooden case is supplied, as well as a front panel/printed circuit board as per the July article.

We did not assemble the kit, however, it appeared to be complete in all details. A length of rainbow cable and a number of clips are supplied, so that the constructor can assemble his own clip leads. This has the advantage that they can be made to length as required.

A reprint of the July article is provided as the instruction manual, along with a short note giving details of how to insert the PCB pins into the board without damaging the lettering on the front.

The constructor is required to supply and fashion the IC lead bending tool required to mount the ICs onto the board, as well as the battery mounting clamp. In the unit submitted for review, we also noticed that the PCB was too large to fit into the wooden case, and would require careful filing in order to achieve a correct fit.

Apart from these minor criticisms, however, we were very impressed with the kit, which we feel is very good value for money. The combination of the veneered box and silkscreened front panel make for a very professional finish to the completed project (D.W.E.)

Quartz Hour Meter from Wetzer

Wetzer Messtechnik, the well-known and long-established West German manufacturers of precision time measuring equipment, have recently extended their range of hour meters by the introduction of two quartz controlled DC-powered counters.

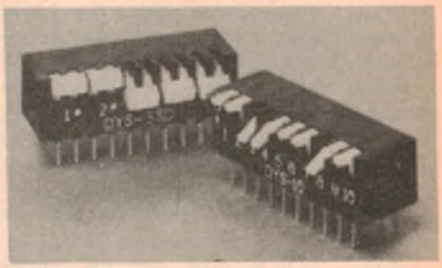
Advantages of the new models are the ability to run from either 12V or 24V DC, low power consumption (drain is only 15mA), and the ability to operate with high precision over a wide temperature range—from −40 to +80 degrees C. The meters are also provided with a waterproof plastic case.

Two models are available, type H202 with a minute hand as illustrated, and type H402 with a rectangular format. Type H202 is suitable for outdoor use.

Further details are available from the Australian agents, Richard Foot (Aust.) Pty Ltd, 63 Hume St, Crows Nest 2065.

NEW PRODUCTS

Right-angle DIP switches



The DYS Series dual-in-line switches have "piano key" type actuators to provide easy operation and convenient viewing of switch status. They are designed for card-edge mounting on PC boards, and are available in SPST (4 to 10 stations) and SPDT (2 to 5 stations).

Contacts are gold plated for long, reliable service life and all terminals are sealed.

For further information contact Namco Electronics, 239 Bay St, North Brighton 3186.

Serviceman—from p78

radio sets would not work when first switched on, I can assure you that this kind of servicing calls for a completely different approach.

In these circumstances one learns to expect anything. If a set doesn't work it is just as likely to be because someone down the line was feeling a bit drowsy and fitted the wrong component, or fitted it the wrong way round, or transposed some cable connections, or a whole swag of other faults which will defy imagination. But, once conditioned to this situation, one learns to look for faults which could never occur spontaneously in the field.

But in field servicing that is exactly what one does look for; components which once worked correctly but have now failed. No one ever thinks in terms of wiring faults or incorrect components. Yet this is what this service department was faced with; a production line fault disguised as a field fault; a wrong component but with nothing to indicate that it was wrong.

So my bet is that they spent many fruitless hours looking for a non-existent faulty component, eventually reaching the conclusion that there was nothing wrong with the set, except that it wouldn't work properly!

I wonder how they finally tumbled to it? That would make a beaut story in itself.

Component kits for the laboratory

Recently released by Philips are several component kits for the workshop or laboratory. Our picture shows the carbon film resistor kit which consists of some 24 plastic drawers containing approximately 50 pieces each. Resistor values range from 10 ohms to 100k. Other kits in the range include: a ceramic capacitor kit (72 drawers, 25 pieces per drawer, 0.56pF–22000pF); a resistor PR & VR kit (56 drawers, 50 pieces per drawer, 10 ohms to 68M); a metal film resistor kit (56 drawers, 50 pieces per drawer); and a metallised polyester capacitor kit (56 drawers, 50 pieces per drawer, .01–6.8uF, various voltage ratings). Further information from Philips, Electronic Components and Materials, PO Box 50, Lane Cove 2066.

British amateur gear

These two items of equipment should be of potential interest to amateur radio operators. They are a 65-230MHz wavemeter and a 432MHz linear amplifier (Model EDL432), both manufactured by Polar Electronic Developments Ltd, England.

The wavemeter is a self-contained absorption type covering the 4 metre, 2 metre, and American 1½ metre bands (220MHz), as well as other useful frequencies encountered in amateur equipment. Being RF activated, it requires no batteries or external power supplies.

The instrument is particularly useful for lining up oscillator chains and multiplier stages in transmitters, receivers and converters for the various VHF bands. Cost is $64.40.

The Model EDL 432 linear amplifier was developed from an original design published in the German magazine "VHF Communications". It employs the popular 2C39A triode valve in a grounded grid configuration to give high gain and excellent stability.

Gain is typically 10dB with an anode voltage of 1kV, and output power is typically 50W with 5W drive. The input circuit is enclosed in an aluminium box and employs an air-spaced capacitor in an "L" configuration.

The anode circuit is housed in a separate die-cast box on top of the input compartment. The EDL 432 costs $187.45.

Reader enquiries to British Merchandising Pty Ltd, Box 3456, GPO, Sydney 2001.

Books & Literature

"Monumental . . ."

RADIO, TV & AUDIO TECHNICAL REFERENCE BOOK. Edited by S.W. Amos. Published by Newnes-Butterworths, London, 1977. Hard covers (pages not numbered), 215mm x 137mm, illustrated by circuits, diagrams and photographs. Price in Australia $55.00.

To judge by the jacket notes, this is one of a series of quite monumental reference books published by Newnes-Butterworths, including books for electronic, electrical, mechanical and civil engineers. They range in size from 1400 to 1800 pages and while the pages in this present book are not continuously numbered, I would guess that it is in the same league—measuring, as it does, over 60mm thick.

Pity the poor reviewer then, who somehow has to form an opinion and summarise so much material, not only spread over so many pages but well and truly packed tight, in relatively small type. To help him prepare this material, Editor S. W. Amos had the assistance of 31 highly qualified contributors. Before his retirement (to carry literary "bricks"?) S. W. Amos was head of the BBC Publications Dept and a regular contributor to "Wireless World". Perhaps this kind of background is more relevant to the credibility of the book than any remark I might make, based on a necessarily cursory examination of the contents.

But what of the contents?

It is divided into 35 chapters, 2 appendices and a general index – far too many headings to list individually. However, by abbreviating and compacting the subjects, the coverage might be summarised thus: Fundamentals of sound & TV transmission – Components – Transmission lines – Valves, picture tubes, etc – Semiconductor devices, circuits and manufacture – Microphones – Loudspeakers – Disc & tape recording – Hifi amplifiers – Sound & TV transmitters, studios & equipment – Propagation and antennas – Sound and TV receivers – Mobile radiotelephones – Batteries & power supply equipment – Test equipment – Installation and service, transmitters, sound and TV receivers, tape equipment, etc – Electrical interference – Formulas and equations.

