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MAY 1979

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ELECTRONICS Australia

VOL. 41 No. 2 MAY, 1979

Australia's largest selling electronics & hi-fi magazine

Teach yourself computing!

Designed specially for the beginner, this new microcomputer project talks directly to your TV set and is programmed in easy-to-learn high level language — but it will only cost you around $100! See our story on page 82.

Stereo Equaliser

Our new Playmaster Equalier has performance equal to or better than the finest commercial models, but you can build it for a fraction of the price. The description starts on page 56 . . .

On the cover

Engineer Les Wilson poses with one of the receiving aerials for the weather satellite ground station he has built at Sydney's Macquarie University. Weather pictures from the station are used daily by Sydney TV stations, as explained in our story on page 18. (Picture by Sungravure photographer Warren Webb).

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Editorial Viewpoint

Accountability still not airborne . . .

Until now, I have resisted the urge to comment here on the Australian Broadcasting Tribunal's public hearings for TV station licence renewals, but the events that have taken place in the last few weeks seem to demand some comment. The first hearings in Adelaide were unsatisfying enough, but the Sydney hearings surely bordered on the farcical.

There were challenges to the legality of the hearings and the objectivity of the Tribunal's chairman; rejection of some public interest witnesses and arguments regarding submission relevance — and acceptance of others — with no clear criteria established; the acceptance of a principle whereby some witnesses could be cross-examined but could not perform cross-examination themselves; and clearing of the public from the "public" hearing by Commonwealth police. On top of this came the dramatic resignation of the Tribunal's only member who did not have a background in commercial broadcasting.

Day by day the hearings limped on, but the only real result was that the Tribunal's credibility steadily crumbled away. The Tribunal's chairman and the Minister for Post and Telecommunications have both made statements reaffirming their committment to the public accountability of broadcasters, but in the absence of any real effort to salvage the situation these assurances have sounded particularly hollow.

What the hearings have demonstrated with crystal clarity is that the whole concept of linking public accountability with licence renewal just won't work, particularly with the Broadcasting and Television Act as it stands at present. In fact it probably won't work anyway, because refusal to renew a station's licence is such a draconian measure that in practice it can never be used.

It seems to me that we need an Act which clearly and unambiguously defines the principles upon which public accountability of broadcasting is to be based. Then we need a Tribunal with members representing a broad range of community interests, to interpret those principles in practice. The broadcasting industry should obviously be represented on such a Tribunal, but only as one interest group among many. And finally the Tribunal needs the power to set realistic penalties commensurate with a misdemeanour — like ordering the station off the air for a specified period on a specified day, for example.

One thing is certain. Unless the Federal Government acts to change the Broadcasting and Television Act, to remove its legal ambiguities and give it some "teeth" which will work in practice, the Tribunal will soon lose whatever credibility it may still possess. And with it will go public confidence in the Government's committment to public accountability in broadcasting.

— Jamieson Rowe

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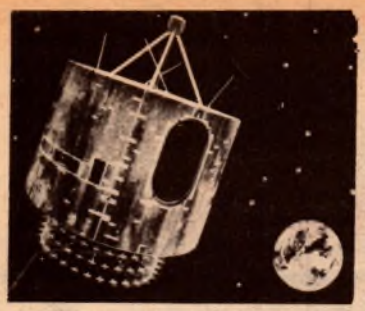


News Highlights

Innovations in auto electronics from NS

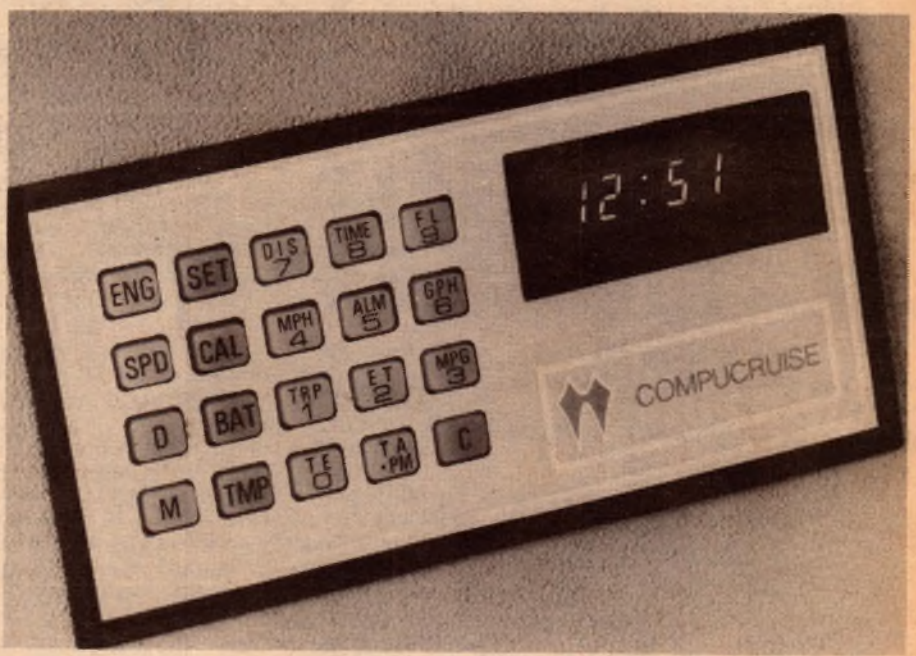
National Semiconductor Corporation has mounted a major effort aimed at making it a major supplier of advanced electronic systems in cars. Already, the company has shown a range of innovative new products.

NS has identified several key areas in the automobile which it says can be enhanced through the use of advanced semiconductor technology. The car of the future could include such electronic gadgetry as: electronic computer-controlled ignition; radios with electronic tuning and AM stereo; electronic clocks, speedometers, tachometers, displays and trip computers; electronic braking; anti-skid controls; and electronic fuel injection.

The company already supplies devices for such systems as speed controls, illuminated entry, intermittent wiper controls, and the Trip Computer used in the Cadillac Seville.

Recent product releases from NS and based on NS components, include:

- A computer-controlled, pushbutton seat adjustment system;
- A digital tuning system for AM-FM car radios;
- The Prince On-Board Computer, and
- The Compucruise computer.



The Compucruise on-board computer: it performs no less than 44 different control and measurement functions.

Computer-controlled seat

The computer-controlled seat adjustment system was developed jointly by NS and Recaro. It uses NS' low power COP410L 4-bit microprocessor to enable the driver to automatically find the correct seating position.

The Recaro seat can be adjusted in four different ways — it can be moved back and forth, up and down, the entire seat tilted backwards or forwards, and the seatback tilted backwards or forwards. Each of these positions is programmed via four switched on a keyboard. Two memory keys are provided so that a set of positions for two different drivers can be stored in RAM.

Once the system has been programmed, the driver has only to press the appropriate memory key and the seat will automatically adjust to his correct seating position.

Digital tuning system

Also microprocessor controlled, the digital AM-FM tuning system is a highly versatile unit. Its mains features include: precise tuning and display of station frequency, keyboard entry of station frequency, storage of several stations in memory, pushbutton scanning and station search, power on to last station tuned, provision for a clock, and static drive of the LED display for noise-free operation.

The unit uses phase lock loop techniques and is built around just four integrated circuits: the COP420L microcomputer, the DS8907 PLL synthesiser, the MM5450 serial data LED driver and the LM130 voltage regulator.

On-board computers

Manufactured by two different companies, the Prince On-Board Computer and the Compucruise both use 4-bit microcomputers from NS' COP400 family. The Prince is made by Prince Corporation and has 36 keys and switches, each offering single function operation, and two digital displays.

Trip information on the Prince is available as miles or kilometres to go, distance travelled, distance on a tank or tanks of fuel, vehicle location and vehicle speed. The driver can pre-program trip stops and turnoffs and have an audio-visual warning one mile before they occur. Time functions are available as time of day, elapsed time, stop watch, time alarm, and estimated time of arrival (constantly updated).

Fuel functions are displayed as instant or average miles or kilometres per gallon, instant or average cost per mile or kilometre, fuel used, and cost paid per gallon.

Compucruise is similar in concept, and can perform no less than 44 functions! It can indicate the most fuel-efficient driving speed, can give inside and outside temperature and coolant temperature, can function as a cruise control (the driver just enters the desired speed via the keyboard), and can even tell you when the car needs a tune-up!

Desktop computers from Matsushita

Japanese electronics giant Matsushita Electric has entered the Australian microcomputer market with a range of compact desk-top computer systems to be sold under the National Panasonic brand name. The new systems will be marketed by The Computer Company Pty Ltd, 4 Cliff St, Milson's Point, NSW.

Four systems will be marketed initially, differing only in the size of the disk storage. The 700 features of 160Kb of dual minidisk storage, the 800 500Kb floppy discs, the 850 1Mb of double-sided dual floppy disks, and the 870 2Mb of dual double-density floppy disks. Prices will range from as low as $5000 for a system configured as an intelligent node in a distributed processing network.

Typical price for a stand-alone system is approximately $16,000 including packaged software, a 150cps matrix printer, installation and training.

The processor is built around Intel's 8085A chip and is offered with either 32k or 64k bytes of main memory.

AWA-Ford link for DISCON bid

Amalgamated Wireless (Australasia) Limited and Ford Aerospace and Communications Corporation (FACC) have joined forces in pursuit of the contract for the Defence Integrated Secure Communications Network (DISCON).

FACC was recently announced by the Minister of Defence (Mr Killen) as a qualified potential prime contractor for the DISCON program.

Besides participating in the overall system design, AWA will have subsystem design responsibilities in the areas of terminals and transmission.

Viewdata demo in Moscow

The British Post Office's viewdata system Prestel, which enables its customers to use the telephone and domestic television sets to obtain information from a central computer, was demonstrated to government departments in Moscow in January. A week earlier the system was displayed at the White House, Washington.

The initiative for both demonstrations came from the governments concerned. The immediate object is two-fold. First, a viewdata national network would provide instant government contact with the public. Second, an internal, closed viewdata system linked to the data banks of each government department could reduce paperwork and time spent in internal communications.

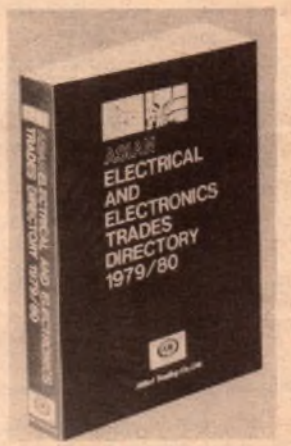
The British Government was the first to take up the Post Office's invention. The system is now on trial in the UK and due to go public before the summer of this year. It already contains nearly 8000 pages of advice and information from various government departments as well as commercial information such as share prices, theatre guides, sports results and weather reports.

Directory of Asian firms & products

Published only last February, the first edition of the "Asian Electrical and Electronics Trades Directory" provides details of over 3500 active manufacturers, suppliers, exporters, importers, wholesalers, distributors and agents in all Asian countries except Japan. The countries covered are Korea, Hong Kong, Taiwan, Singapore, Indonesia, Malaysia, Thailand and the Philippines.

The 632-page volume indicates the availability of electrical and electronic components, instruments, equipment and appliances. Besides the company name and location, information is provided on such things as: year established, number of employees, names of top executives, capital & assets, and annual turnover.

The directory is arranged country by country, with each company listed in alphabetical order. An alphabetical product index identifies and locates suppliers of the various products.



"Asian Electrical and Electronics Trades Directory" is available from the Australian agents, Information Interface Publishing Pty Ltd, 3rd Floor, 121 Walker St, North Sydney 2060. Price is $104.00.

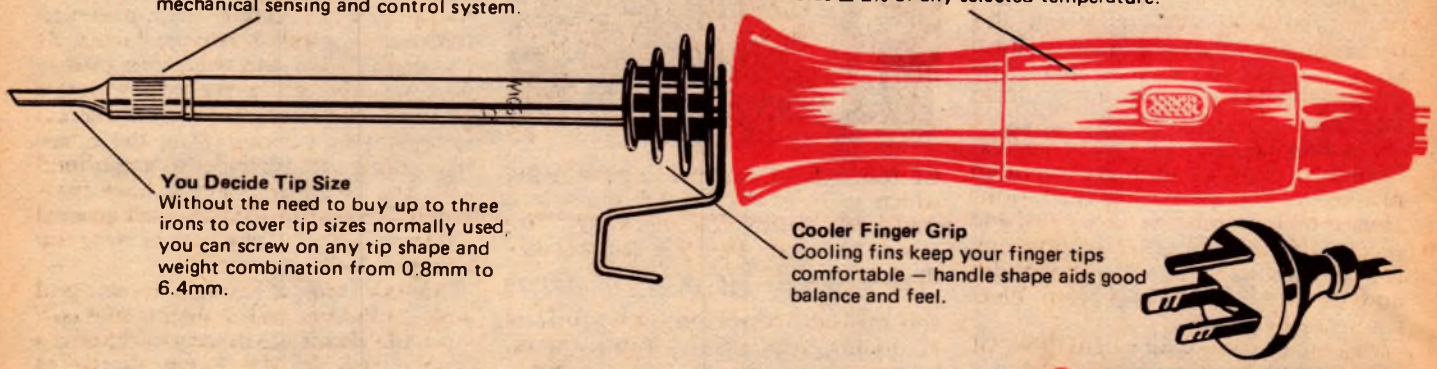
AWA wins ICAO Doppler VOR contract

Amalgamated Wireless (Australasia) Limited has been awarded a contract by the International Civil Aviation Organisation (ICAO) for the supply of one of the company's successful type VRB-50D Doppler VOR (very high frequency omnirange) aircraft navigational beacons for the Civil Aviation Training College in Thailand.

A professional iron with adjustable temperature–wattage and tip size...

Automatic Wattage Selection
Let the actual wattage required for the job be decided by the iron's simple mechanical sensing and control system.

Automatic Temperature Control
Dial any intermediate temperature 200°–400°C without changing the tip; holds ± 2% of any selected temperature.



You Decide Tip Size
Without the need to buy up to three irons to cover tip sizes normally used, you can screw on any tip shape and weight combination from 0.8mm to 6.4mm.

Cooler Finger Grip
Cooling fins keep your finger tips comfortable – handle shape aids good balance and feel.

240V Mains Operated

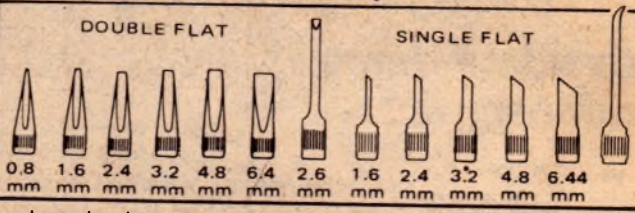
Have you experienced the frustration of starting to use your 15 watt iron only to realize the tip is going cold before the solder flows – alternatives?

(a) Wait 5–10 minutes to heat up your 30 watt (even though the tip on it is really too big). (b) Be a supreme optimist and hope your 15 watt will eventually heat up the joint before you cook the component and lift the track. (c) Switch on your SCOPE TC60 and while waiting the 45 seconds to heat – screw on the tip size you really want.

The SCOPE TC60 will decide the wattage required for each joint.

SOLDERING–DESOLDERING STATION

Long life tips for Scope TC60 iron.



Iron plated screw-on pre tinned. *This tip is fitted as standard.

Some other SCOPE TC60 features –

- **Component Protection** is aided by earthed tip and barrel. Critical components and operator can then be earthed to common point.
- **Simplicity** of temperature control system suggests less maintenance. An expanding metal probe detects temperature variations inside each tip and operates a mini micro switch in the handle.
- **Temperature Key** is inserted into handle. 40°C variations per quarter turn. Key is removable to discourage unwanted alteration to temperature setting.
- **Neon** indicates when power is being applied to elements – monitors control system.

50V, 24V Versions are available with 50W element.

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Multi-pole solid state DIL relays

A solid-state relay to replace and upgrade electromechanical switches in critical military and commercial equipment has been developed by General Electric electronic researchers.

Described as "industry's first optocoupled power field effect transistor", GE's miniature semiconductor switch is a unique combination of electronic components, including a light-emitting diode (LED), a photodiode array chip, and a MOSFET. Light from the LED activates the solid state relay and also provides for high-voltage isolation between input and output signals. The power MOSFET provides the "contact function".

The new GE device is said to be "extremely rugged" and is intended primarily for switching functions aboard military vehicles, airplanes, and spacecraft, where shock, vibration, and rough handling — combined with dirt and dust — play havoc with electromechanical relays.

In commercial applications, the GE solid state switch is expected to serve as an interface between power circuits and microprocessors in such products as major appliances, transformers, lamps, and motors, as well as in electronic controls for automobiles.

GE researchers display a sample relay, which provdes four switch poles in a standard 16-pin DIL package. The power switching elements are MOSFET devices.

Vic. teachers visit BWD factory

BWD Electronics recently hosted a visit by representatives from the Victorian Education Department involved in teaching electrical and electronic principles. Representatives from RMIT, Moorabbin Technical College, Box Hill Technical College, Sunshine Technical College, Belcombe Army Apprentice School and the State College of Victoria toured the BWD factory, examining techniques used in the production of oscilloscopes, power supplies and a wide range of instruments.

BWD described their current success in producing and distributing their wide range of instruments as having been due to a combination of aggressive marketing techniques and the application of new technology to keep their products competitive.

Canada may supply Aust. satellite

Canada has become the frontrunner to supply Australia with hardware for a domestic satellite, following a recent visit to Canada by the Minister for Post and Telecommunications, Mr Staley.

For the Canadians, who have been engaged in space research for more than a decade, the potential Australian requirement for a communications satellite has huge economy of scale advantages. If they can successfully sell their technology for a first generation satellite to Australia, they will have markedly reduced costs for their own system.

The Canadians are said to have particular expertise in the use of low-powered satellite transmitters, or transponders. Putting high-powered transponders into a satellite lowers its useful life span and therefore pushes up cost, although saving money on the ground through small antennas. However, by concentrating the beam of a satellite transponder to a confined area, the Canadians claim to have combined the cost savings of small ground antennas with reduced power from the transponder.

Buying the Canadian-developed Anic C satellites off the shelf would cost Australia about $25 million each, plus a launch cost via the Space Shuttle of about $10 million each. Ground stations would cost around $1000 each.

Biological risks of EM radiation

An American scientist has recently warned of the possible harmful biological effects of electromagnetic radiation.

Speaking in Maryland at the National Bureau of Standards' second annual Workshop on Electromagnetic Interference, Don R. Justesen said that there were two "warring" parties of scientists — those who believe there are no biological consequences other than thermal effects; and those who believe that long-term low-level exposure to electromagnetic radiation poses hazards to organisms, including man.

Justesen, head of the neuropsychology and behavioural laboratories at the Veterans Administration Hospital, Kansas City, noted that organisms are sensitive to the Earth's natural electrical and magnetic fields (birds use the magnetic field to navigate), and that artificial sources of electromagnetic energy "could" interfere with biological systems. He called for further study in this area.

NEWS HIGHLIGHTS

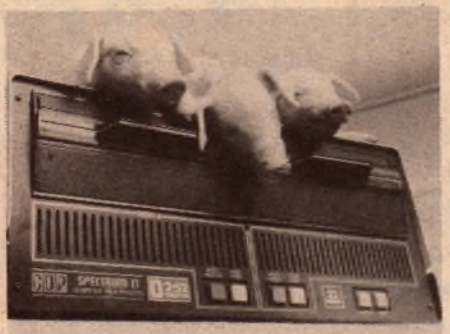
Computer to help run pigfarm!

Australian computer manufacturer D. D. Webster Electronics Pty Ltd of Scoresby, Victoria, recently completed its most unusual installation to date. The company installed its Computex Spectrum-11 Model D computer in the farmhouse loungeroom of pig farmer Paul Davis!