Looking through the book, one finds a huge amount of basic information, as fundamental as it is timeless. But the illustrative diagrams and pictures which often lend a vintage quality to such material appear to relate to practice within the last decade, organised into a remarkably uniform style of presentation. As much of the text as I could read also indicated care in its preparation.

A purchase price of $55.00 is a considerable outlay, even in this inflationary era, but perhaps it's really not excessive for what is the nearest thing to a

complete electronics library within two covers. Our copy came from Butterworths, of 586 Pacific Highway, Chatswood, NSW, 2067. (W.N.W.)

. . . and another

RADIO HANDBOOK. Twentieth Edition by William I. Orr, W6SAI. Published 1975 by the E/E Division of Howard Sams & Co. Inc. Hard covers, 1080 pages 234mm x 160mm. Price in Australia $26.50.

The twentieth edition of an amateur radio handbook first created in 1934, this present volume contains a veritable mine of information for any amateur or prospective amateur.

It begins with a chapter on the background to amateur radio communications, then embarks on a comprehensive course of instruction commencing with electrical basics and working on through DC and AC circuit configurations and components. This done, the reader learns about semiconductors, vacuum tubes and their respective circuitry.

From chapter 7 to chapter 23 the reader is introduced progressively to the world of amateur communication-type receivers and transmitters, and to their associated principles and circuitry; to systems of modulation, design con-

siderations, problems of radio and television interference, mobile systems, power supplies, etc. One chapter is devoted to specialised amateur endeavour in the realm of radio teletype, slow scan television, space communications and moonbounce.

Chapters 24 to 30 deal with radiation, propagation, cables, antenna systems, and so on. Electronic test equipment takes up chapters 31 and 32, with further chapters on construction practices, electronic maths, components and reference data.

If this outline seems sketchy, it is because the chapter index itself, with headings and sub-sections take up no less than 5½ pages. At the back of the book is a subject index which picks up in detail where the chapter index leaves off.

All told, it's quite a book and, while intended primarily for amateur station operators, plenty of other readers could find it a most helpful reference. Our copy came from Prentice Hall of Aust. Pty Ltd, 7 Grosvenor Place, Brookvale, NSW 2100. (W.N.W.)

The Amateur Bands

by Pierce Healy, VK2APQ

20th Jamboree-on-the-air

The collaboration of radio amateurs and world scouting organisations over the past nineteen years has enabled Boy Scouts and Girl Guides to exchange greetings and expressions of good fellowship on a scale not practicable through the usual communication channels.

The 20th Jamboree-on-the-air will be held over the weekend 15th-16th October, 1977, starting at 0001 hours local time and terminating 48 hours later. These are suggested times only; many stations may find it more convenient to start on the Friday evening and each station is completely free to select its own times and periods of operation.

It is stressed that J-O-T-A is not a contest, but an opportunity provided by international amateur radio for Boy Scouts and Girl Guides to exchange greetings, and learn first hand of cultural and other activities in which they may share a common interest.

It is expected that the Governor-General and Chief Scout of Australia, Sir John Kerr, will again perform the opening ceremony in Australia from the national headquarters station, VK1BP, which will be located in the grounds of Government House, Canberra, ACT.

The basic rules remain unchanged:

1. Observe national licensing regulations—branch organisers or amateur radio friends can advise on these.
2. Use only authorised frequencies and modes of transmission.
3. Advise the branch organiser of your intention to participate.
4. Ensure that a report of your activities is sent to the branch organiser for inclusion in the official report.

This year the World Scout Bureau station will operate under the call sign F0AA from the village of Ferney-Voltaire in France, just across the border from Geneva. With the support of international amateur radio clubs and Ferney-Voltaire Scouts, operation will be on all bands and modes for the full 48 hours of the event. It is also hoped to use an OSCAR satellite.

It is suggested that a watch be kept for stations operating around the official world scout frequencies:

Band	Phone	CW
80 metre	–	3595KHz
40 metre	7.090MHz	7.030MHz
20 metres	14.290MHz	14.070MHz
15 metres	21.360MHz	21.140MHz
10 metres	28.990MHz	28.190MHz

Unfortunately the 80 metre phone frequency does not fall within the Australian amateur allocation.

During the past years overseas stations could hear and were eager to contact Australian stations but were unable to do so because the Australian stations were engaged in long contacts with their local counterparts. It is therefore advisable to listen before calling "CQ Jamboree", and between overs, to ascertain if overseas stations are endeavouring to contact you. Even invite a call from them.

Amateurs who may wish to offer the use of their station, either at home or from a scout hall or camp, may obtain further information from:—

National Organiser—Commissioner Noel Lynch, VK4ZNI, 15 Noeline Street, Dorrington, QLD 4060.

New South Wales—Branch organiser, Bob Clifton, 605 Pennant Hills Road, Beecroft 2199.

Western Australia—Commissioner Peter Hughes, VK6HU, 58 Preston Street, Como 6152.

South Australia—Commissioner Dick Ashton, VK5DQ, Lot 186, Ashton Rise, Hackham 5163.

Victoria—Commissioner Paul Thomas, 1 Rosemary Street, Chadstone 3148.

Tasmania—Commissioner Ken Lane, 15 Nelumie Street, Lindisfarne 7015.

Queensland—Commissioner Les Weller C/- Scout Headquarters, 132 Wickham Street, Valley, Brisbane 4000.

Girl Guides Association NSW—Mrs Valda Lambert, 4 Joffre Street, Hurstville South 2221.

The official report on Australian participation in the 1976 JOTA, compiled by the national organiser, Noel Lynch, VK4ZNI, contained this summary:—

Number of Scout groups and districts	– 605
Scouts and leaders	– 7571
Number of Guide companies	– 155
Guides and leaders	– 1554
Non-uniformed visitors	– 1221
Amateur stations	– 266
Amateur operators	– 356
Intra-state contacts	– 1763
Inter-state contacts	– 1792
Overseas contacts	– 1996

Two aspects of JATO are worth noting:— first is the excellent public relations created in many countries, at both governmental and local community levels. The second is the excellent opportunity to promote amateur radio as a worthwhile activity within the community.

With the foregoing in mind amateurs are urged to arrange with their local Scout or Guide group to participate in the 1977 JOTA. You will find it an enjoyable experience.

ITU NEWS

In case it should be thought that the International Telecommunications Union has problems only in the radio communications field here is an extract from a press release from Geneva;

The international telephone network is made up of many separate parts, millions of telephones, and hundred of thousands of exchanges and circuits between them, all of which have their individual properties and characteristics. The job of Study Group XVI of the International Telegraph and Telephone Consultative Committee (CCITT) is to consider and make recommendations about the speech performance of the connections that this network establishes.