As well as the computer, the installation includes an ADM3A video terminal, a Teletype 43 printer, and an RT11 operation system — all for a total price of $13,500. Mr Davis, a former computer programmer, created the software himself, and is now using the system to manage the piggery. He says that it will save time, eliminate tedious bookwork, and provide more accurate day-to-day reporting to help him increase his profits.

A sample of the sort of information and reports it can give include:

- Which pigs are ready for market;
- Which are the superior breeders at any given time;
- Where genetic defects occur;



- When it is time to retire an animal from breeding;
- Feeding schedules and their costs.

Besides a fully comprehensive pig management program, the system also includes sales and cost analysis, production and forecasting, budgetry control, standardised accounting and least cost rations.

Inmos pilot plant for Colorado

Inmos, the £50 million company set up by the Government's National Enterprise Board to put Britain into mass production of computer chips, has moved its United States headquarters from Dallas, Texas, to Colorado Springs. The company's US pilot production plant and research development centre are also to be established there.

The American decision follows quickly on the decision to establish the British research centre in Bristol where currently Iann Barron, the British microprocessor expert, who is co-founder of Inmos with two Americans, has begun recruiting staff.

The establishment of the US centre in Colorado has surprised some experts because it is away from Silicon Valley, the world centre of microelectronics in California. The reason is presumed to be that there will be less competition for experienced engineers and space.

Fixed head VTR

Toshiba Corporation has developed a fixed-head video tape recorder featuring a cassette with a single reel of endless tape. The 100 metre loop of tape has 220 tracks across its width, runs at 6 metres per second, and gives one hour of playing time.

The relative speed between the head and the tape is similar to that of the currently popular helical-scan VHS and Betamax VCRs (which use a slow-moving tape and rapidly moving heads), permitting the use of similar types of heads and tapes.

IBM develops 1um FET technology

An experimental one-micrometre technology that can produce silicon microcircuits nearly 10 times as dense as present ones has been developed by researchers at IBM's Thomas J. Watson Research Centre in the United States. The circuits also switch three to four times as fast as earlier circuits of the same type, and dissipate one-tenth the power.

These experimental computer circuits are believed to be the smallest silicon logic circuits yet fabricated in large arrays. The technology would make it possible to put 256,000 memory locations, or more than 10,000 logic switches, on a chip 4 millimetres square!

New satellite station at Ceduna

The Australian Overseas Telecommunications Commission (OTC) has started work on a $10 million earth satellite station at Ceduna, South Australia. The new station, to be known as Ceduna 2, will operate alongside an existing station and will operate to a second satellite in the Indian Ocean region. This will mean that Australia will have two direct and separate communications links to Europe.

With the exception of the surface panels for the antenna dish, the antenna will be fabricated in Australia. Amplifier equipment is to be supplied by E-Systems Corporation, of Dallas, Texas, while multiplexing equipment will be manufactured by Standard Telephones and Cables Pty Ltd.

Winners of Parameters/EA contest No. 6

Pictured at left and above are the prizewinners in the Parameters-EA Grand Instrument Contest No. 6, being presented with their prizes. At left is 1st prize winner Jim Maguire, of Concord West, NSW, and above 2nd prize winner Kit Scally of Ryde NSW, both with Peter Thompson of Parameters.

Japan fights back — innovation is the key

Faced with declining competitive power due to sharp appreciation of the yen, harassed by protectionism in Europe and North America, and under pressure from manufacturers in Taiwan, Korea and Hong Kong, Japanese companies are responding with an explosion of innovative products and sweeping relocation of production.

by GENE GREGORY

3-9-10 Shimo Ochiai, Shinjuku-ku, Tokyo, Japan.

At the Japan Electronics Show this year a vast and spectacular array of new products provided convincing evidence that the Japanese industry intends to meet mounting competition from other Asian electronics manufacturers with continuing technological leadership. In the limelight were promising innovations such as PCM (pulse code modulation) adapters which convert home video cassette recorders into super hifi audio tape systems, PCM disc systems with laser playback, new metal particle cassette tapes which reportedly equal open-reel tapes in sound quality, a new generation of metal particle tape decks, flat-screen TV sets, miniaturized hifi components, and a variety of new applications of microprocessors.

These new prima donnas have not emerged full blown like Venus rising mature from the foam, as in Greek mythology. Nor are the Japanese electronics manufacturers magicians who can produce dazzling innovations with a snap of the finger. Years of laboratory R&D, as well as industrial engineering were required, with more time for market testing.

Matsushita video disc system.

Some of these innovations are the industry's answer to a question posed by the life cycle of its leading growth product in the 1970s, colour television. Extensive development programs begun early in the decade to find new growth products are now yielding a steady flow of new products. And, given the pace of development in other Asian industries, they could not have come at a better time.

But new products for export do not solve the problem of rising protectionism in principal markets. Quantitative restrictions on imports, arbitrary imposition of dumping duties, and administrative and judicial harassment have combined to accelerate the expansion of overseas production, particularly in the United States and Europe. Hitachi, Toshiba and Sharp are now following in an exodus that began after the first yen revaluation when Sony and Matsushita established their first production facilities in North America and the Caribbean. This year, however, Japanese makers began increasing the volume and the varieties of their products manufactured in advanced countries, as well as in those developing countries that still have unfettered access to major industrial markets.

Sanyo Electric Co., for example, has adopted a comprehensive global rationalization plan intended to balance domestic operations, exports and overseas manufacturing activity. In pursuit of this objective, Sanyo is moving production of radios, tape recorders, CB radios and small stereos to its affiliates in South Korea, Taiwan, Hong Kong and Singapore. Colour TV production at its Warwick facilities in Arkansas is now running smoothly and is due for expansion, and stereo manufacture has begun at the company's new plant in San Diego, California. Meanwhile, in Europe, Sanyo has recently formed a joint venture with Italian partners to produce a range of home entertainment equipment for EEC countries, adding to its already highly successful operations in Spain.

The group's production abroad in the year ending November 30 is estimated at 220 billion yen ($A956 million approx), accounting for 27 percent of total Sanyo sales. The comparable ratio for the previous year was 21 percent. While Matsushita still produces more in its 29 overseas manufacturing facilities, the share of offshore production in Sanyo's total output is about twice that of their Kansai neighbour.

Just how fast and extensive this shift to overseas manufacturing has been is best illustrated by colour TV production in the US, which this financial year is expected to overtake total Japanese exports of television sets to that market.

By early August last year it had already become apparent that Japanese colour TV manufacturers would likely fail to attain the volume of exports to the US fixed by the orderly marketing agreement between the Japanese and US governments for the year ending next June.

Under that agreement, Japanese colour TV makers are obliged voluntarily to restrain their exports to the US to a pro rata quota of a total 1,750,000 sets yearly. In the first year of "voluntary restraint" that ended last June, Japanese exports were exactly on target.

But the prospect has worsened since

Above: National's VHS video cassette recorder. Unit is available in Australia and features pushbutton controls, a digital clock, and a timer for automatic recording and switch-off.

Just released by National Panasonic, the Model TR-5010A is a portable b&w TV receiver with a 13cm screen and an in-built AM/FM radio. It can be operated from the mains, a car battery, or from its own internal batteries.

the yen exchange rate against the US dollar rose to break the 190 yen level at the beginning of August. As a result, compensatory retail price rises on the US market have made Japanese 48cm and 30cm colour TVs more expensive than their American counterparts, wiping out their price competitiveness and, accordingly, resulted in a decline of sales.

Japanese manufacturers have therefore begun totally to shift production of these standard trade models to offshore plants, switching exports to larger, more sophisticated models.

Innovations in colour TV by Matsushita alone this year have included large-screen TV projection systems, integrated circuits which automatically control colour saturation, multi-purpose TV sets equipped with two screens mounted in the same cabinet, a video signal processing device which makes it possible to record and reproduce both sound and pictures using a standard audio cassette tape recorder and a colour TV receiver, a new single-beam picture tube with low power consumption, and another tube — the Quintrix II — which substantially improves image resolution. In addition, Matsushita also unveiled the world's first pocketable monochrome TV with a 6cm liquid crystal display screen. The tiny TV unit looks like a cigarette case and weighs only 640 grams.

Similarly, Hitachi, Sanyo and Sharp have developed various types of electro-luminescent film panels using liquid crystals or light-emitting diodes which will replace conventional picture tubes. These panels, which can be hung on the wall like a photograph or painting, inaugurate a new era of flat screen TV. Development of a thin colour panel is still for the future. But demand for black-and-white sets, especially in the battery-powered pocketsize version, is expected to be substantial.

Meanwhile, Japanese colour TV makers are fighting a proliferation of rearguard legal battles in the US. The Ministry of International Trade and Industry, along with 10 major Japanese TV manufacturers, have decided to appeal to the US District Court to overrule the US Treasury Department's decision to impose $US46 million antidumping duties on imports of Japanese colour television sets during a two-year period up to June 1973.

The duties are being imposed retroactively on the basis of the Treasury Department's ruling in 1971 that Japanese-made colour TVs were being dumped in the US and the excuse that the Department simply never got around to imposing the duties earlier. The deadline for the duty payment was set for November 26, 1978, but the companies concerned made it clear in advance that they had no intention of complying with the Treasury Department's order.

MITI and the TV manufacturers claim that the method used in assessing the duties is contrary to international rules and that importers could eventually be forced to pay as much as $US400 million for the period up to 1977. The matter was made worse by a further incidence of double jeopardy when the National Union Electric (NUE) of the US filed a court action for damages amounting to $400 million on grounds that dumping of Japanese TV sets in the US caused the bankruptcy of US TV makers.

Beset with so many troubles abroad, Japanese colour television manufacturers found a source of encouragement in the decision of the Government to start sound multiplex broadcasting on an experimental basis in October. The Japan Electronics Industry Association expects the demand for multiplex adapters will amount to 369.7 billion yen ($A1.6 billion) in the three

Not much bigger than a credit card, this mini electronic calculator from Toshiba doubles as a digital watch with calendar, stop watch and alarm. The unit is only 3.5mm thick.

Japanese industry fights back . . .

years from fiscal 1979 to 1981, pending the development of a new generation of multiplex receivers.

This development will provide further impetus to Japan's audio equipment makers, who seem to have entered a new era of stable growth following a sharp zigzag in production during the past several years. Production — which showed an annual growth rate of 20 percent up until 1974, making Japan the world's largest source of audio equipment — suffered a severe setback in 1975 when total output dipped below the previous year. Although production again rose substantially in 1976, it lapsed into a 2.4 percent decline in 1977.

It is generally believed that production this year will increase by about 6 percent, continuing to rise at an annual rate of between 5 and 10 percent over the next several years. Faced with the continuing appreciation of the yen and import restrictions in some important markets abroad, Japanese manufacturers are not expecting any sharp increases in exports. Neither are they expecting any steep rises in domestic demand, despite the development of smaller system components one-third to one-fifth the size of conventional counterparts.

The pacesetter for the trend toward smaller hifi components has been Pioneer Corporation, which recently put on the market system components one-third the size of conventional units. According to Pioneer engineers, development of these miniaturized units was motivated by the size of Japanese houses; but these "mini" components are also expected to find enthusiastic reception outside Japan.

Parallel with the trend towards miniaturization, Japanese manufacturers are eliminating the need for interconnecting cables by equipping record players with FM transmitters. A complementary FM receiver is fitted to the amplifier. Conventional push-button and lever switch actuators are also being replaced by electronic touch control systems, and several makers have introduced MPU-programmable cassette decks using microcomputers capable of automatically selecting up to 20 tracks by remote control.

In a yet more extensive use of microcomputers, Hitachi has introduced a "control centre" — an AM-FM tuner with an in-built preamplifier and a microprocessor to control both a cassette deck and a record player. An infra-red remote control device enables the user to control all functions from his armchair!

It's only a matter of time, too, until digital techniques usher in stereophonic systems that use lasers to play back plastic discs encoded with pulse-code-modulated (PCM) audio signals. Manufacturers have just begun discussions to come up with the unified standards necessary before PCM can become a practical alternative. Mitsubishi, Teac and Tokyo Denka are jointly developing a semiconductor laser pick-up device which is expected to considerably reduce the cost of optical video disc systems, and which will make possible the combination of video playback and ultra-hifi audio reproduction in a single system.

Sanyo Electric Co. has already shown a PCM adapter for video cassette recorders that can be used for VHS, Beta or industrial video systems, converting them directly into super hifi audio systems.

Side-by-side comparison of two remarkable TV displays from Matsushita. Pocket-size TV receiver at left employs a flat LCD screen, while portable colour receiver at right features a single beam TV tube with no shadow mask.

With this development, the VCR for home use is expected to fulfill its anticipated role as the successor to colour TV as the product leader of Japan's consumer electronics industry.

At present, Japanese firms produce most of the world's VCRs. With domestic demand estimated at 500,000 units and the US market at 700,000 sets in 1978, the inauguration of exports to the European market in 1978 boosted production to 1,400,000 sets — or double the output of 1977. In 1979 and 1980, the industry expects to produce 2,250,000 and 3,300,000 sets respectively, which would mean a growth rate between 45 and 47 percent. The ratio of exports to total proeuction, which was 52.6 percent in 1977, is expected to rise gradually to 58.1 percent in 1979 and 60 percent in 1980.

By 1980, it is expected that unit production costs will drop to about 150,000 yen ($A650) which will bring the VCR within reach of 41 percent of Japanese consumers, leaving another 34 percent of the market to be tapped if prices can be lowered to 100,000 yen ($A430).

The outlook for calculator, electronic wristwatch and CB radio demand is not nearly so brilliant, however.

Retail prices for quartz watches have dropped drastically since the beginning

Left: the SM-3700 is the latest addition to the Toshiba range of 3-in-one stereo music centres and features pushbutton FM tuning, a belt-driven turntable, a Dolby cassette deck, 4 band tuner, and a 20W RMS per channel amplifier.

Japanese industry fights back . . .

JVC JR-S600 stereo receiver with in-built graphic equaliser.

Teac A-107 stereo cassette deck. An impressive performer, it features Dolby noise reduction, memory rewind, and automatic cut-out for all functions.

From Aiwa comes the TPR-950, a portable stereo cassette recorder loaded with features and incorporating a multi-band radio. Power output is quoted at 5W per channel.

of 1978, with some new models placed on the market recently at retail prices below 10,000 yen ($A43), raising the curtain on a new era of severe price competition. At the same time, watch manufacturers have moved voluntarily to curb their exports this year in view of mounting moves to restrain the nation's overall exports.

Watch exports have been rising sharply since 1975, reaching 28.5 million pieces last year — a phenomenal 45 percent increase over the year before. The watch industry initially expected about a 15 percent gain in 1978, despite the yen appreciation and a sales offensive by Swiss makers now massively entering the quartz watch market. But they have since revised their estimates downward as major makers, such as Seiko and Citizen, have moved to curb their exports this year in line with the request of MITI (Ministry of International Trade and Industry). Both Seiko and Citizen will in turn boost production abroad, supplying movements from Japan.

Seiko has already launched quartz wristwatch production in Singapore, and is supplying several European makers with movements for production of quartz watches under their own brand name. Citizen has in the meantime begun quartz watch production at its Hong Kong factory, doubling production in the Colony, and will build a new factory in the Republic of Korea.

After a bitter experience in 1977, makers of electronic calculators saw the market turn for the better this year. Efforts to produce calculators of higher value, added with complex functions and ultra-thin design, succeeded in boosting demand in Japan and abroad for replacement and additional machines.

As in the colour TV and audio fields, innovation in calculator design and production the past two years has been an impressive demonstration of the industry's ability to extend the life cycle of products once the market has become saturated. Competition in innovation has replaced price competition, with favorable results for both sales and profitability.

Production of the new generation of calculators — broadly classified into thin and complex types — has been possible as a result of advances in power-saving LSI technology and the development of FEM liquid crystals. Improvements have also been made in small silver oxide batteries and new lithium batteries are being used in some machines. As most calculators are now equipped with CMOS large-scale integrated circuits and liquid crystal displays, power consumption has been reduced, enabling the manufacture of thinner and smaller calculators.

At the same time, Sharp Corporation has developed a unique automation system for producing substrates and other inner parts of electronic calculators with only 5 percent of the labour required by previous production processes. The first production using this system went on stream at the beginning of 1978 at the company's Nara plant to produce 200,000 calculators monthly. Sharp's monthly calculator production capacity of 1.5 million was expanded to 1.9 million last July when a second line using the new production method was added to the Nara facfory.

But there is a limit to global demand, and with worldwide output of calculators ranging between 70 and 80 million units annually, prospects for future growth of the Japanese industry in this area are limited. At present, the Japan Business Machine Makers Association does not expect either production or exports to rise above their 1976 record highs before 1980. But given the volatility of this market and the rapid changes in technology it is hazardous to make predictions beyond the relatively short-term.

If the outlook for calculator production is uncertain, prospects for CB radio are downright dismal. Both production and exports of CB radios, which held stage centre as one of Japan's star exports only two years ago, have continued their sharp decline. A survey of 30 principal CB radio makers earlier this year indicated that one-third of the firms had suspended production entirely, while other makers had slashed output by as much as 70 to 90 percent of record levels in 1976.

Those manufacturers that could do so have shifted production to other lines, such as car radios and stereo equipment. But for many makers exclusively producing CB radios, that option was not available. Most of these have resorted to drastic retrenchment and sale of fixed assets to cope with the situation. However, since an early recovery in demand for CB radios cannot be anticipated for quite some time to come and the staying power of these specialized firms is limited, they are expected to disappear from the scene.

Albert Einstein: a centenary tribute

March 14 this year marked the centenary of the birth of Albert Einstein, the scientist who formulated the theory of nuclear energy and the laws of relativity. This article is a tribute to that centenary.

by ELMAR LAISK, M.Sc.
Visiting Fellow in Physics at Macquarie University.

It is a remarkable coincidence that the two scientists who did so much to formulate the theories of nuclear energy were both born, within a week, one hundred years ago.

Albert Einstein, the founder of the Theory of Relativity and the father of nuclear energy was born on March 14, 1879 in Ulm; Otto Hahn, the discoverer of nuclear fission, on March 8, 1879 in Frankfurt-Main, Germany. Their birth places were not far apart, but they were only destined to meet when both were celebrities in their respective fields — relativity and nuclear chemistry.

It is also notable that Einstein's birth and James Clerk Maxwell's death concur in 1879. Einstein's theories made much use of Maxwell's theory of electromagnetism. The only other similar coincidence between giants of science occurred in 1642 when Galileo died and Newton, his supreme scientific successor, was born.

Numerous universities and learned societies all over the world commemorated Einstein's 100th birthday this March. In particular, ceremonials took place in the USA, his adopted country; in Switzerland, the birthplace of Special Relativity; in Israel, his national country; and in India, where another famous scientist, S.N. Bose contributed in a way to the theory of relativity.

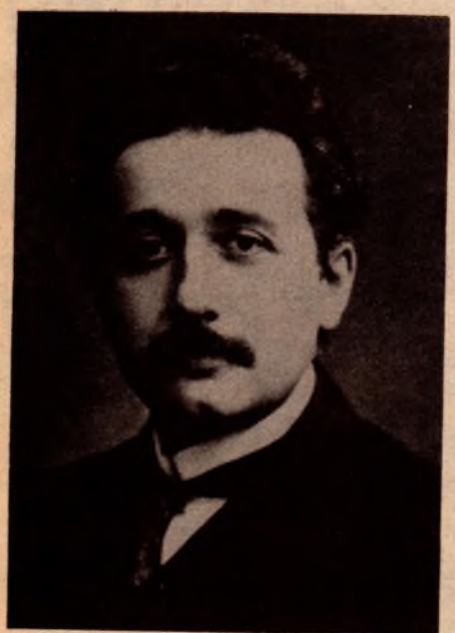
Einstein's life — a summary

Albert Einstein's early years were spent in Munich, Germany, the family having moved there soon after his birth in 1879. At first, Albert appeared retarded and withdrawn, avoided physical exercise, and did not mix readily with other children. He seemed to daydream a lot.

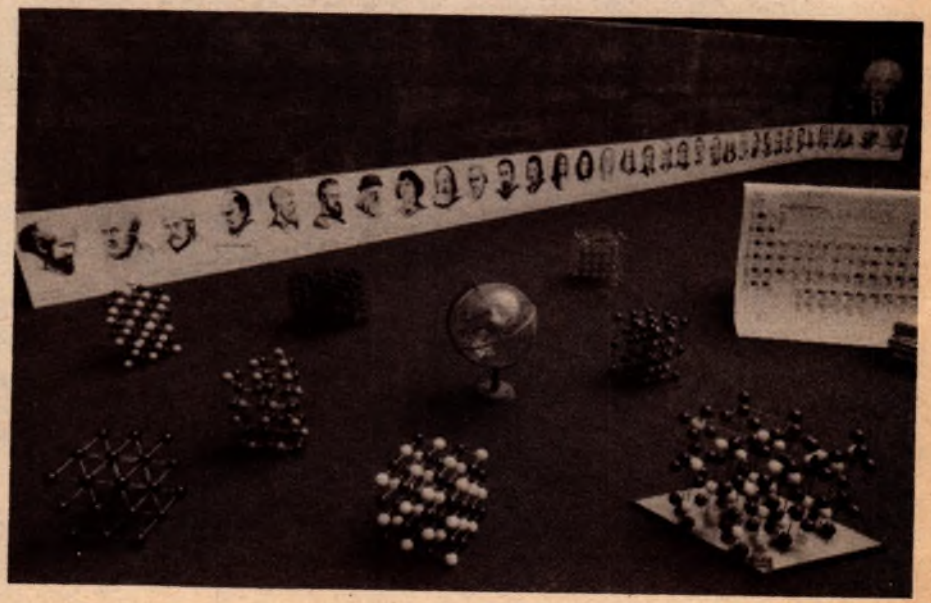
His mother loved music, Beethoven in particular, and arranged violin lessons for the six year old Albert. At first he did not like violin; but as his skills improved so did his enthusiasm and he especially enjoyed playing Mozart sonatas. The violin gave him many blessed moments of relaxation throughout his later life.

Although the Einstein family was Jewish, young Albert entered a neighbourhood Catholic primary school and thereafter a nearby high school. He disliked most of the subjects because of rote learning, except mathematics and physics. His interest in these was promoted by his uncle, an

BELOW: A photograph of Einstein, taken around the time of the formulation of the Theory of Special Relativity.



BELOW: A symbolic display at Macquarie University to commemorate Einstein's centenary. Life-size portraits of great scientists serve as milestones leading from the early Greek era of Aristotle, Euclid and Archimedes to the mighty trio of Newton, Maxwell and Einstein. The crystal structure and the sky globe signify the impact of Einstein's theories in nuclear physics.



engineer, and by a young relative who studied medicine and fed science-hungry Albert with books on mathematics and physics. His first memorable experimental gadget was a simple magnetic compass whose behaviour intrigued him for years.

When his father's business failed in Munich, the family resettled in Milan. Only Albert stayed behind to complete his high school education. But he badly failed in exams.

Although a high school drop-out he firmly decided to study physics at the famous Swiss Federal Polytechnic, the ETH in Zurich. Once again he failed the entrance examinations. But his mathematical papers were so brilliant that the Director of ETH personally encouraged him to complete an entrance course in Zurich. This time he was successful and was admitted to the university.

Once in university he again preferred to read books on physics instead of attending lectures and practicals. Professor Pernet who was in charge of practical physics commented "Why don't you study law or medicine rather than physics?"; and Professor Weber:". . .but you have one fault: one can't tell you anything". Some of the exams he passed only with the help of lecture notes by his good friend Marcel Grossmann, a talented mathematician who later was helpful in discussing the mathematical formulation of the theory of relativity.

After graduation in 1900 he could not find a professional job. Grossmann's father recommended him to the Swiss Patent Office where he became a Patent Examiner in 1902. But whenever possible, and in all his spare time, he tried to solve the enigmatic problems of contemporary physics — the constancy of the speed of light, the Fitzgerald contraction, Lorentz mass enlargement and Poincare's arguments against absolute time and space; also Mach's views about their interdependence.

Then suddenly in 1905 at the age of 26, dissociated from any university, he published five "breakthrough" papers in rapid succession. The most important one, termed the *Theory of Special Relativity*, comprehensively and logically explained the length contraction, mass increase and time dilation in fast moving systems, and later the mass-energy equivalence.

It took a few years for the importance of the Theory of Special Relativity to be fully recognised. Then in 1909 he was offered professorships in Prague and Zurich, and in 1913 became Director at the famous Kaiser Wilhelm Institute in Berlin on the recommendation of two eminent physicists, Planck and von Laue.

The Theory of Special Relativity deals only with uniformly moving bodies. In 1915 Einstein published his *Theory of General Relativity*, involving accelerated motion in curved space caused by massive bodies; and gravitation as an effect of space curvature.

In 1933, at the beginning of Hitler era, he was on a lecture tour in the USA and decided to stay. He accepted the directorship of the School of Mathematics and Physics at the Institute of Advanced Studies in Princeton, where he died on April 18, 1955.

Einstein was showered with numerous academic and civil honours during his life, among them the Nobel Prize in 1921 for his work on the photoelectric effect. He was invited to lecture in England, the USA, Japan, Spain and many other countries. On tours he discussed science and politics with Lloyd George, Churchill, Roosevelt, Truman, and many other top statesmen. He knew every top scientist of his era: Lorentz, Bohr, Planck, von Laue, Rutherford, Dirac, Minkovski, Hahn, Oppenheimer, Millikan, de Broglie, Curie, Yukawa, Schrodinger, Heisenberg, Fermi, Szilard, and others.

Philosophically, Einstein had a few ups and downs. One mistake was his firm belief in causality: every event in nature could be explained by its antecedent conditions. The arrival of Quantum Physics with Heinsenberg's Uncertainty Principle blew that theory.

The laws of relativity . . .

(1) The laws of mechanics are not affected by a uniform rectilinear motion of the system of coordinates to which they are referred. One cannot find the absolute velocity of such a system from observations within, but only relative to another system. Einstein's theory postulates that the observed value of the velocity of light is constant, and is independent of the motion of the observer.

(2) Mass, length, time and energy are not absolute and independent quantities as assumed by Newton, but depend on each other and upon relative motion according to Einstein. Newton's laws of classical mechanics operate in space with three dimensions, but the relativistic laws — because of their velocity-dependence — always involve time. Hence the relativistic laws operate in space-time with four dimensions.

However, the relativistic effects on mass, length and time are never noticed in our everyday activities. They become significant only at "relativistic" speeds exceeding 100,000km/sec; ie 1/3 the speed of light. Such relativistic speeds can only be found in atomic physics and astronomy.

(3) In a relativistically fast-moving system, time slows down when observed from a stationary system. A twin making a trip on a fast spaceship to a distant star will return to Earth younger than his twin brother, the difference in age depending on the speed of travel, the time taken, and the acceleration involved in turning and landing.

(4) All lengths in a fast moving system will contract in the direction of the movement, while all masses will increase — approaching infinity at the speed of light. Hence the speed of light is the speed limit for all physical bodies.

(5) Mass is a concentrated form of energy, related by the equation $E = mc^2$, where m is the mass and c is the speed of light in vacuum (3×10^8m/s). If completely converted into electrical energy, one litre of water would yield 25,000 million kWh, worth around $375 million at existing rates.

Since the discovery of nuclear fission in 1938, only a small fraction of the mass of uranium and plutonium nuclei can be economically converted into energy. Conversely, energy can be converted into mass; eg. the production of electrons from energetic gamma rays.

(6) Any mass curves space around it, the curvature depending on the amount of mass. Gravitation is the effect of space curvature. The curved space around a mass forms a spatial sink into which another mass will fall as if pulled by gravitation. The curvature of space around the Sun manifests itself, for example, in bending the light rays passing the rim of the Sun. Such bending has been verified during many eclipses.

(7) The curvature of the space of the whole universe depends on the amount and density of the matter in it. This determines whether the vast universe we live in is (a) closed and steady, or (b) periodically expanding and contracting, or (c) expanding infinitely.

The curvature of the space around an extremely dense and massive star may locally close the space around it, forming a "black hole" from which nothing, not even light, can escape.

Satellite station from surplus gear

Satellite ground stations usually mean big money and modern equipment. Sydney's Macquarie University built their station on a shoestring budget, yet the results are flashed onto hundreds of thousands of TV screens in Sydney every night.

by GREG SWAIN

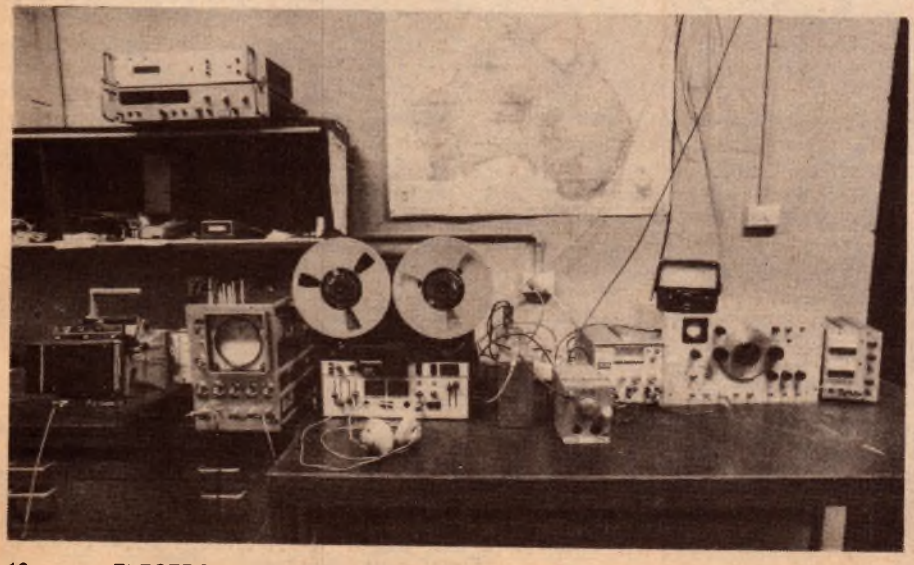
"I'm an electronics engineer — from the valve days," says Les Wilson with a grin. He was being modest; too modest for a man who has spent the last three or four years constructing a ground station to receive pictures from a weather satellite high over the equator to the north of West Irian — and earned himself an M.Sc. degree into the bargain!

That satellite is the Japanese Geostationary Meteorological Satellite GMS-1, launched into space by the United States in July 1977 for the Japan Meteorological Agency. From its 140°E 35,800km equatorial perch, onboard sensors monitor weather conditions over an area extending east from the Indian sub-continent to the mid-Pacific, and south from Sakhalin to Tasmania. This area includes the whole of the Australian continent and New Zealand, the South-East Asian countries, Indochina, China, Japan, and large areas of the Soviet Union.

Les Wilson really doesn't have anything to be modest about. Thanks largely to his efforts over the last four years, television viewers in Sydney and regional NSW centres now see weather satellite photographs of the Australian continent as part of the daily weather report. Accurate weather forecasting is an important facet of modern life, and the use of satellite imagery makes the job that much easier.

"We now supply several Sydney commercial television stations with weather satellite photographs on a daily basis", Les told me when I visited his Macquarie University office in early January. As for the project itself, it all started out of a joint interest he shared in satellite tracking with the late Associate Professor R. E. Mackinson, of the University's School of Mathematics and Physics.

BELOW: An unlikely assortment of gear makes up the signal processing equipment. The tape recorder provides back-up against camera malfunction.



Les suggested that we go and take a look at the "dish". We left his office and walked through the drab concrete hallways of Macquarie University where he now works as a Professional Officer. A few more personal details began to emerge. From 1949 to 1964, he worked for the CSIRO, during which time he was involved in tracking some of the very first Russian and American satellites. During this period, from 1958 to 1964, he was seconded to the School of Electrical Engineering at Sydney University, and from 1964 to 1967 was employed by the University of New England in the Physics Department as a Laboratory Manager.

Within a few minutes we were standing on the third floor gallery of the science building, looking down at the big 5-metre parabolic dish antenna. Constructed of a relatively open aluminium mesh, the dish provides a calculated 36dB of gain for the 1.691GHz S-band satellite transmissions. It sits atop a steel frame tower, peering directly towards the distant satellite at a fixed 49° elevation and a bearing of 19°W.

Provision is made for ±5° adjustment to each axis to take into account any future satellite drift, and to allow the antenna to find the satellite in the first place!

The feed system consists of a tuned circular waveguide horn, mounted on support struts some two metres out from the centre of the reflector. A ¼-wave monopole probe inside the waveguide provides the waveguide to coaxial cable signal transition, and the signal output feeds directly to a solid state S-band preamplifier attached to the top of the waveguide. From there,

ABOVE & RIGHT: Two views of the 5-metre parabolic dish antenna.

the signal is fed via a 40-metre length of coaxial cable to a small laboratory where it feeds into a transistor mixer circuit.

The antenna is certainly an impressive sight as it stares north towards the satellite over the greened landscape that surrounds the University. It was build in the University's own mechanical and electronics workshops, with results that would do justice to a professional construction company!

Even more impressive is the signal processing equipment — impressive not so much for its complexity or appearance, but for the fact that Les has been able to string it all together to make it work. Much of the equipment he designed and built himself, supplementing this with commercial gear and with equipment made obsolete at the conclusion of the American Apollo Moon landing program.

"We were able to buy equipment from Woomera and Auroral Valley at bargain prices," Les told me. "It's dated now, of course. Most of it was made in the mid-1960s, but because it was used for the Apollo program it's all high-quality gear."

The result of all this is a most unlikely looking collection of equipment, some old, some new, some using valves and some using modern solid state components. Nobody could accuse Les Wilson of lack of initiative!

A Hewlett-Packard type 540B transfer oscillator serves as the local oscillator for the system. This unit, tuned to a frequency of 194.1875MHz, provides an output signal of approximately 2V which is fed to a step-recovery diode frequency multiplier. The multiplier is in turn coupled to a simple cylindrical ¼-wave cavity resonator tuned to the 8th harmonic (1553.5MHz), which forms the final mixing signal. Its output is fed to the mixer to heterodyne with the 1.691GHz signal from the satellite.

Output from the multiplier is approximately 1mW, sufficient to drive the mixer and subsequent IF preamplifier. The resultant IF signal on 137.5MHz then passes to an IF receiver, and the output either recorded on tape or directed to a video processor circuit for ultimate display on a CRT. A Tektronix C27 oscilloscope camera equipped with a Polaroid film-pack is used to obtain the required photographic print and negative.

The IF receiver is one which Les first used when he was tracking the earlier NOAA weather satellites on VHF. Surprisingly it uses valves and, according to Les, originally served time as an aircraft VHF communcations receiver. "I just re-wired it and broadened the IF response to suit the GMS transmissions", he says.

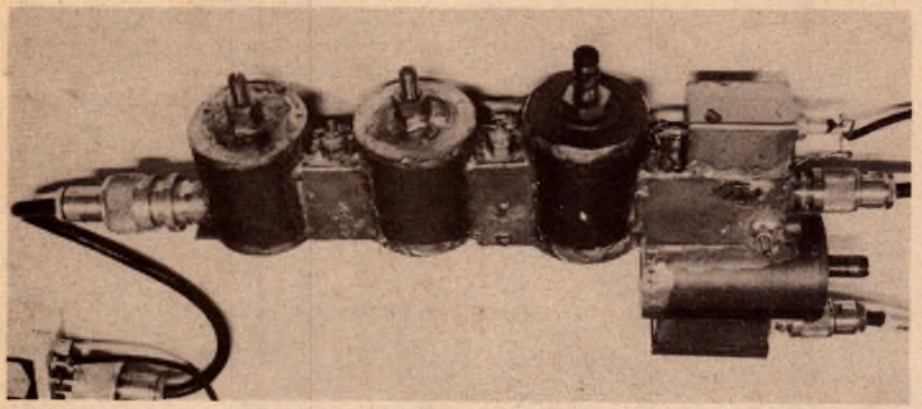
Thus far, Les has not attempted to convert the station to fully automatic operation. That's something he has yet to get around to, although "it shouldn't be too difficult". Power for the tape recorder could be provided by a time clock switch system, while actual switch-on for recording could be initiated by the receiver DC carrier level activating a sensor.

It's really quite an experience to be present when pictures start to come through from the satellite. Transmissions take place every 3 hours, commencing with a 3-second start tone and followed by 5 seconds of line phasing pulses, a 16-step grey scale calibration signal, and time and date alphanumeric information. A 450Hz finish tone is used to indicate the end of a transmitted picture frame.

This information, together with the video picture data, amplitude modulates a 2.4kHz sub-carrier which, in turn, frequency modulates the radiated carrier (1.691GHz). It's the job of the video processor to sort and process the information contained in the satellite signal so that a recognisable picture can be built up on a line-by-line basis on the face of the CRT.

In all, the satellite sends seven pictures during each transmission session,

Satellite station from surplus gear



The microwave mixing assembly. Three cavity resonators perform bandpass filtering on the 1.691GHz input signal, which is then mixed with the 8th harnomic of the local oscillator. Output IF is 137.5MHz.

each frame taking some 3½ minutes to transmit. The edges of these frames are overlapped, so that an effective whole Earth disc (as viewed from the satellite) can be assembled by forming a mosaic. A single picture frame showing the whole Earth disc is also transmitted by the satellite, but as this uses different transmission standards the signal cannot be processed with the existing equipment.

Les Wilson is quick to point out that the picture information is not obtained by a conventional "TV" camera. Instead, data in both the visible and infra-red parts of the spectrum is obtained by a device called a scanning radiometer. This device forms an image by using an optical system and a continuously rotating sensor.

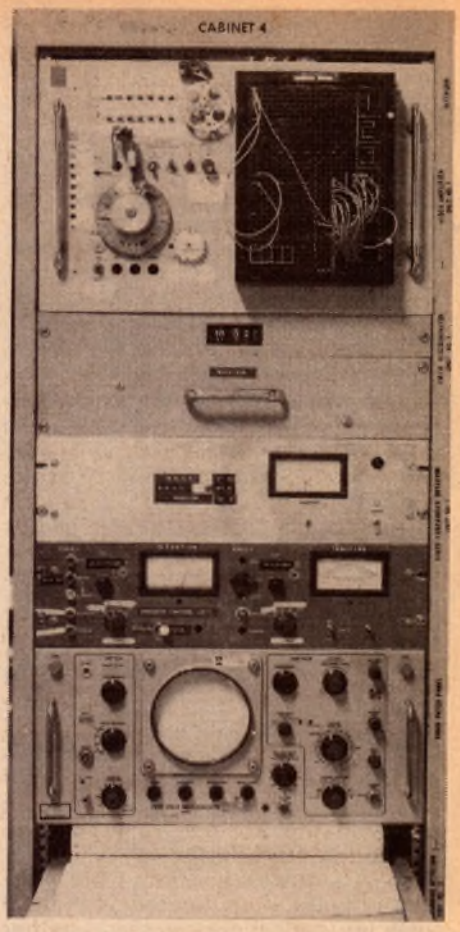
The sensor scans space and the earth below the satellite one line at a time and at a rate of 240rpm. Radiation collected by the sensor provides the video signal information to amplitude modulate the subcarrier.