One exciting new service is to extend this capability to ships at sea via communications satellites. Studies are being carried out of the many problems that must be solved if this new service is to take its rightful place in the automatic telephone network. Other groups are studying the equally challenging problem of getting the automatic control signals to and from the floating subscriber in order to set up connections, and of deciding what numbering scheme shall be used so that an individual ship can be selected just by using the ordinary telephone dial.

REMEMBRANCE DAY CONTEST

The opening address for the 1977 WIA Remembrance Day Contest was made by Horrie Young, VK3AYH, recently retired from the Postal and Telecommunications Department where he was assistant secretary of the Regulatory and Licensing Branch.

The following is a transcript of the address which was broadcast over all official WIA stations prior to the commencement of the contest on the 13th August, 1977.

It is a pleasure indeed to be given the opportunity to open your Remembrance Day Contest.

Of the various contests that are open to members of the amateur service in this country, this particular one is surely of special significance, in that it serves to remind us that there have been instances when we have had to temporarily shelve the practice of amateur radio and instead take up arms in defence of our country.

The role that the amateur radio operator played during hostilities, with his broad understanding of telecommunication technology and practical operating experience has been amply demonstrated and is no doubt appreciated in the defence area as well as by members of the community at large.

Unfortunately it is one of the sad facts of war that casualties are inevitable and of course Australian amateurs serving in the armed forces suffered in this regard.

It is to these men that we should direct our thoughts on the occasion of the Remembrance Day Contest. A positive way of revereing their memory, and expressing our gratitude to the sacrifices they made that we may be permitted to pursue our various interests in a free society, is by engaging in a competitive exercise using a communication medium which, in life, they knew so well.

As you participate in this contest you will doubtless be conscious of the fact that there are a number of countries whose administrations do not endorse amateur radio at all. I believe we can count our blessings in this regard.

In these days, when heavy pressure is being brought to bear by some administrations for greater radio frequency spectrum space, it is not so surprising that some overseas countries consider the amateur service as one rating a very low priority in their communication system or, indeed, any at all.

It goes without saying, of course, that in such circumstances the Australian amateur movement must remain ever watchful of the influence that such people can bring to bear, especially in the international forum that decides those issues.

It is surely important that the amateur service should continue to be active in various areas throughout the world as one forming a particularly useful part of our human society.

This service is also capable of providing a noteworthy contribution to education, in radio communication technology, as well as practicable communication craftmanship.

I believe that the skills used in the contest that you are about to commence are worthwhile contributions towards achieving this end.

And, now I know that you are all anxious to commence operating in your contest so I would just like to conclude by saying; thank you for listening and it gives me a great deal of pleasure to declare this, your 30th Remembrance Day Contest, open.

Good luck and happy hunting to you all.

WIRELESS INSTITUTE NEWS

The federal executive of the WIA, in collaboration with the International Amateur Radio Union, have prepared proposals for amateur service frequency allocations for the World Administrative Radio Conference in Geneva in 1979. These proposals (as

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.

AMATEUR BANDS

follow) have been forwarded to the Australian Post and Telecommunications authorities for consideration when preparing the Australian brief for that conference.

1. Return of the 1800-2000kHz band.
2. Eliminate sharing 3500-4000kHz band.
3. Expand the 40 metre band to 7000-7500kHz and eliminate sharing.
4. Allocate new amateur bands around 10.5MHz, 18.5MHz and 24MHz.
5. Expand the 20 metre band to 14-14.5MHz.
6. Expand the 15 metre band to 21-21.5MHz.
7. Retain the 10 metre band as is (28-29.7MHz).
8. Press for the retention of all presently assigned VHF/UHF bands, a new amateur band at 220MHz and obtain further amateur bands up to 275GHz.

These proposals were adopted in 1975 and it is difficult at this stage to indicate how they will finally crystallise into an integrated whole on a world wide basis.

In some important countries the possibility of amateur radio obtaining a reasonable share of the spectrum still shows considerable variations, resulting from pressures from other services.

Indications of the attitude of administrations to some of the submissions made by national amateur societies are:— Europe's CEPT, the organisation through which Europe coordinates its telecommunication policies, is unlikely to support a 220-225MHz allocation.

VERON, the Netherlands society, cannot expect to receive more than 10kHz in the 160 metre band.

In South Africa the portion 1930-1970kHz might be supported for amateur use but not on an exclusive basis. Indications are that it is going to be extremely difficult to allocate a portion of the 80 metre band exclusively to amateurs. The segment 7.0-7.15MHz for exclusive amateur use might be possible but the proposals for 10.1-10.6MHz and 18.1-18.6MHz were rejected. The use of 220-225MHz was rejected but 2300-2310MHz and 3400-3410MHz are considered acceptable.

Indications from Sweden show problems about the 3.5MHz and 7.0MHz proposals although the administration reacted favourably towards the 14, 21 and 28MHz proposals.

In Switzerland the authorities seem to be against 10MHz and 18MHz bands as well as 50MHz and 220MHz bands. But some support was detected for the 24MHz band proposal. Many difficulties appear in relation to retention of the 70cm band for amateurs except for the satellite window.

The first Canadian draft for WARC 79 provides three new bands at 10, 18 and 24MHz. The 80 metre allocation is reduced to 3.5-3.8MHz and for 40 metres a band 6.9-7.1MHz for exclusive amateur use.

These few extracts illustrate a few of the massive problems confronting the amateur service at WARC 79 and they affect all amateurs, not just members of national societies.

The work of the IARU, quite apart from forming basic international policy, lies in the dissection and evaluation of those variables to achieve a common position world-wide.

At the last international working group meeting of the IARU it was agreed that the next meeting of the group would be held in Geneva during the Aeronautical Mobile WARC in February 1978. Not only to discuss the international position but also to observe the proceedings in such a WARC and meet as many participants as possible. Most of the people attending would also be likely to represent their administrations at WARC 79.

Six new members have been accepted into the IARU. These are the amateur radio societies of Sierra Leone, Bahrain, Botswana, Turkey, Papua New Guinea and Jordon. The grand total for IARU societies is now close to the hundred mark. But remember, there are at present 153 countries who are members of the ITU with voting rights at WARC 79.

Among the items the WIA federal executive has submitted to the Post and Telecommunications Department is the subject of third party traffic.

On the 27th June, 1977 a letter was addressed to the P & T Dept. pointing out the concern felt by the Institute for many years about the absolute prohibition of third party traffic, particularly the effect of this on training for, and involvement in, emergency situations. It was pointed out that the basis of the Government's policy had always appeared clear, namely, the protection of the revenue in the preservation of its own monopoly of communications.

But this must now be assumed to have changed by the introduction of the CB service, acknowledging the needs and desires of a section of the community being given priority. The change is welcomed because if it can be extended to the amateur service it will enable that service to play an even more meaningful role in the community by gaining experience in message handling on behalf of others.

Not desiring to move away from the amateur service definitions in the ITU Radio Regulations, the Institute suggested that in the flow on from the decisions already made, it proposes that a regulation similar to the FCC's 97.114 should be adopted in Australia as a matter of urgency.