Information from the satellite is first transmitted to a monitoring station in Japan before being re-transmitted through the satellite for dissemination to other users. "The coastal outlines and the longitude and latitude lines have to be inserted by a computer at the control station", Les Wilson explains. The computer automatically darkens the colour of the line it is inserting should the background reach a certain white level."

But in spite of Les' obvious enthusiasm for the project, one soon gets the impression that his real interest was with the now defunct NOAA polar orbiting satellites. These were the satellites that he first received pictures from; these are the ones that he keeps coming back to in conversation.

Of course, tracking the NOAA satellites was a whole new ballgame.

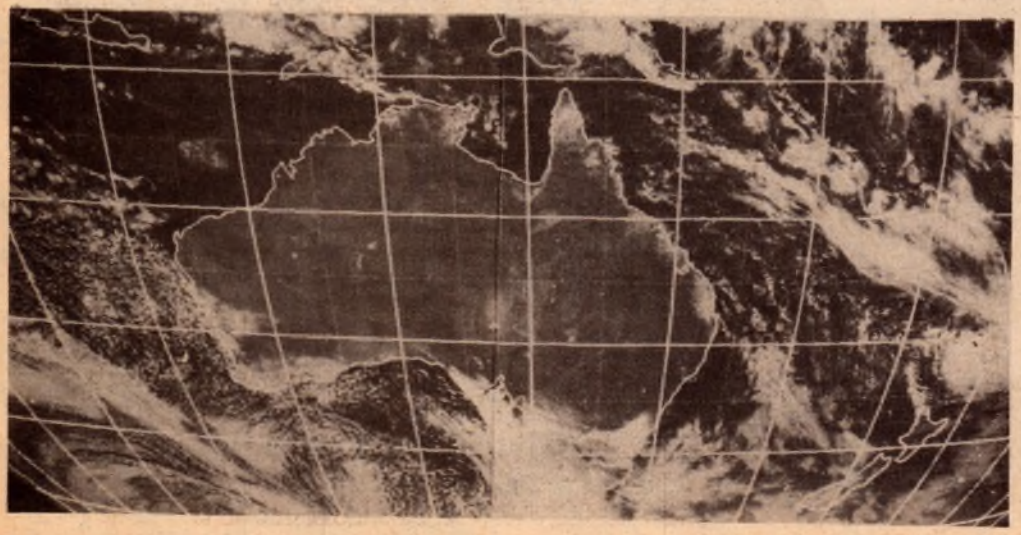
For starters, the NOAA satellites were not geostationary. Instead, they were launched in "sun-synchronous" polar orbits, at heights of around 1500km. As a result, receiving pictures from these satellites on a regular basis necessitated the use of automatic tracking equipment. A sun-synchronous orbit is one



Program control unit (top) is rack mounted with NOAA satellite receiving and tracking equipment.

in which the spacecraft passes within range of a fixed point on the Earth's surface at approximately the same time every day.

The NOAA satellites also differed from GMS-1 in that they transmitted pictures on VHF (around 137MHz) instead of UHF, so the receiving equipment used was quite different. Other differences included variations in sensor scan rate — 48rpm vs. 240rpm — and variations in carrier frequency deviation and RF bandwidth. But like



Weather satellite photograph of Australian continent transmitted by GMS-1. Picture is made up of two separate frames; dark areas represent warm regions, white areas represent cold regions.

GMS-1, the video signal from the scanning radiometer was used to amplitude modulate a 2.4kHz subcarrier, which then frequency modulated the radiated carrier.

The biggest challenge with the NOAA satellites was the design and construction of an aerial system that would automatically track the satellite as it passed overhead. The aerial proper consists of a crossed Yagi having seven elements, each element 1½ wavelengths long, coupled to a two-axis mechanical drive mechanism powered by electric motors. An "automatic program unit" and a signal sensing unit were used to initiate aerial tracking of an orbital pass whenever the satellite signal was detected at the horizon.

Automatic tracking by the aerial was achieved by connecting up the drive motors so that they followed instructions from the program control unit. These instructions took the form of voltage increments which were fed to the non-inverting input of a differential amplifier in the aerial tracking drive sensor. A potentiometer, mounted concentrically with the tracking axis shaft, was used to sense the position of the aerial and apply an appropriate signal to the inverting input of the differential amplifier.

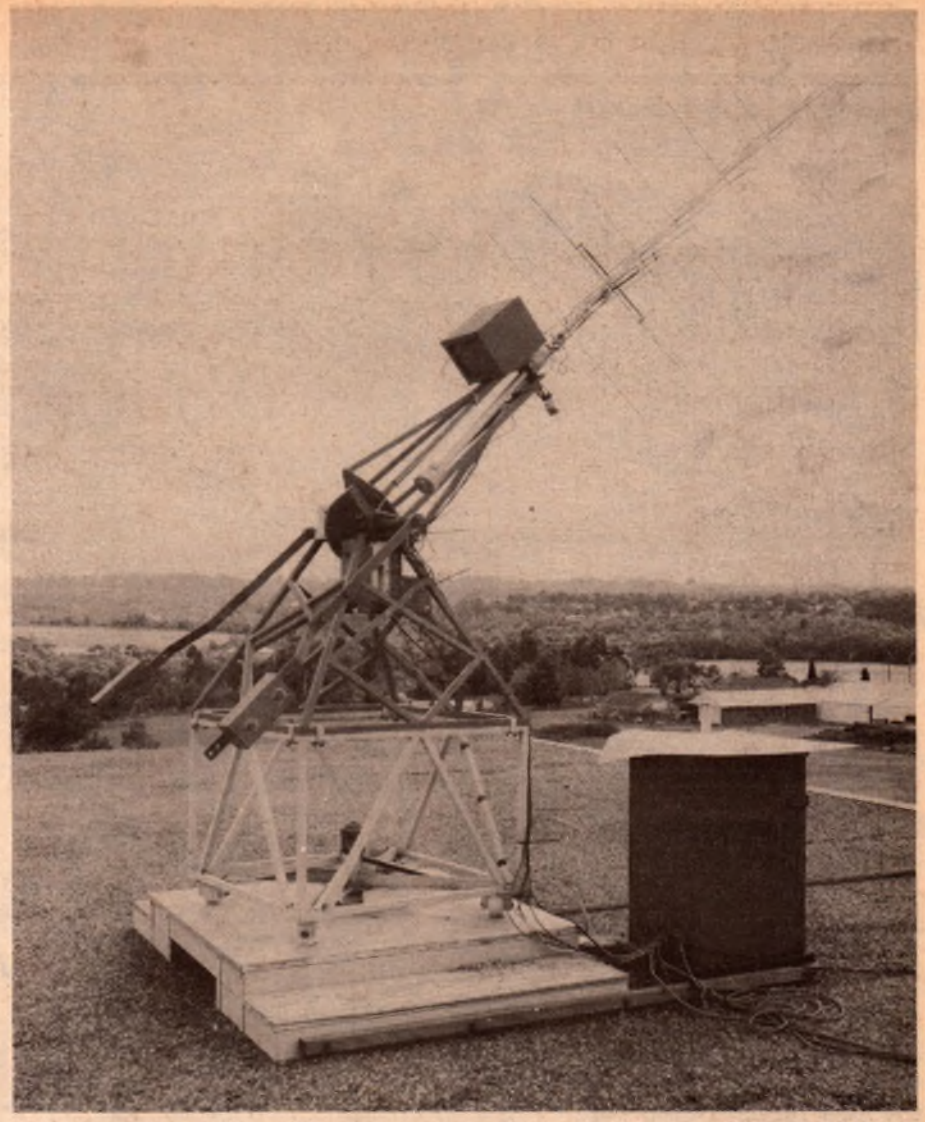
Two transistor switches were connected to the output of the differential amplifier and, depending on whether the output went positive or negative, activated one of two relays to drive the tacking motor either forwards or backwards. The aerial continued moving until the signal from the moving arm of the potentiometer at the inverting input equalled the signal at the non-inverting input.

Some rather unusual improvisions were made in the construction of the VHF aerial. Part of the gearbox, for example, was taken from a washing machine agitator! As for the program control unit, Les built that himself. It is a mixture of cams, relays, switches and electronic circuitry. A 24-hour clock provided basic timing information for automatic system turn-on and tape recording.

Les no longer receives pictures from the NOAA satellites, the last of which was NOAA-5. "They've had it now", he explains. "We lost the signal some time back".

The gear built for the NOAA satellites hasn't been dismantled, however. Plans for a new series of polar orbiting satellites to replace the NOAA series are well underway and, in fact, the first satellite has been launched. Les has already been able to track and record data from this satellite.

For the present though, GMS-1 remains the centre of attention. After all, that's where the pictures are coming from and will hopefully continue to come from for some time. As a system, it's proving invaluable for monitoring weather patterns.



ABOVE: VHF aerial used for automatic tracking of NOAA satellites. BELOW: 7-frame mosaic of whole Earth disc as transmitted by the GMS-1 satellite.

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See EA September 1976

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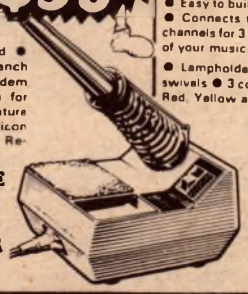

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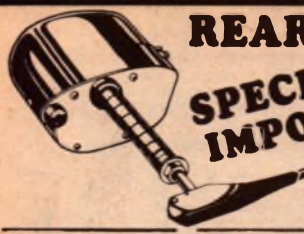

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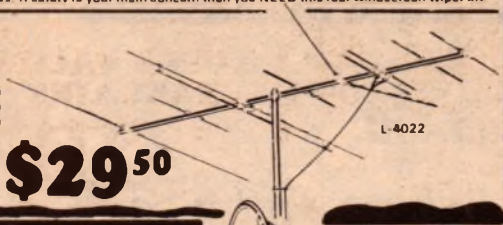

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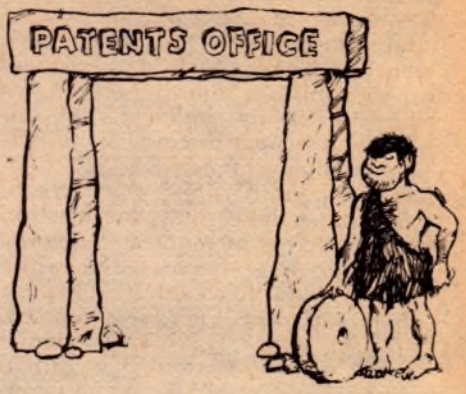

A never-ending argument: Who invented what, where and when?

One does not need to be involved for long in technical pursuits before coming up against arguments as to who originally thought of a particular gadget or process. Nor can one ever be quite certain that the person credited with an idea was the one who first entertained it. Predecessors have a habit of popping out of the woodwork!

What prompted this line of thought was a letter from a Western Australia reader which read thus:

Dear Sir,

Reference editorial viewpoint for February 1979: The Matsushita one-gun colour TV tube is not new.

The February 1972 edition of the American magazine "Popular Science", page 64, featured an article on "Uniray — Amazing One-Gun Colour Tube" by Ronald M. Benrey.

The report was on a colour tube developed by a Philadephia engineer David Sunstein, which tube is virtually identical to the Matsushita tube.

The enclosed copy of the article suffers in B&W but I would appreciate comment.

(C.A., Lesmurdie, W.A.)

The "Popular Science" article, to which C.A. refers, does indeed describe a type of colour picture tube which bears a strong resemblance to the recently announced Matsushita type, and which allegedly existed in prototype form in the mid 1950s. It was called the "Uniray".

The tube used a sequence of vertical red, blue and green phosphor stripes, separated by narrow black lines — much as in a modern, conventional vertical-stripe tube with in-line guns. However, the Uniray used only a single gun, with provision to vary the intensity of the beam selectively as it swept across each individual stripe.

Deposited behind the stripes was a very thin layer of aluminium, transparent to the electron beam but not to visible light. On the rear surface of the aluminium was a pattern of white phosphor lines, one immediately behind each third black dividing strip. As the electron beam scanned the screen area, it would energise the red, green and blue phosphors in the normal way. At the same time, blips of white light would be produced by the white phosphor, illuminating the inside of the tube.

Attached to the flare of the picture tube, and peering through an area of clear glass, an electron multiplier phototube reacted to the white flashes, producing pulses which could be decoded to indicate to the circuitry the exact instant at which the beam would encounter the next group of stripes. It was modulated accordingly.

In short, the Uniray tube used information feedback from the screen itself, to ensure proper colour registration, rather than relying on precise tube geometry and precise electronics — and adjustment — to put the beam or beams where they were supposed to be at all times.

The basic concept was clearly similar to that adopted much more recently by Matsushita and announced in our February 1979 issue.

According to the "Popular Science" article, the prototype of the Uniray tube was produced around the mid fifties. That would put it towards the end of a period of very intensive research into colour picture tubes, backed principally by the might and money of RCA.

What attention had they given to the single gun approach during that period — the five or six years preceding Uniray?

For a first-hand account of this, I had only to turn back to our July 1977 issue and an article by Dr Harold B. Law on "The Shadow Mask Colour Picture Tube".

In that article, the author refers to work by Dr Frederick Nicoll, which led to the deposition of side-by-side colour phosphor stripes. Using this work, Dr Law was able to demonstrate an electronically produced colour image in 1949, using striped phosphors and an in-line gun configuration. Not only does that establish a practical application of phosphor stripes but also a scanning geometry that was exploited twenty years later in the Sony Trinitron.

In the same year another RCA scientist, Dr Russell Law, also picked up the striped phosphor technique but arranged the stripes horizontally so that each group coincided with a scanning line. With the aid of a grid pattern in the path of the beam, he was able to switch the beam slightly upwards or downwards, so that the spot would strike the three lines of phosphor in turn, thereby building up a complete colour image from a complex pattern of minute dashes.

In 1950, the scheme was officially demonstrated and voted as being very good.

Despite this judgment, Dr Law's one-gun tube is not even mentioned in a number of early TV textbooks in our library. Instead "An Introduction to Colour TV" by Kaufman and Thomas (1956) explains the operation of another single-gun striped phosphor tube called the Lawrence "Chromatron". The principle appears to be the same as that of the tube credited to Dr Laws, although the additional information is offered that the signal applied to the post-deflection gride is a sine wave derived directly from the 3.58MHz colour sub-carrier.

David Sunstein's involvement during this period is not clear but it is apparent that single-gun colour tubes had been conceived, built and demonstrated before the mid fifties. Sunstein's contribution would have been to demonstrate a way in which the movement of the scanning beam in relation to the stripes could be sensed electrically. Ostensible, this would obviate the need for high-voltage post-deflection, critical geometry, multiple electron guns, shadow masks, &c; all

told, quite an imposing list of advantages.

On the other hand, the "Popular Science" article did admit to certain limitations: the vertical stripes were clearly discernable and white spots tended to become blobs. It is not clear whether this was due to the primitive nature of the developmental tube or whether it was just too difficult in 1955-72 to multiplex the beam at a sufficient rate to cope with a fine-pattern screen.

But, more importantly, the electron beam could not be modulated below a certain level, otherwise the white flashes of light which indicated its position would simply not be produced. Thus the tube could never depict "black" areas (beam cut right off) so that the available contrast was inherently limited.

Whatever the reason, it is clear from the "Popular Science" article that a tube, allegedly demonstrated in the mid fifties, had still not been taken up in 1972 — fifteen or more years later. In the meantime, literally millions of delta-gun shadow-mask tubes had been built by companies around the world. One can only assume that RCA — and others — had diminished the "impossible" problems of the delta-gun tube so effectively that it was established as the preferred way of doing things.

And so to 1979 and to Matsushita's announcement of their "new" single-gun tube.

"Is it really new ?" asks our correspondent. In one sense it may not

NOISE IN MOBILE FM/STEREO

Sir,

While pleased that at least one other reader has commented on the subject of ignition hash and its effect on mobile FM broadcast reception, there are a couple of points I should like to comment on arising from Mr. T.B's letter in the February issue.

Firstly, in regard to FM impulse interference suppression devices, I should like to correct Mr. T.B's imputation regarding my knowledge of their existence. Had he checked the reference I offered at the conclusion of my original letter, he would have noted that while I did not discuss the devices in detail, I was certainly aware of the relevant circuitry.

However, my (admittedly limited) experience with such devices is such that while, in several cases, ignition hash has been miraculously reduced, I have been frustrated by other vehicles which, in the time available, did not wish to respond in the same dramatic manner.

Reference to the Clarion EE-063 suppressor unit data will also reveal that a price has to be paid for the cancellation of the impulse interference in terms of increased distortion and reduced multiplex separation. This unit, being typical of those available, even requires certain models of Clarion's own range to be modified before it can be fitted.

The "modest price" of this particular unit is around $35, excluding fitting, and, while a customer might not be unduly perturbed about increased distortion and reduced stereo separation, he might certainly quibble about the extra overall cost for the unit's supply and fitting.

Before leaving the topic of FM suppression devices-and I hope I have made it clear that I regard these devices as useful palliatives but not yet the cure — I should also like to point out that the initial calibration and setting up procedure calls for equipment not normally available in a car radio repair workshop, not to mention the time factor yet again.

Secondly, I would have to agree with Mr. T.B's statement that "with a lot of care and time . . . . . any car can be made interference free."

As Mr. T.B must be aware, in business time is money, and competition in Melbourne is such that, unless a customer is made specifically aware of the time that may be involved to suppress his vehicle for adequate FM reception, then it is simply not economic to attempt to suppress his vehicle beyond the standard techniques used for AM reception.

Again, there are AM/FM MPX receivers available in Melbourne for as little as $65, but the importers did not see fit to also import any matching suppressor unit. It is simply uneconomic to attempt to modify such receivers so that they will cope with possible ignition hash by attempting to fit the Clarion EE-063, for example. It is also unrealistic to point out to the customer that the "higher-priced" FM MPX receivers have the suppressor units already incorporated . . .

Before signing off, however, I should like to restate the question asked in my earlier letter, viz. why should a strong, noise-free stereo signal being received via VHF-FM, be subject to excessive mutilation in a vehicle with its engine running? I look forward to any suggestion which might allow the real problem to be identified and hopefully, cured. In the meantime, I join with Mr. T.B-and "Electronics Australia" — in calling for circular polarisation for all Australian FM stations, as being at least a step in the right direction.

N.H. (North Carlton, Vic)

be, because David Sunstein apparently demonstrated a prototype using a similar principle circa 1955.

On the other hand, it could be maintained that the Matsushita tube is new, if only because of its use of ultra-violet triggering. It would presumably obviate the need for an internal light shield, with no risk of contrast pollution due to visible white flashes. It may also be possible to obtain ultra-violet flashes with a beam intensity below that necessary to produce output from the visual phosphors, thereby preserving the black areas. With modern circuitry, it may be possible to modulate the beam much more effectively than in the past and to exploit a modern, fine-grain screen.

If challenged along these lines, Matsushita might well maintain that their tube and its attendant technology is as much an advance on the Uniray design, as the latter was, in its time, on the efforts of Law and Lawrence.

On the other hand, there is no guarantee that Matsushita engineers even knew about the Uniray tube. And there was certainly no stirring of memory in our office, amongst those of us who handled the Matsushita press release.

I guess that, in a Utopian situation, the dissemination of technological information would be so well organised that one would not need to rely on chance encounter, memory, notes or incomplete references. As yet, we haven't reached that stage and, with so much technology being kept under wraps, it may be a long time before we do.

So, right now, while we have reacted with interest to our correspondent's letter, we are not about to construe it as a challenge that we should have known about the Uniray tube. Or to pass judgment on Matsushita for either not knowing or not acknowledging the work of David Sunstein.

In saying this,we are influenced by a startling disclosure in an appendix to Dr. Law's article on the shadow mask picture tube:

The effort by the RCA team circa 1949 must go down as one of the most concentrated ever in the history of commercial research: spare no expense, spare no personnel. Out of it came a string of concepts, developments, processes and patents which transformed an almost forlorn hope into a brilliant success.

Yet when the battle had virtually been won, they discovered that the concept behind the shadow mask tube had been the subject of a patent application filed by Werner Flechsig in Germany in July 1938,

Does this make Flechsig the inventor of the shadow-mask tube?

In a limited sense, maybe — but had it been left to Flechsig, the tube may never have got beyond a mere idea, buried along with countless other forgotten ideas in a repository of patents.

Of more practical note is the person or team which borrows or inadvertently duplicates that idea and develops it into a viable device or system or process.

Apportion the credit any way you like! Let me add one more thought:

By tradition and repetition, our conventional textbooks and magazines have settled upon a certain group of people as being responsible for key inventions and concepts in the realm of electronics. Some of their names have been enshrined by being allocated to basic units in the Systeme Internationale.

Yet one doesn't have to dig very far to discover that many of our traditional inventors may have derived their inspiration from others. Or that the distribution of credit seems to vary with the nationality of the author: English, French, German, American, Russian, &c.

What's more, it's still going on. If some overseas literature is to be believed, the Interscan microwave landing system for aircraft guidance is American.

You know . . . I could have sworn that the CSIRO and AWA had something to do with it, and that Tullamarine was in Victoria!

To change the subject, we reproduce here a further letter in the running debate about the reception of FM/stereo, notably in an environment of auto ignition hash. It is a subject which may generate increasing interest as new FM stations are gradually commissioned. As you may have noted, the ABC is now talking about setting up a complete country FM network, using the towers and sites already involved in their television programs.

N.H. makes his points quite succinctly and, lacking any special expertise in mobile installations, I will leave it to others to answer if they can his repeated question about the vulnerability of FM/stereo to vehicular ignition interference.

One point, however, I am happy to add. On a purely honorary basis, I am a director of Sydney's newest public broadcaster 2CBA-FM. As such, I had a large hand in moves which culminated in the station being allowed to instal and use a high quality circularly-polarised antenna.

It seems to be working out very well indeed and will provide a firm basis for field testing by engineers attached to the P&T Department and to the Broadcasting Tribunal.

Here's hoping it will become a trend setter.

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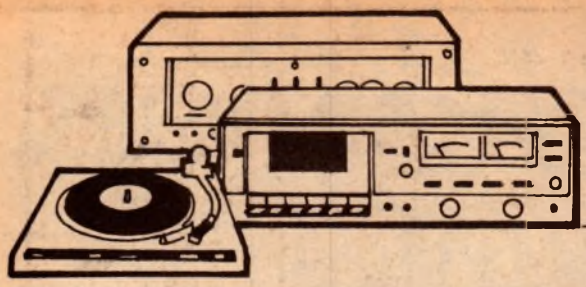


Hi Fi Topics

ULTRA HIFI AUDIO IS ON THE WAY — A SPIN-OFF FROM VIDEO DISC TECHNOLOGY

The current hassles to do with video cassettes and video discs may appear to be rather remote from the audio/hifi field, but that is far from being the case. In the foreseeable future you may well be relaxing to the sound of ultra hifi, multi-track music as a direct spin-off from video related techniques.

by NEVILLE WILLIAMS

To date, domestic video players have been seen as entertainment units in their own right. Manufacturers have concentrated solely on recording and reproducing TV-style information and any potential the equipment might have in the audio/hifi field has been ignored.

It's now beginning to look as if the lure of video is less compelling than has been assumed and video merchants may well need to exploit the ultra-hifi option to help sell their wares.

Illusions about video recordings have been around ever since the days of 78rpm discs: "Wouldn't it be wonderful if you could watch Nelson Eddy and Jeanette Macdonald as well as hear them?"

The inherent attraction of video in the home seemed to be demonstrated by television and its enormous acceptance. People around the world could see and hear, and countless millions have spent their evenings doing just that. The stage seemed to have been set for home video recorders and players; but now, despite an enormous investment in technology and publicity, the public seems to be only vaguely interested.

Why?

Perhaps the public have learned that watching television is very demanding on both time and attention; they're not convinced that they want to add to that demand, especially at considerable cost.

They might have learned the truth of that old adage of educators: you retain 10% of what your hear; 60% of what you see. Whereas you can listen to a sound recording over and over again, repetitive viewing merely becomes tedious. You exhaust the visual content too completely, too soon.

A continuing supply of fresh television material is one thing; the ability to provide your own "repeats" is quite another!

In the March issue ("Forum" p18) I drew attention to overseas reports which indicated that the sale of domestic video cassette recorders had fallen well below predictions, despite massive consumer advertising and promotion. Sales executives in Australia are now admitting that the same thing has happened here, aggravated by the high cost of hardware and tapes and by confusion over the multiplicity of systems.

Clearly, consumers are not enamoured with the idea of recording and storing material off air. It may even be that, over and above the problems already mentioned, they find the idea too "technical", too much trouble! This was something that virtually killed open reel audio tapes and, while we are talking here about video cassettes, they still have about them an air of complexity.

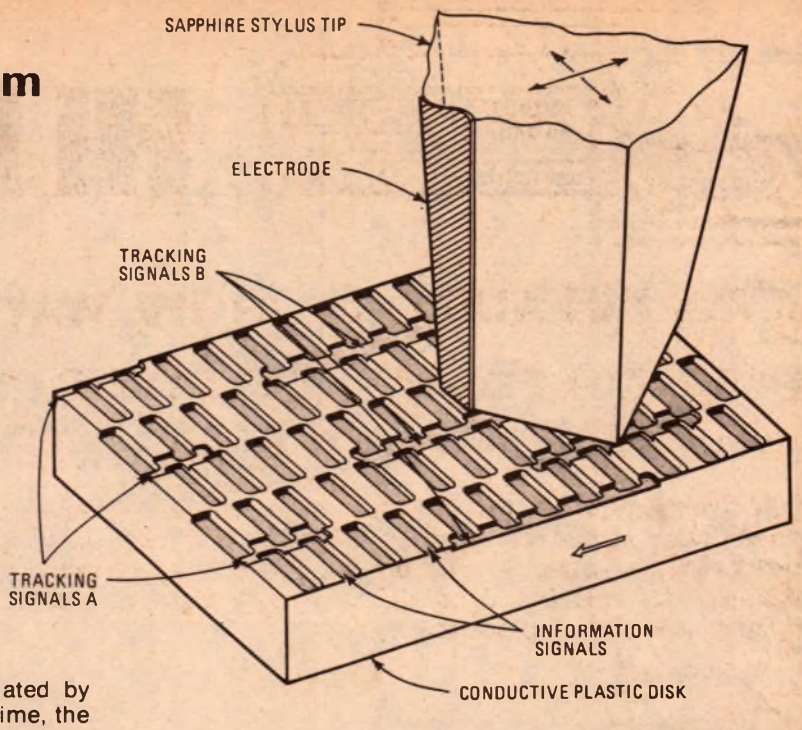
Whatever the reason, that's the way things actually are and large consumer electronics companies have had to rethink their whole approach to the home video market. Do the public really want tape and the ability to record off air? Would they be more receptive to pre-recorded discs and players at (hopefully) half the cost of cassette equipment?

Responding to the thought, a whole array of video disc systems, put aside for tape, have to be hastily resurrected, dusted off and accelerated towards possible production.

It is being done under such pressure

An informal interlude at the official opening of Sydney's new FM/stereo station 2CBA, on March 5. The Hon. Tony Staley, Minister for Post and Telecommunications (right) shares a joke at the announcers' console with well known TV personality Roger Climpson. Operated by the Christian Broadcasting Association, 2CBA-FM transmits on 103.2MHz (amended from the original figure of 103.5), with an effective radiated power of 10kW into a circularly polarised antenna, sited in North Sydney. The studios are at Five Dock, in the near western surburbs.

The JVC video-audio capacitive playback system



Reproduced by courtesy of "Electronics" magazine, this diagram illustrates the video disc system developed by the Victor Company of Japan (JVC) as perhaps a logical extension of RCA's "SelectaVision".

The basic program information is carried as a spiral track of pits 1.4um wide pressed into the surface of the disc. Rotating at about 900rpm, the disc has a playing time of about 60 minutes per side.

In the RCA system, the pits were in shallow grooves which served to guide the stylus. The JVC disc is quite flat but has a second set of elongated pits to guide the stylus, using an electronic servo system. Because the underside of the stylus is substantially flat and much wider than an individual track, it skims lightly over the surface, with little wear.

The plastic used for the disc is conductive, allowing the strip electrode on the stylus to sense the pits as they pass beneath it. The result is a pulse signal which can be modulated by video and/or audio as required. At the same time, the tracking signals can be used to monitor the speed of the disc. Short-term flutter is countered by moving the stylus slightly forward or backward.

For high quality stereo recording, the system will accommodate 14 information bits for each channel, plus extra error correction bits. The sampling frequency is 44,056kHz for a top audio frequency of 20kHz.

The original master recording is produced using photolithography and a laser beam. User copies are produced by refined but otherwise normal pressing techniques, leading JVC to suggest that the system as a whole would involve about half the consumer outlay required for video cassettes.

At the time of writing, JVC have not committed themselves to going ahead with this system but it is not to difficult to imagine it being taken up by their parent organisation (Matsushita/National/Technics) and finding a common standard with RCA.

Who knows? If the pitted disc could be made reflective as well as conductive and a common standard found, it may also merge with the inclinations of those who are convinced that playback should be by optical means!

that, as we said in the March editorial, the fear now in the retail industry is that it will be landed with an even greater variety of video disc systems than there is of video cassettes. If that happens, the public will go cold on those, too!

It may be argued that lack of viewing time and visual boredom must apply as much to discs as to tape, but discs do have certain things going for them. They can be mass-produced, and promise to be cheaper even than blank video cassettes, let alone pre-recorded cassettes. They can also be attractively packaged like LP audio discs, and collected, stored and used in a similar manner. Consumers will be able to choose video albums that take their fancy, pop them into their domestic player and enjoy the result with a minimum of fuss and tolerable outlay.

That's the scenario, anyway, which I am sure manufacturers hope will be followed. But they have one other option which I believe is vital:

Without too much hassle, they can adapt their disc technology and their players so that, at the flick of a switch, the user can have multi-channel super high quality audio signals to feed into the hifi system. That will provide two reasons for investing in the new equipment, with video the prime and ultra hifi audio the bonus, or vice versa.

How close is this to reality?

The Teldec video disc, developed jointly by Telefunken and Decca has been around the European scene for about 10 years. Derived from audio techniques, it uses a flimsy plastic foil disc which rotates at 1500rpm (1800 for US/Japan NTSC standards) and plays for about 10 minutes. A tiny sled-shaped stylus tracks the groove and communicates vibrations to a ceramic transducer as the back end of the "sled" bumps over the modulation in the bottom of the groove.

The Teldec disc, as such, has a dubious future but, in the meantime, Matshushita in Japan have taken up the basic principles to produce their VISC system as one of the options open to that huge conglomerate. VISC operates at 450 or 500rpm, according to the standard involved, and offers up to two hours of colour video plus stereo sound. Matsushita may or may not take up this purely mechanical system but it exists as an option, with long play and an impressive bandwidth.

However, the first of the new generation video discs actually to reach the public has been released for trial marketing in Atlanta, USA. It is sponsored by Magnavox, a subsidiary of North American Philips, and backed by program material from MCA. Reportedly, Universal-Pioneer are set to manufacture for Japan.

Similar to a system announced by Philips about four years ago, it uses a disc of diameter about 30cm, double sided, and rotating at either 1500 or 1800rpm, according to the TV standard involved. In a long-play option, the disc spins at full speed only when the inner grooves are being scanned. At other diameters, the speed is reduced to maintain a constant groove velocity, thereby doubling the normal playing time from 30 minutes to 60 minutes per side — seemingly the present target for video discs.

The Philips/MCA disc has a mirror like appearance. Beneath an outer transparent layer is an inner reflective layer carrying a spiral of tiny pits. These are scanned by a very fine laser beam carried on a traversing mechanism and caused to follow the spiral by an electronic servo mechanism. The pits modulate the light reflected from the

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inner surface of the disc and the video and audio signals are recaptured by decoding the light beam pulses.

According to reports, the player is retailing from about $700, and colour video discs for between $6 for a 30-minute documentary to $20 for a full length modern feature. The tip is that these are all no-profit or below-cost prices, struck purely to get the system accepted and established.

In response to the Philips move, RCA have grabbed their SelctaVision disc off the shelf and are making noises about a player which will sell for around $400 and discs which will also carry 60 minutes of program per side.

The RCA system is much simpler than the Philips/MCA method, using a disc which looks not unlike a conventional LP. It carries a fine shallow groove, which is tracked by a diminutive, readily replaceable stylus. However, the groove has no provision to vibrate the stylus in the normal phono manner. Instead, the modulation is in the form of tiny pits impressed into the bottom of the groove. As the stylus glides smoothly over the top of them, the pits induce a tiny signal into the system by a variation in capacitance.

JVC, a company with strong ties to Matsushita, has developed its own capacitive sensing system but with an electronic servo system rather than grooves to guide the stylus.

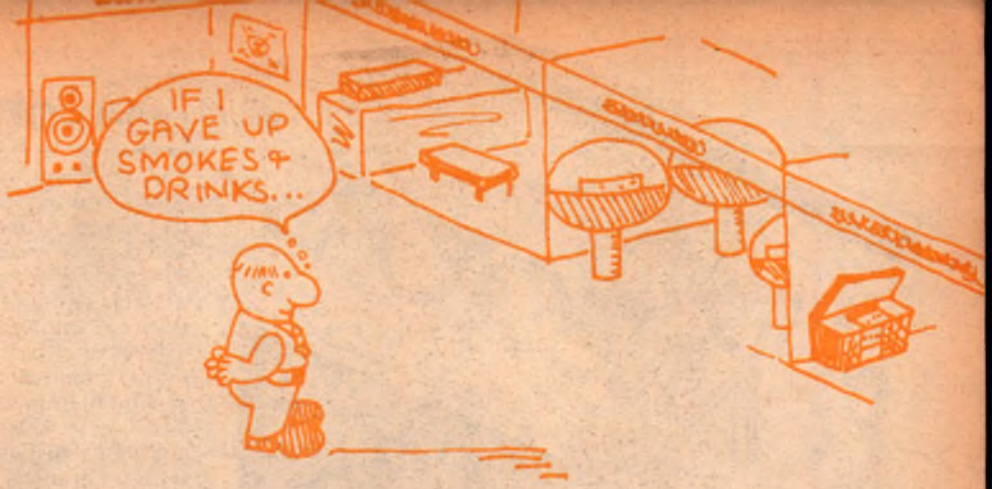
Overseas magazines have carried rather confusing reports of what is going on behind the many closed lab doors but it would seem that the major companies are tending to divide between the optical (Philips) approach and the non-optical (RCA) method. But the opticals then divide between laser and non-laser techniques, and the others between mechanical and capacitive pickup, direct groove tracking and electronic guidance.

If all the rival companies pursued their ideas to the marketing stage, consumers would indeed be faced with a far greater diversity of standards than currently rules with video cassettes. However, there is some hope for rationalisation, even if it ends up with what one commentator has referred to as the "Philips" and "Stop-Philips" alignments. Two standards would be better than half a dozen or more!

It is likely that decisions made in respect to video will be reflected directly in the audio option with manufacturers now mindful of the possible audio spin-off. Certainly, with several Megahertz of bandwidth available, there is the opportunity to bring the benefits of digital audio right into the home.

The principles of digital audio recording were explained at some length in the February issue, although limited to

(CONTINUED OVERLEAF)



HIFI SHOWS FOR 1979

June 22 sees the opening of a new series of Australian HiFi Audio shows in Australian capital cities. The ninth year that the shows have been held, they provide enthusiasts with a unique opportunity to see and hear the latest products on the audio/hifi market.

The first of the shows, in Sydney, will be held on Friday, Saturday and Sunday, June 22, 23 and 24, at the Chevron Hotel. Space for about 40 stands is provided in the main exhibition area — this for passive displays. For actual sound demonstrations, visitors can make their way to rooms on the fourth and fifth floors, where equipment can be heard operating in more isolated surroundings.

The Brisbane HiFi Show is scheduled for July 27, 28 and 29, this time at the Parkroyal Motor Inn. Again, there will be a general exhibition area, with demonstration rooms on the first and second floors.

The Melbourne show follows on September 7, 8 and 9 at the Southern Cross hotel, with a large exhibition area, adjoining rooms with special facilities and demonstration rooms on the fourth floor.

Adelaide follows hard on the heels of Melbourne: September 14, 15 and 16, at the Town House on the corner of Hindley and Morphett Streets.

The promoters are stressing that the shows are not a general exhibition of consumer electrics or electronics. They are devoted to audio/hifi, with the aim of showing prospective buyers the range of currently available equipment including, of course, items which are being exhibited in Australia for virtually the first time.

Admission to the public is entirely free, with no need for invitations or tickets.

The scheduling is the same for all venues: Friday — 12 noon to 10.00pm. Saturday — 10.00am to 10.00pm. Sunday — 10.00am to 6.00pm.

It is anticipated that most of the major brands will be featured, with companies like Yamaha, Akai, Sharp, Celestian and Tandy all preparing to launch new lines on to the Australian market.

To be officially released at the Sydney hifi Show is this completely new Nakamichi 580 front loading cassette deck. It features a completely new two-motor transport system, with a third motor to carry out the functions normally allotted to solenoids. It also has a new high intensity erase head and, indeed, foreshadows the technology that will be required for metal coated tapes. A new style-matched high performance receiver will also be amongst other new Nakamichi products on display by Convoy International Pty Ltd.

HIFI TOPICS — continued

the mastering stage.

Briefly the normal (analog) audio signal is passed through so-called A-D (analog to digital) circuitry. This samples the audio signal at a supersonic rate, usually in the range of 40,000 to 50,000 samples per second, and defines the amplitude of each sample by a digital number, computer style, using up to 16 information "bits".

From that point on, the equipment no longer handles a music signal, as such. It simply handles, processes, records and ultimately recovers a stream of numbers at the rate of 40,000 to 50,000 per second, depending on the standards being used. The basic technology is the same as for a computer system handling any other chain of numbers for any other kind of data.

Provided the system doesn't make mistakes with the numbers — and there are elaborate precautions against this happening — the numbers emerging from the far end of the audio chain — duplicate those due to the input and input processing. When these numbers are transformed back into a music signal by a D-A (digital to analog) converter, the recovered music duplicates the source — free from noise, distortion, hum, wow or flutter.

In the February issue, we pointed to the benefits which could accrue by using the digital system throughout the studio processes, right up to the laquer master. With the now emerging video disc technology, the digitised signal can be brought right into the home and translated back into analog immediately before being fed into the domestic hifi amplifier.

Right at the moment, company intentions regarding the audio field are even more obscure than in the up-front

For studio and home . . .

Pictured above, the Linz 8066 is a 3-way loudspeaker system announced recently by Audiosound Electronic Services. Intended for domestic or small studio use, it has a 10-inch heavy duty woofer, in a vented enclosure critically designed to meet Thiele parameters. A separate and specially designed compartment houses the mid-range unit, while the tweeter is a 1-inch low-mass dome type noted for its smoothness and dispersion. The phase compensated crossover network employs air-cored conductors and polyester capacitors, while 3-position 3dB stepped attenuators allow separate modification of the mid-range and treble balance. Dimensions are 830mm high, 330mm wide and 410mm deep. The Linz 8066 is suitable for use with amplifiers rated to 80W RMS per channel. For information: Audiosound Electronic Services, 148 Pitt Rd, North Curl Curl, NSW 2099. Phone (02) 938 2068.