RADIO CLUB NEWS

WAGGA DISTRICT AMATEUR RADIO CLUB: The newly elected committee of the club is president—Harley Davison, VK2NFG; secretary/treasurer—Sid Ward, VK2SW; vice-president—Doug Menneke, VK2ZMP, committee members—Bruce Dicker, VK2NCZ, Russ Read, VK2AZR, and Brian Sheperd. WICEN coordinators are Sid Ward, VK2SW and Doug Menneke, VK2ZMP.

Meetings are held at the Wagga Rescue Club Headquarters, Bolton Street, Wagga, on the last Friday of each month at 8.00pm.

Visitors are always welcome. Club members play a very active role, through their WICEN organisation, during flood emergency periods in the area.

DARWIN AMATEUR RADIO CLUB: At a meeting called by a DARC WICEN co-ordinator Doug Haig, VK8JD, the general sequence and club organisation in times of emergency were set out.

General sequence—

Yellow—Alert WICEN members—low priority and drive.
—Nets—establish 2 and 80 metre networks to inform members, establish a 20 metre network with VK5 and VK6 call areas.
—Call backs—for 2 and 80 metres every two hours, for 20 metres every hour.

Amber—Full WICEN—high priority and drive.
—1. Co-ordinator to establish DARC station on the air.
a. HF link to south
b. link between club station VK8DA and VK8HA
c. 2 metre callback—members-to-members, to notify of intended emergency location.
—2. Members designated to shelters
a. no call backs—notify when leaving.
b. members must be aware of cyclone poster on display at club.
c. Items etc.—batteries, torches, communications, checked.

Red—If you are not inside now—too late.

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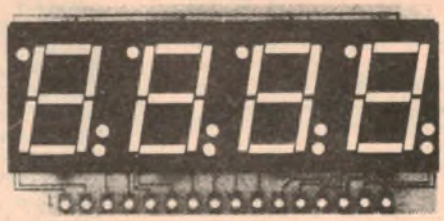
CK10 and CK20 counter module kits complete; with NSB 3881 Display $22.00; with NSB 5881 Display $23.00.



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Club organisation:

Amber—Establish radio networks on HF and VHF.

a. make contact with southern stations and establish WICEN on 14.1MHz. Notify WICEN of state of emergency and conditions.

b. Establish a 2 metre network to maintain up to date information for those on frequency and formulate what local assistance can be given if requested.

2. As personnel arrive . . .

a. secure area. b. secure cars, mobile capability first. c. secure all loose equipment etc.

3. Check water and fuel etc.

4. Check emergency aerials.

5. Remove 20 metre beam.

6. Remove 18AVT and 2 metre dipole antennas.

For communications just prior to, during, and immediately after the alert a long wire antenna and tuning unit for HF, and a 2 metre dipole ramset to wall, will be used.

Red—Fully secure club house and maintain contact as long as possible.

Procedures as emergency lessens and passes, and offer of services, have been set out in similar detail.

LIVERPOOL AND DISTRICT AMATEUR RADIO CLUB: Early in June, 1977, a group of interested amateurs decided to form a radio club to serve amateurs living in the south-western areas of Sydney.

The first formal meeting was held on the 12th July, 1977 in the State Emergency Services Hall, Christie Street, Liverpool. There was an attendance of 35 and the current financial membership is around 30 and growing each day.

Apart from the usual general interest meetings of a technical nature and club business the club provides social functions such as weekend barbeques.

Instruction classes are held at the SES hall each Tuesday evening at 7.30 pm. These cover novice level theory and Morse code practice.

Office bearers are:— President—Athol Tilley, VK2BAD, Vice-president—John Ham, VK2ZMT; Secretary/treasurer—Peter Harding, VK2NGK; Education officer—Louis Berley, VK2ZOA; WICEN/SES Ross Young, VK2YAR; Public relations—Sue Brown, VK2BSA; Assistant/PR—Nev Fenton, VK2ZBQ.

CENTRAL COAST AMATEUR RADIO CLUB: The call sign VK2EH has been issued to the CCARC. The station address is that of the club's new repeater site of Somersby.

The call sign VK2EH was requested by the club to perpetuate the memory of the previous holder, Ern Hodgkins. This action has received the full support of the NSW Division WIA and Ern's next of kin. The club feel that it is a fitting tribute to a man who did much for amateur radio.

REPEATER NEWS

WESTLAKES RADIO CLUB: Repeater now operational at Bar fire tower, Watigan state forest, on channel 10 (147.7MHz in: 147.1MHz out). Twin aerials in use temporarily, duplexer under construction.

BLUE MOUNTAINS RADIO CLUB: A site has been obtained at Medlow Bath. Repeater could be operational late September. To use channel 9 (147.65MHz in: 147.05MHz out).

ST GEORGE AMATEUR RADIO SOCIETY: A second repeater is being planned, to be sited on Mt Bindo (west of the mountains). Equipment is under construction and should be operational in November. To use channel 1 (146.05 in: 146.65 out).

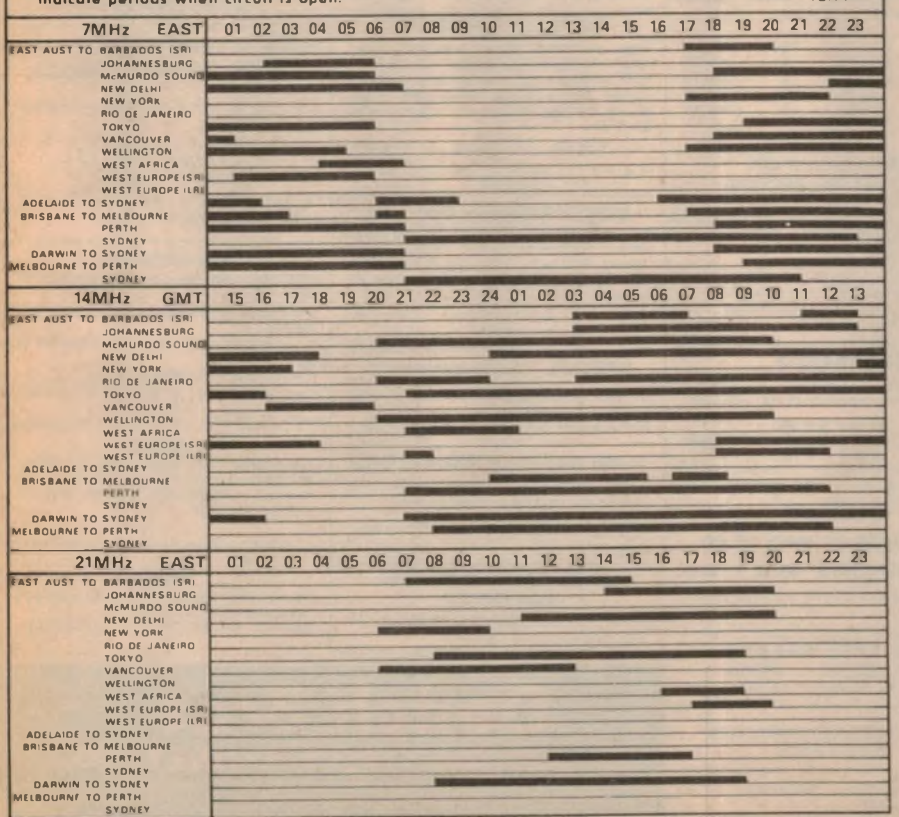
NORTH WEST AMATEUR RADIO GROUP: Repeater operational on temporary site near Tamworth. Final site still to be determined. Using channel 5 (146.15 in: 146.75 out).