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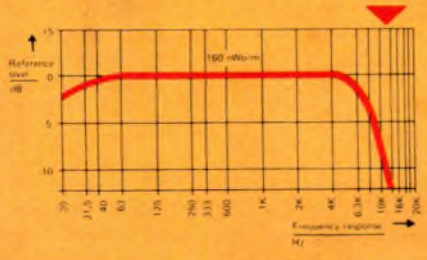

A Better Designed Case: Cases are of smooth lines, with rounded edges and corners to improve handling and efficiency.

A Better Designed Cassette: The Cassettes are of the screwed type and side one can be easily identified.

Inside the cassette is a special noise shield to avoid unwanted 'hum'.

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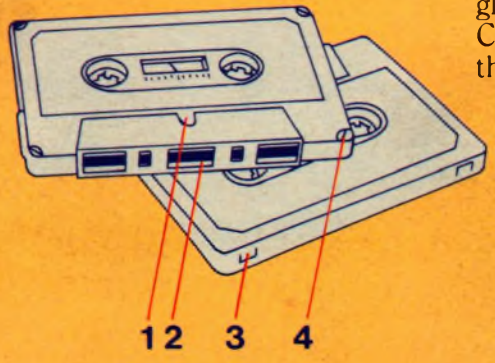

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3. knock-out tabs at rear of cassette prevent unintentional erasure (optionally either side).
4. screwed cassettes.

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Technics have been the innovators of so many outstanding new concepts in audio technology. And they have done it again: the RS-M85, the world's first quartz locked direct-drive flat type cassette deck.

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The bar graph FL (fluorescent) level meters are the most novel features of the RS-M85. Electronically controlled, so response time is instantaneous, these make conventional needle-type meters obsolete. Highly accurate, the FL meters give direct parallel readout for instant comparison between channels.

The capstan drive has a quartz-locked servo system that keeps tape speed constant. The record/playback head is laminated with Sendust, a recently developed material which is exceptionally hard and durable. Wide frequency response and negligible distortion contribute to the high quality in sound reproduction.

The RS-M85 is just one of the exciting models from the range of Technics cassette decks. See them for yourself at your dealer.

National Technics hi-fi

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Richard Allan loudspeakers . . .
they come in all shapes and sizes

Whether one wants to fit out a disco, amplify a musical instrument or make up a compact home hifi system, there is every chance that the requirements can be met from the current range of Richard Allan loudspeaker drivers. At least, that is the impression one gets from the most recent batch of leaflets to hand from the Radio Parts Group of West Melbourne.

One such leaflet describes the Richard Allan "Super Disco" range comprising the HD8, HD10, HD12, and HD15, with nominal inch diameters as per the type number and each available in either eight or 15 ohms impedance. Not intended for hifi work, the drivers concentrate the power where it is most needed for instrumental, vocal and disco applications. The leaflet gives specifications and curves and offers suggestions as to how the drivers can be used to best advantage.

By contrast, a larger, triple-fold leaflet illustrates the imposing range of drivers intended for use in wide-range systems. Illustrated are no less than eleven woofers, all of 8 ohms impedance and ranging from 127mm to 381mm diameter. There are four 203mm (8in) units which can cope with bass/midrange requirements and two additional units for mid-range only. To go with these is a choice of cone or dome tweeters. Three full-range drivers, 305mm, 254mm and 203mm, complete the hifi complement.

The reverse side of the leaflet lists details of Richard Allan enclosures of various types, cross-over networks and built-up systems.

Other smaller leaflets expand on this basic information. If you want to know more about the Richard Allan loudspeaker range, contact the Radio Parts Group at 562 Spencer St, West Melbourne, 3003. Phone (03) 211 8122.

video battle but, behind the scenes (and to mix metaphores) there are signs that the audio tail is tending to wag the video dog. The reason simply is that the audio/hifi industry is big time, with a proven track record, and with a hunger for something new.

And noise-free, distortion free audio with a dynamic range of 85 to 90dB would indeed be new.

Which is why RCA recently made its first simultaneous analog and digital recordings of a symphony orchestra, to test the value and attraction of the new technique.

And why Philips is talking about an 11cm compact disc based on laser video technology.

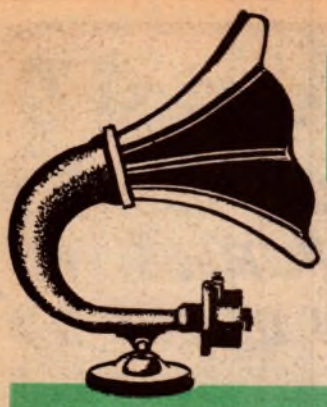
And why a whole string of companies from those involved in the original TED disc, through the big-time audio names, to IBM are all peeping out through the cracks in their respective lab doors!

Mystery solved!

We were intrigued when we came across the Dick Smith range of ultra-dynamic high density tapes pictured above. Their rather unhandsome black-blue-white packaging obviously differed from that shown on page 15 of last month's DSE catalog. Were they old stock, we asked Marketing Manager Gary Johnston? "No way", he replied. "It's the same top quality tape and mechanics as advertised but with a cardboard sleeve design that bugs me! We changed it for the catalog but we're working on another 2001 design again that will be more in keeping with the real quality of the product."

Full marks for frankness!

SANYO AUSTRALIA PTY LTD are well poised for a big sales drive during the current year, as evidenced by a recent round of trade nights and seminars. Featured were a variety of home appliances, audio and hifi equipment, in-car entertainment equipment and a new colour VCR for home television recording. A turntable featured uses precision engineered linear drive, while an in-car cassette system offers triple-button remote master control. Sanyo's new VCR is designated as the Betacord VTC9300P and, as the name suggests, uses the Sony Betamax recording standard. It offers 3¼ hours of recording time on a cassette, 72-hour timing facility, daily-mode timing and other facilities, plus a projected colour camera for home use.



AUDIO TALK

by LEO SIMPSON

Damping Factor & loudspeaker damping

Following last month's discussion on so-called high definition loudspeaker cables and their mythology, it is now appropriate to discuss "damping factor". The significance of an amplifier's damping factor is widely misunderstood, which when you come to think about it, is not surprising. After all, the damping factor of an amplifier bears little or no relationship to the damping actually applied to a typical loudspeaker system.

Well what is "damping factor" and why does it cause such confusion? We can answer these questions in two steps. First, we shall define what damping factor is, and then define what it is not.

Damping factor is merely the ratio of an amplifier's output impedance to its nominal load impedance. So if an amplifier has a damping factor of 50 with a nominal loud impedance of 8 ohms, then the output impedance of the amplifier is 8/50 or 0.16 ohms.

Normally though, when measuring damping factor, one does not go to the bother of measuring and calculating the output resistance and then dividing it into the nominal load value. All that is done is to measure the difference in amplifier output voltage between no-load and normal load (8-ohms) conditions, and divide this difference into the load voltage. This is done at a convenient power level, usually one watt.

Actually this method is the same as that used for measuring the regulation of a power supply. And really, an audio amplifier can be regarded as a voltage source with low output impedance.

Damping factor is normally measured at a frequency of 50Hz. This is right in the piston range of all wide range speakers, and it is also close to the fundamental resonance of many loudspeakers, ie, just where they need damping the most.

Another practical reason for measuring damping factor at 50Hz or a similar low frequency is that this parameter is normally reduced at low frequencies, compared to that obtainable at mid-frequencies. This is often the case with amplifiers which have output coupling capacitors; the rising reactance of the capacitors at low frequencies increases the amplifier output impedance. Thus the damping factor is reduced.

As an illustration of this phenomenon, consider an amplifier with a mid-frequency (1kHz) damping factor of 50, which has an output coupling capacitor of 1000uF. At 50Hz, the reactance of a 1000uF capacitor is 3.18 ohms. Add this to the almost negligible output impedance of the amplifier (which is 0.16 ohms) and, by vector addition, the output impedance becomes 3.184 ohms. When divided into the load impedance of 8 ohms, the damping factor is a mere 2.5!

Before we can consider whether or not a damping factor of 2.5 is inadequate or not, we must define damping as it is applied to loudspeakers.

The concept of damping (in the electrical sense) first arose out of the losses inherent in tuned circuits. A tuned circuit in an oscillator may have high or low losses. If the losses are high, oscillation will tend to die away quickly when excitation is removed; the tuned circuit is said to be highly damped. If the losses are low, the oscillation will tend to decay slowly; the circuit is said to be lightly damped.

Damping was also used to describe the mechanical and electrical methods applied to indicating meters, to stop the pointer swinging about wildly with changes in the current being measured. Similar thinking lies behind the concept of damping as applied to loudspeakers.

The voice coil of a loudspeaker is situated in a powerful magnetic field. When a voltage source is applied to the loudspeaker, current flows through the voice coil, causing the speaker cone to move. In that mode the loudspeaker can be thought of as a motor,transforming electrical energy to mechanical energy. But this process is reversible and the loudspeaker is also a generator, producing a voltage which is proportional to the velocity of the voice coil in the magnetic field. In conventional terms, this voltage may be thought of as the "back-EMF".

Now consider a situaton when the voltage applied to the loudspeaker is suddenly reduced to zero. Instead of the speaker cone ceasing its forward (or reverse) motion, it will tend to keep going in the same direction and to keep generating the same "back-EMF" as it was before the applied voltage dropped to zero. Now, if the "back-EMF" could be shorted out, the speaker cone would come to an abrupt stop.

This would be because the electrical loading placed on the voice coil "generator" by the short would be transformed to a mechanical load on the speaker cone. This is what actually happens in practice. The low source impedance provided by a typical good quality amplifier tends to short out the "back-EMF" and thus provides a degree of control over the speaker cone motion. This is the concept of damping.

The damping described above should be categorised as electrical damping and is but one component of the total damping applied to a typical loudspeaker system. The major component of loudspeaker damping is mechanical, made up of the total air loading exerted on the speaker cone by the listening room, the enclosure and its venting system and the filling material in the enclosure.

It is generally true to state that loudspeakers with sealed enclosures have more mechanical damping than vented enclosures. As a consequence, vented enclosures often have a boomier and more uneven bass response than sealed enclosures.

Having defined what damping is, we should note that it is only effective in the frequency region where the cone behaves like a true piston, ie, where the voice coil is tightly coupled to the cone. For a typical woofer, the piston range will span several octaves above its fundamental resonance, ie, up to several hundred hertz.

At higher frequencies, the speaker cone tends to "break-up" and no longer behaves like a piston. The voice coil progressively decouples from the cone and the effective radiating area of the cone is reduced till, at some relatively high frequency, the cone hardly moves at all and the voice coil dust cap alone radiates, if at all.

To return to the main argument, I stated above that the electrical damping provided by an amplifier is only a portion of the total damping applied to the loudspeaker.

Even with the above proviso, there are a number of factors which may substantially reduce the efficacy (and thus importance) of the electrical damping which can be provided by an amplifier. All of these factors depend on the

magnetic circuit of the speaker. For a start, if the speaker has a large magnet structure and provides a high flux density in the voice coil gap, then the back-EMF generated by the speaker, for a given drive current, will be proportionately higher. This will mean that the amplifier will be more effective in providing electrical damping.

Second, if the speaker has a long-throw voice coil, then only part of the voice coil will be immersed in the magnetic field at one time. This means that the voice coil will generate proportionately less back-EMF and amplifier damping will be consequently reduced.

But the most important factor of all, which greatly reduces the efficacy of the damping provided by the amplifier, is the resistance of the voice coil itself. In a typical 8-ohm loudspeaker, the voice coil resistance is about 6 or 7 ohms. Against this, we can see that the fraction of an ohm output resistance of a typical amplifier is negligible. So, by comparison, if an amplifier has a relatively high output impedance at 50Hz of, say 3 ohms, the overall change in the electrical damping is not large. For the electrical damping provided by the amplifier to be really effective, the voice coil resistance would have to be considerably smaller with respect to the total loudspeaker impedance.

We might conclude then, that the electrical damping provided by the amplifier is not of major importance. Whether or not that is the case depends on the particular loudspeaker system, and whether the designer has relied on electrical damping to achieve the specified performance. Whatever the conclusion, it would be wrong to assume that an amplifier need not have a low output impedance.

Ideally, the amplifier should have zero output impdance. If not, when driving a loudspeaker system with typical large variations in load impedance, the amplifier will be unable to provide constant voltage drive. This would be undesirable, because loudspeaker designers normally assume that the driving amplifier is a constant voltage source.

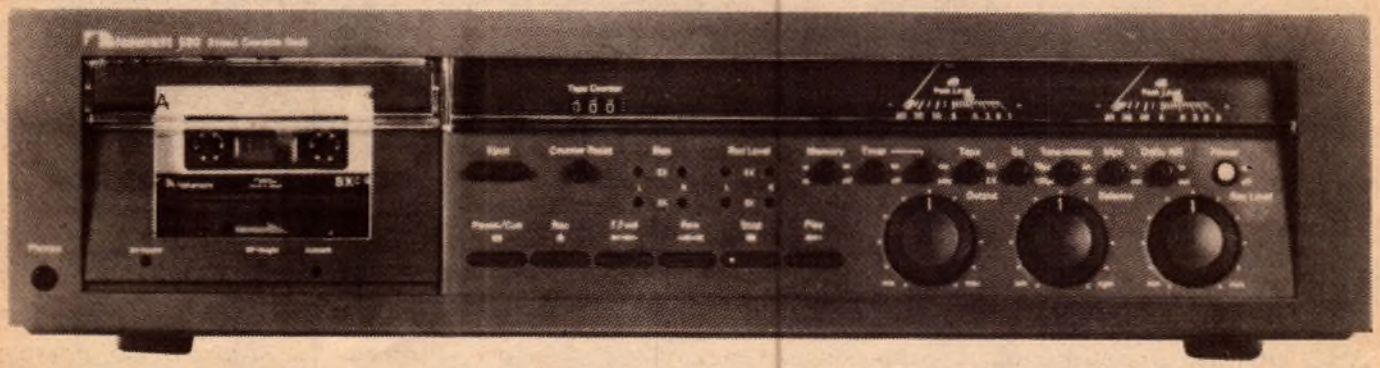
If we decide that for an amplifier to be a constant voltage source with less than 1dB (or $\pm$0.5dB) total variation over the whole frequency range when driving typical loudspeakers, then the source impedance must be less than about 0.3 ohms.

Our conclusion is therefore a paradox; High damping factor is not of great relevance as far as damping of loudspeakers is concerned. But as an indirect indicator of low output impedance, high damping factor is desirable. Confused? Well never mind. Most amplifiers have a high damping factor anyway, as a spinoff of normal design procedure.

Introducing

ANOTHER OUTSTANDING CHAPTER IN NAKAMICHI'S BOOK OF CASSETTE DECK ACHIEVEMENTS

Nakamichi 580
2 Head Cassette Deck



The Features

The 580 is designed with a thoughtful selection of features which make the deck more convenient and enjoyable to use.

Motor-Controlled Head Assembly

The Direct Flux Erase Head

The Crystalloy SuperHead

Pause/Cue Feature

Timer Operation

Remote Control

$599 recommended retail price

The Transport

The 580's Diffused–Resonance transport is basically a 2-motor system: one phase-locked-loop DC servomotor drives the flywheels/capstans, and a second DC motor is used for the fast-wind functions. There is, however, a third motor in the 580's transport; it replaces the solenoid which is commonly used in logic-controlled transports. The use of a motor to govern head assembly movement makes the 580 an extremely quiet machine. More importantly, head insertion is far more gentle than with solenoids, so critical alignments are less likely to be disturbed.

The Nakamichi "Regulars"

- Dolby Noise Reduction System
- Separate Bias and Eq Selectors
- Defeatable MPX Filter
- Tape-start Memory
- Built-in 400 Hz Test Tone
- Front Panel Access to Rec Cal and Bias
- 47 dB-range Peak Level Meters
- Full IC Logic w/Total Tape-end Shutoff
- High-output Headphone Amplifier

These days, choosing the right cassette deck is at best a difficult task. With so many sizes, shapes and features, it's hard to tell which combination will best suit your needs. And, if you rightly place performance ahead of gadgets, the choice is no less difficult because there is as much fiction as there is fact in published specifications.

Unless you are a technical wizard, it is nigh impossible to make meaningful comparisons on the basis of printed information alone. The answer, perhaps surprisingly, is Nakamichi who has uncovered new magnetic head technology, new transport technology and new electronic circuit design techniques, all of which combine to make startling improvements in reproduction accuracy — improvements which are not necessarily reflected in the published specifications or the price.

Nakamichi 580
2 Head Cassette Deck

For additional information, direct all inquiries to:

CONVOY INTERNATIONAL PTY. LTD.
4 Dowling Street, Woolloomooloo, N.S.W. 2011
Telephone: (02) 358-2088. Telex: AA23111

Mail this coupon to Convoy International for a colour brochure on the 580.

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CSA

Nakamichi 580 cassette deck sets new standards

The Nakamichi 580 2-head cassette deck, which is currently being released on the Australian market, heralds a new generation of high performance Nakamichi equipment. It may fairly be said to set new standards in cassette deck presentation and performance.

The name Nakamichi is, of course, well known and well respected in hifi circles and their 1000 series and 600 series cassette decks became something of an industry reference in terms of basic performance. Their physical appearance, however, had less than universal appeal.

The new 580 model is wide and slim, with plenty of eye appeal to those who like the modern technical look. It is not small, however, measuring 500mm (W) x 130mm (H) x 350mm (D). The finish is a smooth, dull black, with white printing and a clear perspex strip over the level meters, the tape counter and the top of the cassette compartment.

We understand that the 580 represents Nakamichi's response to two distinct pressures: the first, to produce an up-dated product; the second, to design for the impending challenge of metal-coated tape. In fact, the 580 is equipped only for the normal range of oxide coatings but there is evidence in the design of forward planning.

In particular, the erase head represents a complete departure in concept which, according to Nakamichi, exposes the tape to the basic erase field rather than to the mere leakage from the conventional gap. The system has the potential to increase the intensity of the erase field, as necessary, without running into head saturation. The spin-off, as far as the 580 is concerned, is the ability to erase conventional tapes to the same degree of quieting as can be achieved by full bulk erase. The claim is supported, in the manufacturer's literature by comparative full spectrum noise curves.

Another notable feature is a complete new transport system employing three motors. One motor drives the twin capstans, which are of different diameter and operate at different rotational speeds, in order to spread rather than concentrate any mechanical resonances. A second motor drives the take-up and fast spooling systems, while a third performs the mechanical control functions that would otherwise involve solenoids. Nakamichi claims that motor control is much smoother, with less chance of jarring the precision assembly.

We would hazard a guess that the mechanism has been designed to provide an ultimate option of running metal tapes at half speed, thereby doubling their playing time for medium-fi requirements. There is no such provision on the 580 but, again, it benefits by a notable spin-off: a wow and flutter figure of 0.07% (DIN 45507), the best figure we have measured to date!

Looking now at the front panel, the load/eject mechanism is, again, the smoothest we have encountered. The cassette is clearly visible at all times through the front cover and both can be removed easily to give access to the heads for cleaning. Access is also available to factory (or service) pre-set adjustments for head position and R/P head azimuth.