VK3 WIA NORTH WEST REGION: Mt Macedon repeater still under test. No operational site yet available. To use channel 5.

WIA SOUTH AUSTRALIA DIVISION: Another repeater being considered for Adelaide region, but no site announced.

IONOSPHERIC PREDICTIONS FOR OCTOBER

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. 10.77



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SORRY NO C.O.D

Shortwave Scene

by Arthur Cushen, MBE

Radio Nederland, which recently announced plans to upgrade its transmitting facilities in Holland, is to retime its service to Australia next month. The station's "All Round DXers Course" has continued to be popular with listeners.

In recent years Radio Nederland has established relay bases at Bonair and Madagascar. Now the transmitters at Lopek in Holland are in need of upgrading. At the moment Radio Nederland has four transmitters of 100kW each, one of 50kW and one of 10kW. Having visited this transmitting site, I can say that it is undoubtedly one of the neatest laid out transmitting facilities now in operation.

The plans call for the installation of four transmitters of 500kW each. No decision has been made for the actual transmitting location; it could be at Lopek the present transmitting site or it could be an area in the province of Zealand in the south western corner of Holland. Of course, the studios will remain in Hilversum.

As for November the broadcasts in English through Bonaire will be retimed to transmissions of 50 minutes as against 80 minutes at present. They will be 0730-0820GMT on 9715 and 9770kHz and 0830-0920GMT on 9715kHz. A transmission in English from Lopek will be broadcast from November 6 1330-1420GMT on 5955, 6020, 6045, 7210 and 98895kHz.

Radio Nederland's "All Round DXers Course" has proved so popular that more than 10,000 have been issued to DXers world-wide. The course covers 26 lessons on all aspects of radio listening. It was written some years ago and was introduced with a special article by the writer. The course is still available from DX Juke Box, Radio Nederland, PO Box 222, Hilversum, Holland. The lessons are set out in groups of four and the listener is requested to answer questions contained with the lessons about various aspects the course.

LIBYA USES 500kW

The Libyan Broadcasting Service at Tripoli has been heard testing with its new 500kW transmitters at 0500GMT. The frequencies in use are 9500, 9700, and 15100kHz. These three new transmitters are located at Sabrata and our reception has generally been good on all three frequencies. 9500kHz does suffer interference from Albania from 0530, though.

According to the BBC Monitoring Service, the schedule of operation is 0430-0100GMT on 9500 and 11700kHz, while the transmitter on 15100kHz operates up to 1600GMT when the frequency is changed to 6100kHz. This frequency then carries the balance of the transmission. Programs are in Arabic and are a relay of the Libyan Domestic Service and Voice of the Arab Homeland.

According to a BBC report, the present schedule of the new Libyan transmitters is 1100-1600GMT on 9500, 9650, 11700, and 15100kHz; and 1600-2200GMT on 6100, 9500, 9650, and 11700kHz. A special transmission to North America is broadcast on 9500kHz from 2200-0100GMT. From this schedule, it is noted that a fourth transmitter has been added and the target areas are Eastern Arab countries, South East Asia, Europe and North America.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

FEBA POWER RESTRICTION

The Far East Broadcasting Association, Seychelles, which was off the air for three weeks in June, now operates at reduced power. According to a letter from the station the power has now been restricted to 50kW, while in the past some transmitters were using 80kW. Recently a frequency change has been observed, with 11900kHz replacing 11845kHz for the transmission in Arabic 0345-0445GMT. This frequency gives better reception, as the old channel of 11845kHz suffered interference from Radio Canada. The station confirmed reception reports with a card from Miss Liz Scott who is the Audience Relations Secretary. The mailing address of the gospel broadcaster is PO Box 234, Mahe, Seychelles.

VATICAN EXTENDS SCHEDULE

The Vatican Radio has informed us that they plan to add an additional transmission to Australia and New Zealand for our evening reception. Some years ago a transmission was heard during the summer months at 1130GMT and as soon as the 500kW transmitter is put into operation an extension of the schedule is anticipated.

The present broadcasts over the old 100kW transmitters are beamed to Australia and New Zealand 2210-2225GMT on 7235, 9615 and 11705kHz. However, when the new 500kW transmitter comes into operation, along with the new log periodic aerial, changes to this transmission as regards frequencies may be expected.

CLANDESTINE STATION CLOSES

The longest running clandestine station, and the one best known to short-wave listeners, Radio Espana Independiente, has closed down. According to the BBC Monitoring Service the station first commenced operating in 1941 and over the years has broadcast 108,300 programs. The broadcasts first originated from the USSR and were beamed to Spain in order to help the communist party in that country, but following the recent elections in Spain the broadcasts have been discontinued. The transmissions were heard on out-of-band frequencies and, after the initial broadcasts from the Soviet Union originated from Romania. Towards the end of the service, broadcasts appeared to emanate from a site in Bulgaria.

HCJB SCHEDULE

The Voice of the Andes, HCJB in Quito Ecuador, is using new frequencies for its service to the South Pacific up to November 6. The transmission to the South Pacific is on 6070kHz at 0830-0900 and 1230-1300GMT, 6160 at 0830-1200, 9745 at 0700-1030, and 11900 at 0630-1000.

Some other changes have taken place and the transmission formerly carried on 15295kHz 2000-0230 is now on 15345kHz, while the transmission formerly on 15345kHz 2230-0030 is now on 15375kHz. HCJB is broadcasting to Europe on 17865kHz from 1800-2100GMT, while a further transmission to Europe is broadcast 1300-1900GMT. HCJB appreciates reception reports. Their address is PO Box 691, Quito, Ecuador.

WORLD RADIO CLUB

The BBC World Radio Club has been retimed for reception in the Pacific area and is now broadcast at 0815GMT on Wednesday instead of Sunday as previously heard. Other broadcasts are on Friday at 2100GMT and on Wednesdays at 1330 and 2315GMT.

The Club now has 34,000 members and the program gives information for short-wave enthusiasts in language acceptable for the non-technically minded. Membership is open to all who write to World Radio Club, BBC World Service, PO Box 76, Bush House, London WC2 4PH. Reception of the World Radio Club to the Pacific on Wednesday at 0815GMT is best on 7150, 9640 and 11955kHz.

LISTENING BRIEFS

EUROPE

SPAIN: Radio Nacional Espania is using the unannounced frequency of 7155kHz for a broadcast to Europe in English 2030-2230GMT. The transmission, on this frequency, was reported by Bill Vogel of Adelaide in DX Post and is an hour long with a repeat at 2130GMT. Two other frequencies are used also—9505 and 11840kHz—while a DX program is noted on Saturday at 2115 and 2215GMT. Madrid has returned to 17735kHz for the Spanish transmission to Australia from 0800GMT. The same program is broadcast on 9530 and 11730kHz.

AFRICA

SOUTH AFRICA: The program of Radio 5, which is a service for teenage listeners in South Africa is now being broadcast on short-wave. According to Gerry Wood of Radio South Africa, the transmission 0300-0530 and 1530-2200 is on 3388kHz, while the broadcast from 0530-1530GMT is on 6010kHz. Due to the fact that 3388kHz is close to Malawia on 3380 and Rhodesia on 3396kHz, this frequency could be changed depending on reception in the Southern Africa area.

PACIFIC

COOK ISLANDS: Rarotonga has dropped the use of 3265kHz in place of 5045kHz for their transmissions. The station has been observed opening at 1630GMT and closing at 0830GMT. The full schedule is 1630-0130 and 0430-0830GMT.

TAIWAN: The Voice of Free China has been heard with strong signals on 17800kHz with the transmission in Spanish to Latin America. The schedule is 2300-2350 on 9510, 9600, 11860, 15225, 17720 and 17800kHz. According to the station announcement, these frequencies are all in operation but only 17800kHz provides reliable reception. English broadcasts from Taipeh at 2140GMT are still well received on 17890kHz.

AMERICAS

CANADA: Radio Canada is heard on new frequencies for its daily transmission in English and French beamed to Europe 0600-0700GMT. The frequency of 9785kHz has replaced 9660kHz and is giving excellent reception during this transmission, while the other frequency changed is 11790kHz which has been replaced by 11935kHz.

USA: WINB Red Lion Pennsylvannia is using 11730kHz for its service to South America and has been heard at 0145GMT before Athens blocks out further reception. The Oakland, California station WYFR has been noted on 9525 and 9715kHz with its service to Latin America and this includes programs in Spanish and English. Reception has been around 0400GMT.

VENEZUELA: Radio Turismo, Valera, has been heard by Sam Dellit of Brisbane opening at 0927GMT on 6179kHz with the national anthem. Full identification is heard at 0929GMT, then Venezuelan music. Another strong signal from Venezuela is on 6190kHz where Ecos del Torbes is heard from around 1000 to past 1100GMT.

DOMINICAN REPUBLIC: Radio Clarin has added a second transmission in English which is broadcast at 2130GMT to Europe, while the other program at 2330GMT to North America continues to be broadcast. According to the BBC, Radio Clarin has discontinued its internal network because of the coverage of its 50kW transmitter on 11700kHz.

INFORMATION CENTRE

VIDEO BALL GAME: Recently, while browsing through your January 1977 issue, I noticed a letter from N.L. of St. Ives, NSW who complained of troubles with the horizontal oscillator in the Video Ball Game (May 1976, File No. 3/EG/8). As I experienced similar troubles I may be able to solve this problem, and also problems suffered by other constructors of this excellent project.

The base diagrams you published for the SOT-54/2 (TO 92 variant) transistors were for the Philips BC548 transistors. The transistors supplied in the kit I received for repair were the National Semiconductor variant in the TO 92 case. As should be well known, the emitter and collector leads for the National Semiconductor types are reversed when compared with the Philips types.

In the case of the kit, I received for repair the only action needed (apart from removal of excess solder, repairing dry joints and replacing overheated tracks) was to reverse the collector and emitter leads of TR1 and TR2. By some fluke, the original constructor had inserted the TR3 transistor correctly.

I trust that you will be able to pass this information on to N.L., as the symptoms he describes are very similar to the ones I found. As other constructors of this project may have experienced similar troubles with their kits, you may care to advise all readers per medium of your excellent magazine. (M.W., Noble Park, Vic.).

• Thank you for this information, M.W., which we have reprinted in full for the benefit of all interested readers.

DARKROOM TIMER: I want a darkroom timer: (1) Digital LSI readout and "stop-start". (2) Count seconds to one hour (minutes and seconds) (3) Programmed alarms to 10 steps—3.13, 3.75, 15.30, etc., to any preset program selected by the operator. It is important to know exactly what part of the program is in operation to a total time of one hour. (4) Alarm to ring at 30 second countdown, and at end of each step, to allow a drain time for chemical in use and time to ready the next chemical. (5) The light from LEDs is not likely to fog film unless exposed for several minutes quite close. However, a dimmer would probably be appreciated by the fastidious colour worker if he uses tray processing. On the other hand photographers like to do as much processing as possible in room light so it must be bright enough to be visible under these conditions. (6) It would be nice to have real time as well. Nothing seems to be available at present and if a unit were cheap, say $25 to $30, you could sell them in made-up form or kit. (J.L., Christies Beach, S.A.)

• Perhaps we would be able to add a mechanical hand which would load and unload cameras, and agitate the tank according to a prescribed pattern! Seriously, J.L., yours is a tall order. While there is no doubt it could be done, we seriously question your suggested price of $30. (Incidentally, Electronics Australia does not deal in components, kits, or complete hardware in any form.) Meanwhile, how's this for a suggestion. Record the entire processing sequence, including timing, on tape. Audible instructions function regardless of room lighting and, by using tape, they can be made as comprehensive as necessary.

TACHOMETER FOR CDI: I recently fitted the Capacitor Discharge Ignition System, featured in the July 1975 issue, to my Rover 3500. The system performs well except that it is not compatible with the impulse tachometer.

I would very much appreciate any advice you can offer me to overcome this difficulty. (W.L., Lane Cove, NSW.)

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

REPLIES BY POST: Limited to advice concerning projects published within the past 2 years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Available only until our stocks are exhausted. Within 3 months of publication, face value. 4 months and older, if available, $2. Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

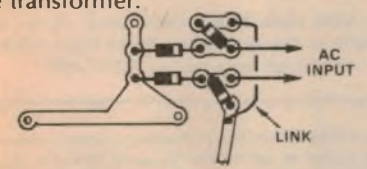
COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield. 2014.

• Unfortunately, the majority of tachometers currently fitted to cars are not compatible with CDI systems. The only solution that we know of is to modify your existing tachometer to the circuit of the "Tune-up Tachometer" featured in August 1975 (File No 3/TM/11). This is not a particularly attractive solution, but at the moment "that is the length of the rhubarb".

200MHZ FREQUENCY METER: Since the 7805 voltage regulator will accept up to 40V DC input I decided to use a transformer with an 11 volt secondary, but without a centre-tap. I have provided a sketch of a modification to the board to enable a bridge rectifier to be used with the transformer.



This also leads to a simple means of powering the DFM from an external battery supply. All that is required is a changeover switch on the input to the bridge rectifier and a pair of terminals for the battery input. This method has the advantage that the polarity of the battery supply is unimportant, by virtue of the bridge rectifier.