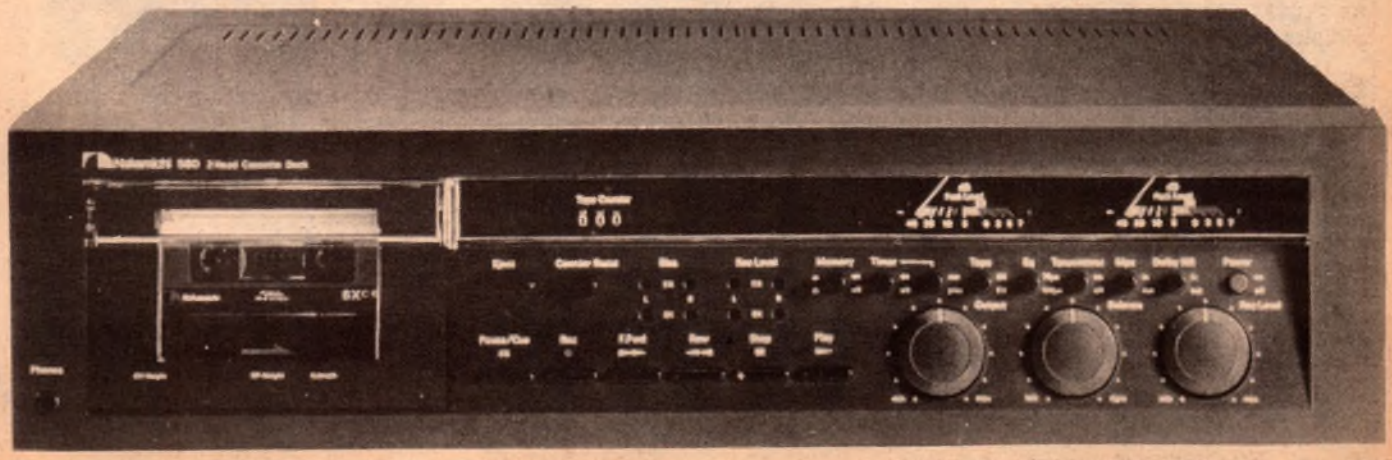
When switched on, the cassette compartment, tape counter and meters are all illuminated, along with the power-on button. In addition, a tiny green spot shows on the touch tab which is currently functional. Operation is particularly smooth and noise-free.

While most users will doubtless operate the 580 deck by way of the panel controls, two supplementary options are available. One is a remote control lead which permits operation of the recorder over distances of about five metres. The other is an infra-red transmitter/receiver, which extends the potential operating distance and avoids the need for a wired connection.

The same remote control socket on the rear can be used in conjunction with an external timer (e.g. the Nakamichi DS-200 digital program timer) to permit pre-programmed recording or playback. The controls to dow with "Timer" mode are already provided on the front panel of the 580.

So also is the button which interlocks operation with the footage counter to provide a "memory" function.

As indicated by the name, the Pause/Cue tab has a double function. During play or record, it will produce a



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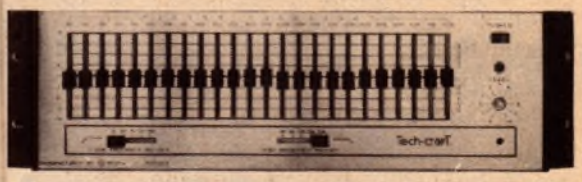

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noise-free pause; in either fast forward or fast reverse mode, pressing the tab brings the R/P head into contact with the tape, thereby simplifying the task of locating the beginning or end of a recording.

Rewind time, by the way, is commendable at about 47 seconds for a C-60 cassette. At the end of any functtion, the auto-stop operates within 1 second.

Above the function tabs are holes giving access to presets which allow the deck to be set up for two major grades of ferric tape: normal low-noise high output, and high coercivity.

Characteristic of Nakamichi thinking, the manufacturers see no necessity to go beyond four brands (Nakamichi, Fuji, Maxell and TDK). There is no specific provision for other types, or for CR02 tape and no in-built metering adjustment to optimise the deck for such tapes, as is done in some other modern decks. Clearly the intention is that the user should accept the factory adjustments and stick to the recommended tapes. Failing that he/she would have to resort to external instrumentation or simply hope that existing adjustments will be near enough.

If the user opts for external instrumentation, Nakamichi recommends their T-100 Audio Analyser, which provides a wide range of facilities for checking and peaking up a high performance system.

What the 580 deck does provide is an internal 400Hz oscillator which can be used to check and adjust the calibration of the twin output meters, with separate adjustments for the respective channels and for the two general classes of tape envisaged. A procedure is also suggested for checking and adjusting the Dolby level, as per instructions in the owner's manual.

Rather than use LED peak indicators, the designers have opted for peak reading level meters, which provide a visual memory of peak levels. The forward response time is very fast but it takes about 3 seconds for the pointers to fall back from full scale to zero.

We found that the meter calibration was very good (within 0.5dB) over the important range from +7 to —5dB, deteriorating somewhat below —5dB. In fact, the calibration in the region of —30 to —40dB, adjacent to the stop, is quite meaningless. It would have been more realistic to limit the calibration and concentrate the attention on the range —20dB to +7dB.

While checking the meters, we also checked the response of the basic deck electronics from input to the recording level, as ostensibly impressed on the tape. It was broad and flat, with the -1dB points at 10Hz and 15kHz; this with the MPX (FM stereo multiplex) filter switched out. With the filter in circuit, the response at 18kHz was 25dB down on the 1kHz reference.

To put the 580 into record mode, the instructions suggest pressing the Pause/Cue and Record tabs simultaneously — a simple matter because they are side by side. The Rec. Level and Balance controls can then be adjusted to ensure that an adequate level and balance will be applied to the tape. To initiate recording, simply press the Play tab; to stop it temporarily, press the Pause tab, and so on. The Stop tab not only stops the transport but also cancels the Record mode.

Connections to the deck are made to a panel on the rear, either by a DIN plug and socket or by the now usual RCA connectors.

One notable — and we think unfortunate — omission is any provision on the deck for a direct microphone input. Nakamichi apparently take a purist view that, if the user wants to use their deck for live recording, they should not be encouraged to plug in any old (or new) microphone. They should buy a proper microphone mixer/preamplifier (what better than the Nakamichi MX-100 plus power supply) together with appropriate microphones!

Finally, how does the 580 stack up in the thing that it is really supposed to do? To record and replay a tape?

To find that out, we loaded it with a TDK SA C-90 cassette, one of those specifically recommended in the Users Manual.

With Dolby switched out and referenced to -0dB at 1kHz, the response was flat to 100Hz, up 1dB at 50Hz, flat again at 30Hz and down -2dB at 20Hz. Going higher in frequency, it was flat to 3kHz, drooping very gradually to 1dB down at 10kHz, sustaining that level to 15kHz. Beyond that, it carried on to 20kHz with no more than an additional 0.5dB loss.

A most commendable curve.

With Dolby switched in, the bass response remains substantially unaltered except that the slight prominence at 50Hz becomes a 0.5dB loss (forget it!) Above 2kHz, there is a gradual drop of -2dB at 10kHz, increasing to -3dB at 15kHz and -3.5dB at 20kHz.

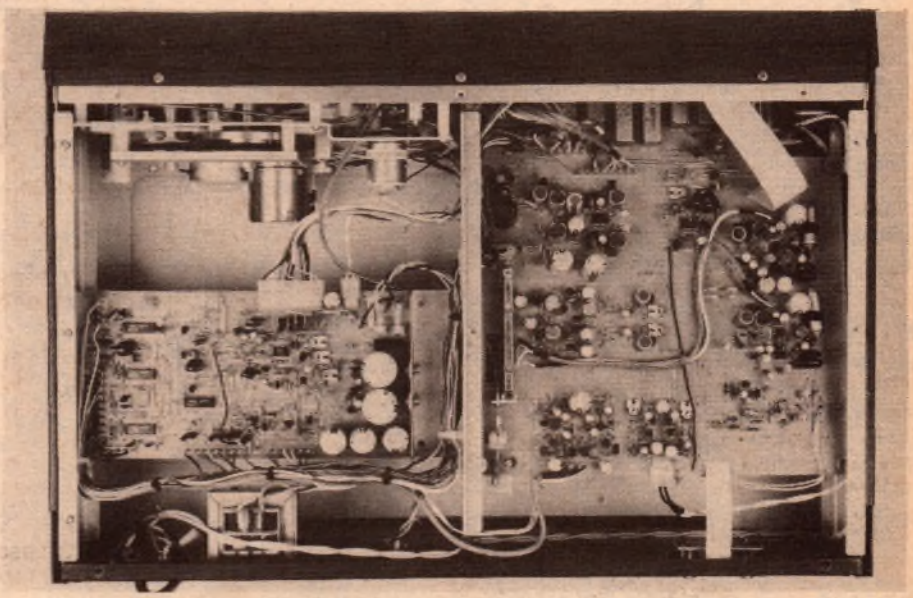
To be pedantic, the response with Dolby is not quite as flat as without but the bonus is a distinct improvement in signal to noise ratio: -52dB with Dolby, -48dB without.

This was confirmed in A-B testing of source and taped signals, as heard on high quality phones. With Dolby in circuit, the copy was virtually indistinguishable from the original, betrayed mainly by the occasional drop-out and the occasional peak loudness passage. Without Dolby, the 4dB increase in tape noise made it discernable to the critical ear.

Total harmonic distortion remained low at about 0.8%, with channel separation at -40dB (100Hz, -41dB (1kHz) and -32dB (10kHz).

Recommended retail price of the 580, as illustrated but complete with manual, is $599. The remote control cord, the infra-red remote control, and external microphone amplifier(s) are available as optional extras.

For further information: Convoy International Pty Ltd, 4 Dowling St, Woollomooloo, NSW 2011. Tel: (02) 358 2088. (LDS & WNW)



This underside photo of the Nakamichi 580 shows the compact transport mechanism which has three motors. The third motor replaces the solenoid functions of competitive deck.

Marantz 3650 Stereo Control Console

Catering to those who prefer separate power amplifiers and preamplifiers, the Marantz 3650 stereo control console offers a large number of control facilities including comprehensive dubbing for two tape decks. It also has switches to set cartridge loading and shunt capacitance.

The model 3650 is very similar in appearance to the Marantz 1152DC stereo amplifier reviewed in these columns in July 1978. The styling of the front panel, in satin gold anodised aluminium, gives an impression of heaviness and is almost perfectly symmetrical in its layout.

Overall dimensions of the Marantz 3650 are 416 x 152 x 283mm (W x H x D) including knobs, rubber feet and rear projections. Mass is 8.5kg.

As shown in the photograph below, the 3650 has a large number of knobs, switches and controls. Inputs are provided for two magnetic cartridges, one of which may be a moving coil type. As well, there are two switches to vary the resistive and capacitive loading for the cartridges, although these are not operative for moving coil cartridges.

The source and tape selection facilities are complex, to say the least. Six buttons at the top left-hand corner of the front panel provide for input selection (to be actually listened to) from either of two magnetic cartridges, tuner, auxiliary or either of two tape decks.

Immediately below the input selection buttons are two large knobs which select the source to be recorded from any of the above six by two tape decks. The two knobs also allow for dubbing in either direction between two decks. There is also a tape equalisation switch, which allows the 3650 tone controls to modify the program tonal content being recorded by either of the two decks.

Following past Marantz practice, the 3650 has bass, mid and treble controls, although this model carries the complication further by having separate controls for each channel and turnover selection for the bass and treble controls. In addition, there is a defeat switch for the tone controls.

The model 3650 has the same high and low filters as used on the model 1152DC mentioned above. As with the 1152DC, the low filter has a slope of 18dB/octave below 15Hz which makes it particularly effective, but the nominal slope of 18dB/octave for the high filter only applies above 20kHz and makes it less effective.

Besides accommodating quite an array of RCA sockets for the inputs and outputs, the rear panel of the 3650 has three sets of spring-loaded terminals for speakers. One set is for the output leads from the accompanying power amplifier, while the other two sets are for two pairs of loudspeakers.

Inside, the relatively large chassis is divided into two sections. The rear half accommodates all the wiring to the input and output sockets and the power supply. The front section, which is shielded from the power supply, is tightly crammed with quite a few vertically mounted PC boards. These are all interlocked together in what looks to be a serviceman's nightmare.

All the circuitry uses discrete semiconductors. The total complement is 97 transistors, 27 diodes and 16 FETs. All that, just for a control unit!

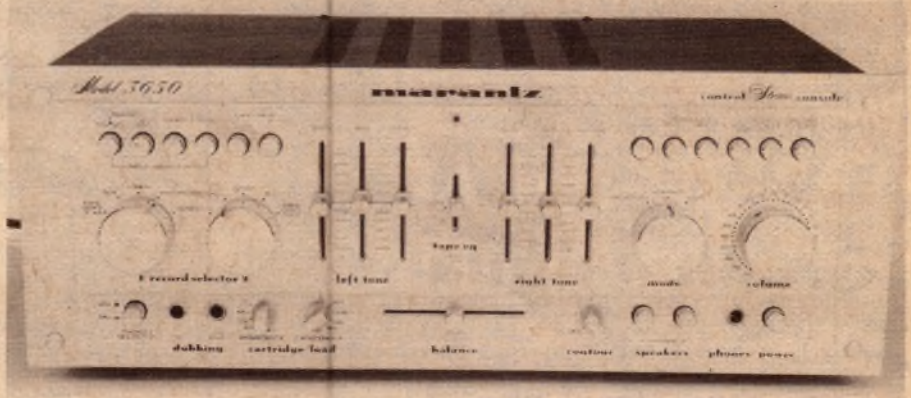
We found little to quibble with in the operation of the 3650, although it takes quite some time to become familiar with all its facilities. We are inclined to think that unless an enthusiast really wants all the facilities offered, he would be better off with a less complicated model.

The instruction manual is written in three languages: English, French and German. Like many multi-language manuals, it is badly laid out with the three separate language texts running down each page. Better to have each language section completely separate. No circuit was included with the manual, so we are unable to comment on this in detail.

Marantz categorize their 3650 with a whole raft of specifications but curiously, we could find no reference to the boost and cut of the tone controls. We measured it as: 50Hz, +13dB, —14dB; 1kHz, +11dB, —6dB; 10kHz +10dB. Frequency response of the high level inputs was 3dB down at 90kHz with the tone controls in flat settings and 2dB at 90kHz with tone controls defeated. RIAA equalisation was within +0.2dB from 40Hz to 20kHz. Phono overload at 1kHz was 280mV RMS. No problems there.

Signal-to-noise ratio for the high level inputs was 77dB unweighted with respect to 150mV RMS in, with 4.7k input loading. For the phono input, loaded with our reference magnetic cartridge, the signal-to-noise ratio was 80dB unweighted, with respect to 10mV in at 1kHz. This is the best phono S/N ratio we have ever measured.

Harmonic distortion performance was equally impressive. Marantz quote it rather vaguely as .005%. We confirmed that distortion over most of the range is very close to this figure. Separation between channels for the high level inputs was 70dB at 100Hz, 65dB at 1kHz and 46dB at 10kHz. This was measured with 4.7k loading the undriven channel input



Our overall impression of the Marantz 3650 is favourable. It is a complex piece of equipment which takes some time to learn to drive, but it performs extremely well and is very quiet at all times. It is quite expensively priced, but should give a lot of satisfaction to those who can afford it.

Recommended retail price of the Marantz 3650 is $660. Further information on Marantz equipment can be obtained from high fidelity retailers or the Australian distributors, Superscope (Australasia) Pty Ltd, 32 Cross Street, Brookvale, NSW 2100 (L.D.S.)

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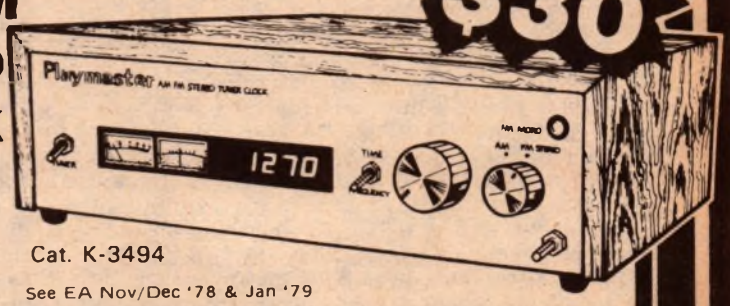

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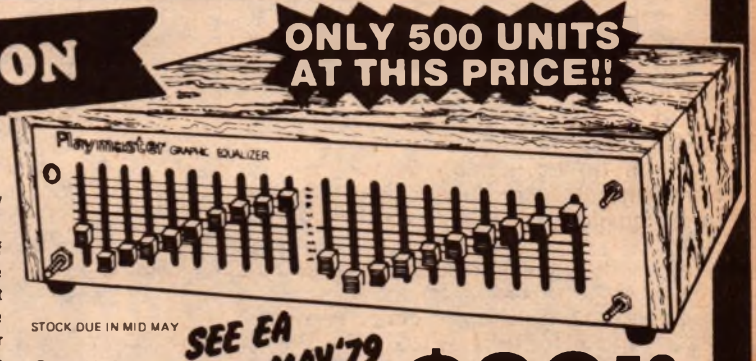

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DSE533

Solid-state modulated RF test oscillator

compact design covers 455kHz-30MHz

This little modulated RF oscillator covers the range from 455kHz to 30MHz in four switched bands. It is compact, relatively easy to build and should be of interest to radio amateurs, servicemen, hobbyists and anyone requiring a reliable source of RF for alignment and other purposes.

by IAN POGSON

It is a long time since we last described a simple RF oscillator — 11 years in fact. The last one was in March 1968, so it is with some justification that we have been asked in recent times to present a new one.

The March 1968 design as such has not dated dramatically, but due to the passage of time, the availability of parts has inevitably changed. As a result anyone interested in building this particular unit is likely to find problems. With this in mind, we have come up with what we think is a worthy successor, using parts which are currently in good supply.

The general approach we have used was to follow the same broad design, with a bandswitched RF oscillator followed by a buffer stage optionally modulated by the output of a fixed frequency audio oscillator. A simple attenuator controls the RF output. The output of the audio oscillator is also available separately from its own output socket. While operation has been arranged from an external mains derived power supply, it can also be operated from a battery source.

So that the RF output attenuator will have some real meaning, it has been necessary to consider the matter of RF leakage from the instrument. This is not an easy one to solve with a simple unit, but by using a diecast metal box and taking some other precautions, we have managed to keep leakage to a tolerable level. It should be realised that with a simple instrument such as this, it is not possible to make tests like absolute sensitivity measurements on receivers. But short of this, general alignment and adjustments can be made quite readily.

Let us now have a look at the circuit in more detail. The oscillator uses two JFETs in the source-coupled configuration, with feedback from the second drain to the first gate via a 4.7pF ceramic capacitor. The drain of the first JFET is grounded to RF, while the second one has a complex load consisting of a 10mH RF inductor in series with a 470uH RF inductor which is shunted with a 15k resistor. The two different values of inductor are used to help in maintaining a reasonably constant RF output across the range of interest. The shunting resistor is to avoid an unwanted resonance.