I have one small criticism of your setting up instructions. These imply that when assembly is complete, power may be applied. This could lead to tears in the event of a power supply fault. I suggest that the power supply components be mounted first, and then tested before continuing with the rest of the work.

There is mention of eleven PC pins but no mention as to where they are to be used. I assume that nine of them are for connections to the range switch, while the remaining three are for the transformer secondary connections. Since they receive scant mention in the text this could lead to some confusion with less experienced builders. In the photographs the 7473 and 7414 are shown in sockets although this is not mentioned in the text. I cannot see any reason why this particular pair of IC's should be socketed. Perhaps some kerfuffle occurred during development.

Cheers and keep up the good work. (B.M., Burwood, VIC).

• Thank you for your comments. As you can see, we have condensed your letter. Your idea of employing a different transformer is a good one although we would not recommend higher input voltages than you have used. In practice, we have found the 5V regulators to be very reliable, but modifications such as yours make it advisable to check the power supply before "powering up".

We take your point about the PC pins but in any case most readers appear to have figured out where to put them, as you have. IC sockets are not specified for any of the IC's and we do not recommend them for the 95H90 or 74C926's. They were used during developmental work and time did not permit their removal before the photographs were taken.

MINI SCAMP: I am currently employed as a programmer, working with RPGII on an IBM System 32 minicomputer. My knowledge of programming is good, but when it comes to the hardware side of things, I find myself a little out of touch. For example, can the KITBUG ROM be used if your Mini Scamp is to be connected to your video terminal, or would a new operating system be required? (N.MacP., Hurstbridge, Vic.)

• As you can see we have shortened your original letter somewhat, N.MacP., as some of your questions will hopefully have been answered by the later articles on Mini Scamp. Yes, you can use the KITBUG ROM to handle basic interfacing between Mini Scamp and our video terminal, as the terminal uses the standard 110-baud asynchronous serial data format used by a Teletype ASR-33 or similar ASCII teleprinter.

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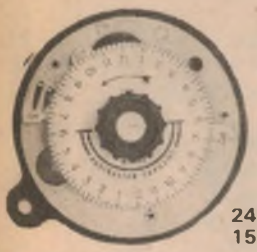

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SPECIFICATION OF STOCK RANGE

Type No.	Series Connections	Parallel Connections
PL 6 / 5VA	6 volts at 0.83 amp	3 volts at 1.67 amp
PL 9 / 5VA	9 volts at 0.56 amp	4.5 volts at 1.11 amp
PL 12 / 5VA	12 volts at 0.42 amp	6 volts at 0.83 amp
PL 15 / 5VA	15 volts at 0.33 amp	7.5 volts at 0.67 amp
PL 18 / 5VA	18 volts at 0.28 amp	9 volts at 0.56 amp
PL 24 / 5VA	24 volts at 0.21 amp	12 volts at 0.42 amp
PL 30 / 5VA	30 volts at 0.17 amp	15 volts at 0.33 amp

DIMENSIONS

L = 55 mm

W = 42 mm

H = 34 mm

The pins are centred to multiples of a 0.1 inch P.C. Grid. Secondary terminals are spaced 0.2"—0.4"—0.2". Primary terminals are spaced 0.8", spacing between primary and secondary is 1.7".

VARIATIONS AND FEATURES

- ★ Double insulated, plastic enclosed, designed to comply with relevant clauses of Australian Standard Codes and Telecom Australia Specifications.
- ★ If required, quick connect terminals enable mains voltages to be kept clear of P.C. Board.
- ★ May be supplied without plastic enclosure, if size is significant, which reduces dimensions to H = 30 mm, W = 38 mm and L = 51 mm.
- ★ Variation in volts from No Load to Full Load (5VA) is approximately 15%
- ★ The transformers may be loaded to 7VA with an extrapolation of regulation.
- ★ Provision is made for five pin terminals and two quick connect terminals at each end, suitable combinations may be manufactured to order.
- ★ Plastic mounting lugs enable transformers with quick connect terminals to be fitted to metal chassis.

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AD 162		$1.60	EACH	OR	2	FOR	$ 3.00
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AS2 18		$2.20	EACH	OR	2	FOR	$ 4.00
BC 309		9c	EACH	OR	15	FOR	$ 1.00
BC 350		8c	EACH	OR	15	FOR	$ 1.00
BFY 50		40c	EACH	OR	3	FOR	$ 1.00
BFY 51		40c	EACH	OR	3	FOR	$ 1.00
BFY 90		$1.20	EACH	OR	2	FOR	$ 2.00
BF 337		80c	EACH	OR	3	FOR	$ 2.00
SE7055		55c	EACH	OR	2	FOR	$ 1.00
TIP3055		80c	EACH	OR	3	FOR	$ 2.00
2N2904		36c	EACH	OR	3	FOR	$ 1.00
2N2904A		36c	EACH	OR	3	FOR	$ 1.00
2N3566		36c	EACH	OR	4	FOR	$ 1.00
2N3568		45c	EACH	OR	3	FOR	$ 1.00
2N3638		30c	EACH	OR	4	FOR	$ 1.00
2N4355		45c	EACH	OR	3	FOR	$ 1.00

BC 350

PNP GENERAL PURPOSE SMALL SIGNAL. 40 V., 100 mA. 1 WATT DISSIPATION AT 25 DEGREES CASE TEMP. DC CURRENT GAIN OF 40 TO 400. LOW SATURATION VOLTS. f_T OF 200 MHz AT 20mA. MADE BY MOTOROLA.

8c EACH, 15 FOR $1.00, 100 FOR $6.00 AND ONLY $25.00 FOR 500.

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400mW ZENERS IN THE FOLLOWING VALUES :

8.2V, 12V, 22V, 24V, 27V, 30V.

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BOARDS FOR ALL PROJECTS ARE AVAILABLE, PRICES AS FOLLOWS FOR EACH BOARD :

SINGLE LAMINATE	90c	6c	PER SQUARE INCH
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DOUBLE FIBREGLASS	$1.80	12c	PER SQUARE INCH

BOARDS TO YOUR OWN POSITIVE OR NEGATIVE ARTWORK AVAILABLE AT THE SAME COST PROVIDED ARTWORK IS SUITABLE FOR PHOTOGRAPHY.

TAG TANTS

3.3	uF	35V	25c	EACH OR 5	FOR	$ 1.00
33	uF	10V	25c	EACH OR 5	FOR	$ 1.00
47	uF	6V	25c	EACH OR 5	FOR	$ 1.00
68	uF	3V	25c	EACH OR 5	FOR	$ 1.00
100	uF	3V	25c	EACH OR 5	FOR	$ 1.00

POLYSTYRENE

120 pF	15c	EACH OR 10	FOR	$ 1.00
270 pF	15c	EACH OR 10	FOR	$ 1.00
470 pF	15c	EACH OR 10	FOR	$ 1.00
820 pF	15c	EACH OR 10	FOR	$ 1.00
.0047 uF	20c	EACH OR 8	FOR	$ 1.00

CAPACITORS

PICTAIL TYPE

22	uF	50V	11c	EACH OR 10	FOR	$ 1.00
22	uF	63V	12c	EACH OR 10	FOR	$ 1.00
100	uF	50V	15c	EACH OR 8	FOR	$ 1.00
220	uF	25V	20c	EACH OR 6	FOR	$ 1.00
220	uF	50V	30c	EACH OR 4	FOR	$ 1.00
470	uF	25V	30c	EACH OR 4	FOR	$ 1.00
470	uF	63V	30c	EACH OR 4	FOR	$ 1.00
1000	uF	50V	40c	EACH OR 3	FOR	$ 1.00
2500	uF	25V	49c	EACH OR 3	FOR	$ 1.00
2500	uF	35V	65c	EACH OR 3	FOR	$ 1.00
3300	uF	16V	49c	EACH OR 3	FOR	$ 1.00

PC BOARD TYPE

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47	uF	50V	15c	EACH OR 8	FOR	$ 1.00
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470	uF	50V	30c	EACH OR 4	FOR	$ 1.00
1000	uF	35V	40c	EACH OR 3	FOR	$ 1.00

POLYCARBONATE

.082	uF	100V	12c	EACH OR 10	FOR	$ 1.00
.047	uF	100V	12c	EACH OR 10	FOR	$ 1.00
.1	uF	100V	12c	EACH OR 10	FOR	$ 1.00
.33	uF	100V	12c	EACH OR 10	FOR	$ 1.00
.47	uF	100V	12c	EACH OR 10	FOR	$ 1.00
.56	uF	100V	12c	EACH OR 10	FOR	$ 1.00
.47	uF	250V	12c	EACH OR 10	FOR	$ 1.00
.56	uF	250V	12c	EACH OR 10	FOR	$ 1.00
1	uF	100V	25c	EACH OR 5	FOR	$ 1.00
1.5	uF	250V	55c	EACH OR 2	FOR	$ 1.00

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DP2	2PIN DIN PLUGS	25c	10	for $2.00
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100K	DUAL LINEAR	59c	2	for $1.00
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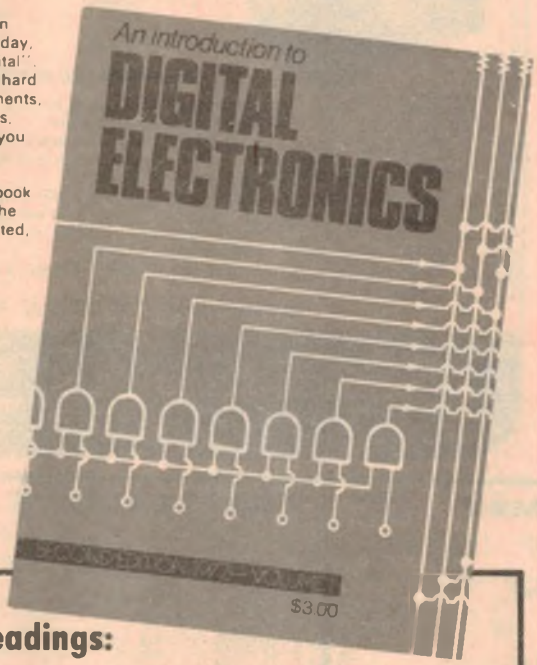

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4. Logic convention and laws
5. Logic design: theory
6. Logic design: practice
7. Numbers, data & codes
8. The flipflop family
9. Flipflops in registers
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15. Arithmetic circuits
16. Timing & control

Glossary of terms

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Advertising Index

WHY YOUR NEXT CASSETTE SHOULD BE A MAXELL UD

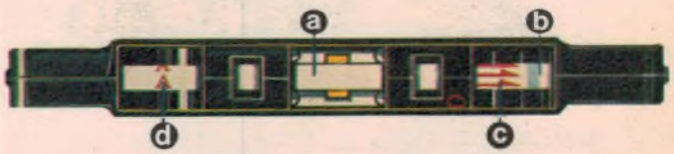
1 THE RESEARCH — More than twenty years ago, Maxell produced their first reel of magnetic tape. At that time, Maxell made a commitment to produce and sell only the finest magnetic products their technology could create.
That commitment still stands today.

2 THE TAPE — This continuous research has lead to the development of the Maxell UD (ultra dynamic) cassette. A tape that has a coating of super-fine PX gamma ferric oxide particles with an extra smooth mirror-finish surface.
All of this adds up to high output, low noise, distortion free performance and a dynamic range equaling that of open reel tapes.

3 THE SHELL — Even the best tape can get mangled in a poorly constructed shell. That's why Maxell protects its tape with a precisely constructed shell, made of lasting heavy-duty plastic.
No fixed guide posts are used. Instead Maxell uses nylon rollers on stainless steel pins thus eliminating the major cause of skipping, jumping and unwinding.
A tough teflon (not waxed paper) slip sheet keeps the tape pack tight and flat. No more bent or nicked tape to ruin your recording.
Maxell doesn't use a welded seal, but puts the cassette together with precision screws. Result — Maxell doesn't jam.

ULTRA-DYNAMIC UD

4 THE LEADER — A leader tape that has a four function purpose.
a) Non-abrasive head cleaning leader (cleans recording head for 5 secs.).
b) 5 second cueing line (recording function starts 5 seconds after the line appears).
c) Arrows indicating direction of tape travel.
d) A/B side mark (indicates which side is ready for play).



Now you know why your next cassette should be a Maxell UD (ultra dynamic).

maxell®

The sound expert's cassette. UD available in C60, C90 and C120.
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WT GD 127M

Our power is your glory.

JT-V71

JA-S71

Our Tuners

Our new range of tuners is built with the same attention to detail to afford more listener satisfaction. We weren't satisfied with the general market standard, and it was only by doing a complete re-appraisal of the two main tuner functions that today we can offer you the best in AM/FM. Each tuner is built to deliver entire state-of-the-art high fidelity performance, and tuning accuracy, to afford you stable and errorless station selection.
JT-V71 tuner (to match JA-S71 amp.) Sensitivity — 1.8 microvolt (IHF); Signal to noise ratio — 75dB; Selectivity — 75dB. Also available: JT-V31 (to match JA-S11 and JA-S31).

JVC

the right choice

Our Amplifiers

Today's sound requirements demand high power at low distortion. And the new JVC lineup is no disappointment in this respect. Featuring extremely high quality transient response, very large plus-minus dual power supplies, large capacitors and large transformers, and the exclusive JVC tripple-power-protection.
RMS output power — min. 80w. per channel; THD — less than 0.1%; Signal to noise ratio — 100dB; Power band width — 10Hz to 100kHz. Also available: JA-S11 (30 watts RMS per channel) and JA-S31 (40 watts RMS per channel).

For details on JVC Hi Fi Equipment, write to: JVC Advisory Service, P.O. Box 49, Kensington, N.S.W. 2033.