Our main reasons for using the source coupled oscillator are that it is simple and allows the use of coils with only one winding and without a tapping. Four coils are required to cover the range. The lowest frequency coil is a ready wound one normally used in broadcast receivers, while the other three coils have to be wound; details are given in the table. Tuning is by

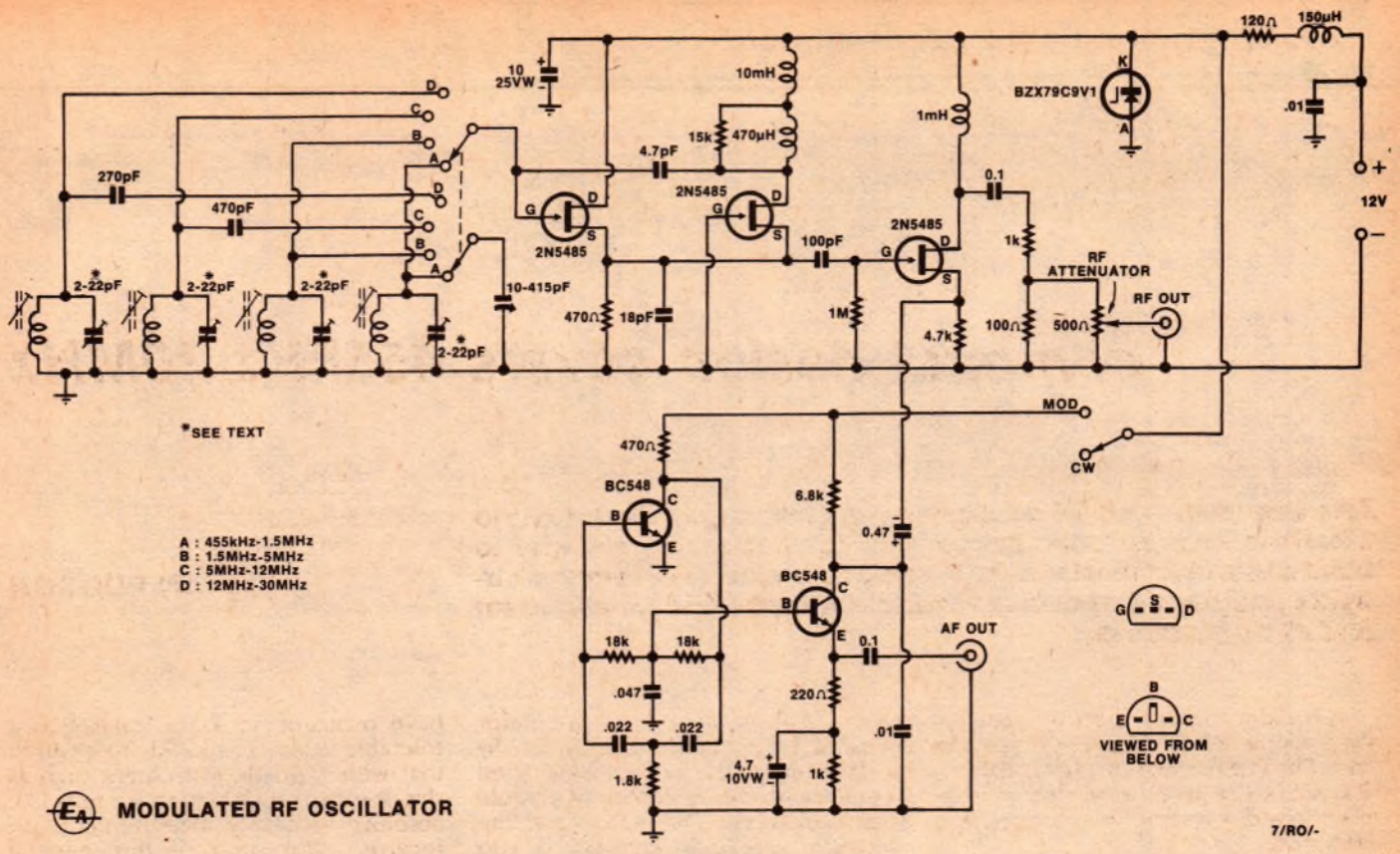
The prototype oscillator was built into a metal diecast box.

Estimated cost

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

$50

This includes sales tax.



E4 MODULATED RF OSCILLATOR

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means of a standard Roblan 10-415pF single gang capacitor and the two higher frequency bands are restricted by series capacitors of 470pF and 270pF to prevent them becoming too cramped. Adjustment for each band is by means of trimmers and the slugs in the coils.

Output from the oscillator is taken from the 470 ohm common source resistor via a 100pF capacitor to the gate of a third JFET, which performs the functions of buffer and modulated amplifier. The buffering function has the desirable effect of isolating the oscillator from the output, thereby reducing oscillator frequency shift due to varying output loading.

RF output is taken from the buffer's 1mH drain load, via a 0.1uF capacitor and a 1k resistor. This feeds the 500 ohm potentiometer, shunted with a 100 ohm resistor, which forms the output attenuator. The combination gives a source resistance of about 80 ohms. The maximum RF output varies somewhat over the full range, but it averages about 100mV.

The audio oscillator is a "twin-T" type using a BC548 bipolar transistor. A reasonably good sine wave is available from the .047uF capacitor and this is DC coupled into another BC548 transistor which acts as an amplifier and buffer. The output from the collector is fed via a 0.47uF tantalum capacitor to modulate the source of the 2N5485. This gives an approximate modulation level of 30%. Audio frequency output is taken from the 220 ohm emitter resistor of the BC548 amplifier. The audio frequency of the prototype was measured at 780Hz with an RMS level of 320mV.

A source of 12 to 14VDC is fed into the unit via the socket provided. At the socket is a .01uF ceramic bypass capacitor. This is followed by a 150uH RF inductor swung between the socket and the appropriate point on the printed board. These items are added to reduce the possibility of RF leakage via the DC supply leads. On the board are provided a 120 ohm resistor and a 9.1V zener diode. They provide voltage regulation for the unit, thereby reducing the possibility of frequency shift due to supply voltage variations.

It should be noted that if some readers may wish to supply the unit with a voltage higher than about 14V, then the 120 ohm resistor should be increased accordingly so as not to exceed the dissipation rating of the zener diode. The maximum power dissipation of the BZX79C9V1 zener diode is 400mW. The total current taken by the prototype was measured at 24mA.

Earlier I mentioned that it has been necessary to design the new oscillator to suit the parts currently available. At the time of writing, all components are available but some items may need some clarification as regards the sources of supply. The diecast metal box is available from Dick Smith stores and may also be available from some other suppliers.

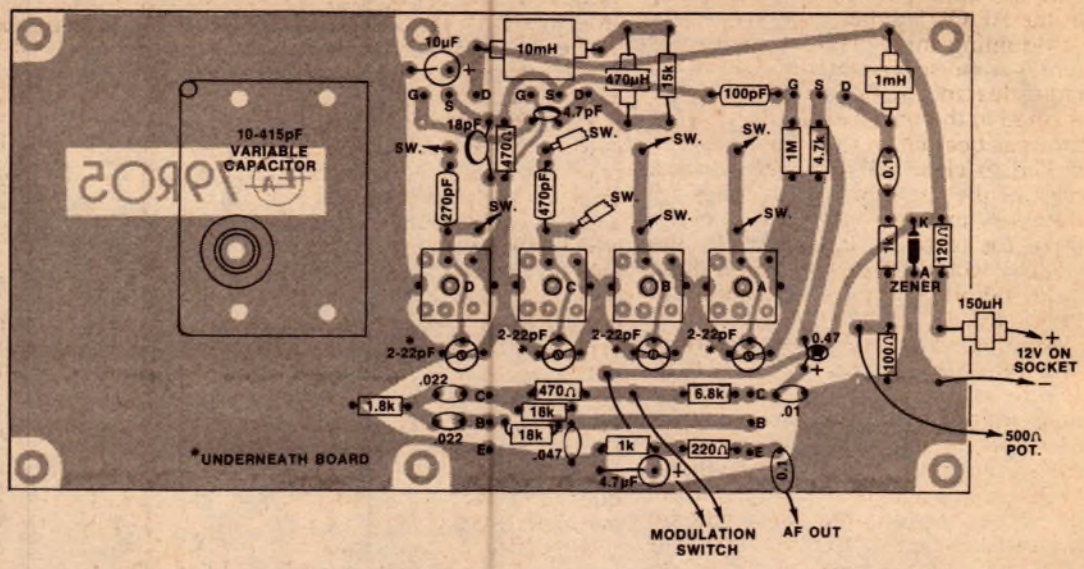
As usual, copies of the artworks for the printed board and the front panel label will be distributed to various suppliers and these items should be readily available.

The type 7211 coil, coil components, "Handspan" dial knob and the Roblan variable capacitor are all distributed by Watkin Wynne Pty Ltd, 32 Falcon Street, Crows Nest, NSW 2065. They may be obtained direct or through most other components stockists.

The four trimmers are shown on the circuit as the 2-22pF Philips plastic dielectric type. This type may be used, but there are some alternative ceramic types currently easier to obtain and they are physically compatible, fitting

Coil winding details:

Band A: Jabel type 7211 2nd RF bandpass coil, or equivalent.
Band B: 100 turns 36B&S enamel, 2 layers of 50 turns each close wound, separated with layer of tape, on Neosid 5mm former, with slug and can. (SMS type A assemblies, without ferrite ring and cup). Terminate on pins 1 and 2, corresponding with used positions on printed board.
Band C: Same as "B" but with 35 turns.
Band D: Same as "B" but with 15 turns 28B&S enamel.



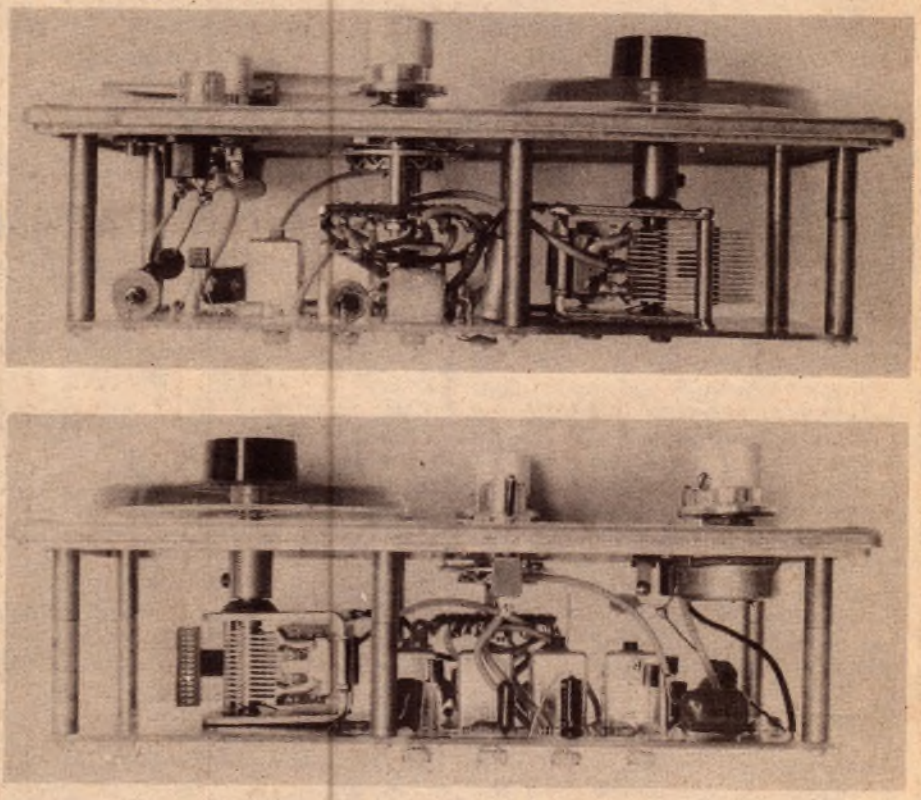
This component overlay diagram shows the PC board as viewed from the component side. Note that the trimmer capacitors (marked with an asterisk) are mounted on the copper side of the board.

the board just the same as the Philips ones. However, the actual capacitance values available differ from the specified 2-22pF. In point of fact, we used ceramic 3.5-13pF units and these are available from Radio Despatch Service, 869 George Street, Sydney, NSW 2000. We understand that Dick Smith Electronics can also supply this type.

The rotary switch is a standard type and should be available from most stockists. The 500 ohm potentiometer is also a standard type, but it should be stressed that a carbon type should be used — not a wire wound one.

The coverage of each of the four ranges has been arrived at after some thought. It was found to be possible to get down to 455kHz with the available tuning capacitor and lowest-band coil, if the upper frequency was limited to 1500kHz. This was decided upon, with the second range starting at 1.5MHz and going to 5MHz. The third range covers from 5 to 12MHz and the fourth range, 12 to 30MHz.

Although we have taken some steps to reduce RF leakage, there is still a noticeable amount. I consider it largely due to leakage across the 500 ohm potentiometer, even when it is turned right off. Checked against a good quality signal generator, the leakage amounts to about 20µV.



These two views show the instrument as viewed from the top and the bottom, respectively. The PC board is stood off the front panel with brass spacers.

Construction, while it is not difficult, calls for a certain amount of care. The usual precautions should be taken with regard to soldering. A good hot, clean iron should be used, taking care to make good soldered joints, without overheating and possibly damaging vital components. All components should be checked that they are the correct ones before each is fixed on the board. Also, due regard should be given to polarities where this is applicable.

In addition to the above points to be observed, there are some other points more or less peculiar to this project which should also be observed. These points will be covered as we go along.

It is a good idea to wind the three higher-band coils before going ahead with the main assembly. Details for the coils are given in the table. The windings should be done such that the windings are mechanically stable. They should be wound firmly and fixed with some paraffin wax or cellulose lacquer. Termination of the windings should coincide with the connections on the printed board. When the coils have been wound, they are fitted into the can and the can crimped to hold the coil in place.

Assembly of the board is next. It is generally best to start with the small components first, gradually working up to the larger ones. It is important to

note that the four trimmers are mounted on the copper side of the board. Also, the 150uH RF choke should be left off for the time being. This also applies to the 0.1uF capacitor at the AF OUT point.

Mounting the variable capacitor requires some special attention. Firstly, a large clearance hole must be drilled or reamed in the board to clear the nut of the rear bearing. Also, a hole must be drilled to clear the rivet head on the back of the capacitor. These holes are necessary to allow the back face of the capacitor to sit on the board. By the way, it would be better to drill these holes before starting the assembly of the board.

Another consideration when mounting the variable capacitor relates to its spindle lining up with the centre of the hole in the front panel. It may be necessary to use some washers to do some judicious packing here and there, to achieve this condition. Finally, it will be necessary to shorten the spindle on the variable capacitor and fit an extension shaft, also cut to length as required.

Having taken the board assembly this far, with the variable capacitor left off to allow easier handling for some further operations, the brass spacers may be fitted. You will notice that we have six spacers 1in long and another six ¾in long. The reason for this is that we needed six spacers 1¾in long but these were not readily available. (If you are able to make your own then so much the better.) The spacers were joined together with some ½in Whitworth screws with the heads removed. These were used as joiners by inserting half of the thread into one end each of a 1in and a ¾in spacer. The joined spacers are then screwed to the printed board.

We will assume that the front panel is ready with all holes drilled. The rotary bandswitch may be mounted and put aside for the moment. Now fix hookup wires to each of the points of the board which have to go to the switch. You have the option as to whether you use both holes with leads from pin 2 of coils for bands A and B, or use a jumper across the switch lugs and only use one of the points on the board. Also, shielded leads, using insulated audio type coaxial cable, should be used for band C. This is done to prevent "suckout" from the adjacent band D, with consequent upsetting of the oscillator at the particular frequency.

Now offer the front panel with switch to the spacers and use the two middle spacers to screw the board to the panel for the next operation. The leads from the board have to be cut to length and soldered to the lugs of the switch. This is a bit tricky, but by giving each lead some thought and working out the order in which they are terminated, it may be done without any great problems.

It is important that the leads be kept

PARTS LIST

1 Diecast aluminium box 190mm x 60mm x 110mm.
1. Lettered front panel (see text).
1 Handspan dial knob
2 Knobs
2 Belling Lee coaxial sockets
1 2-pin speaker socket.
1 2-pin plug for above.
1 Miniature SPDT toggle switch.
1 2-pole 5-position rotary switch
1 500 ohm linear potentiometer.
6 Brass spacers, 1in long tapped ⅛in Whitworth
6 Brass spacers, ¾in long tapped ⅛in Whitworth
1 Printed circuit board 178mm x 89mm, code 79R05.
1 Roblan 10-415pF single gang capacitor
1 150uH RF inductor.
1 470uH RF inductor.
1 1mH inductor.
1 10mH RF inductor.
1 Jabel type 7211 2nd RF bandpass coil
3 Neosid coil former assemblies, SMS type A.
3 2N5485 transistors
2 BC548 transistors
1 BZX79C9V1 zener diode

CAPACITORS
1 4.7pF NPO ceramic
1 18pF NPO ceramic
4 2-22pF Philips trimmers (see text).
1 100pF polystyrene.
1 270pF polystyrene.
1 470pF polystyrene.
2 .01uf greencap.
2 .022uF greencap
1 .047uF greencap
2 0.1uF greencap
1 0.47uF 35VW tantalum
1 4.7uF 10VW electrolytic
1 10uF 25VW electrolytic

RESISTORS (½ watt)
1 x 100 ohm, 1 x 120 ohm, 1 x 220 ohm, 2 x 470 ohm, 2 x 1k, 1 x 1.8k, 1 x 4.7k, 1 x 6.8k, 1 x 15k, 2 x 18k, 1 x 1M.

MISCELLANEOUS
Hookup wire, solder, solder lugs, audio type coax cable, screws, nuts, enamelled wire for coils.

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used in the prototype. Components with higher ratings may generally be used provided they are physically compatible. Components with lower ratings may also be used in some cases, provided the ratings are not exceeded.

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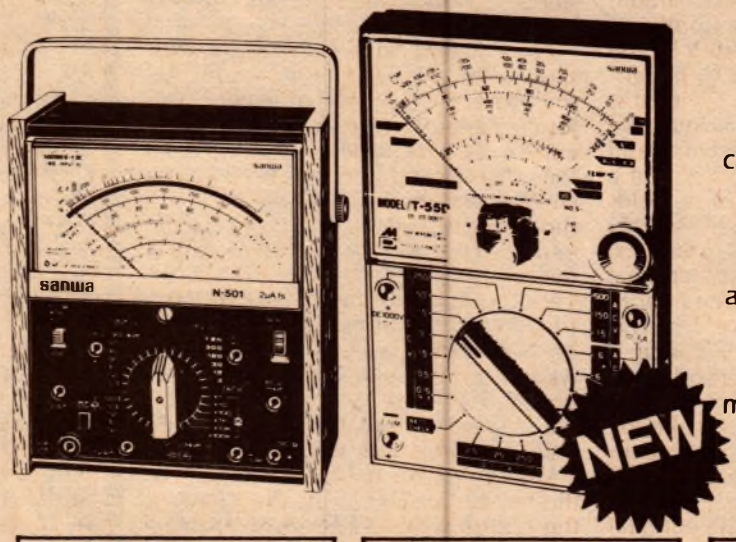

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as short as possible. The shielded leads are only earthed at the switch end. Connect the shields together with a piece of hookup wire and then run from the connection nearest the variable capacitor position, with another piece of hookup wire, which will be soldered to the frame of the variable capacitor later on.

Having got the switch wired up, the rest is quite easy. The switch should now be unscrewed from the front panel and allowed to be supported by the leads for the time being. The front panel is now removed from the stand-offs.

Mount the two coaxial sockets, the DC input socket, the toggle switch and the potentiometer on the panel. Put a solder lug under the nut which holds the DC input socket nearest the switch. A .01uF ceramic capacitor is connected between the lug and the +12V terminal on the socket. Also, a lug is fitted under the nut of the RF OUT socket which is nearest the end of the panel. This lug is soldered directly to the nearest lug on the 500 ohm potentiometer. Then another solder lug is used to make the connection between the centre conductor of the coax socket to the centre lug of the potentiometer.

Before proceeding with the connections between the board and the panel components just dealt with, the variable capacitor should be installed. First of all the spindle should be shortened so that when the boss of the extension spindle is fitted it will just touch the body of the capacitor, although a slight clearance should be observed when finally fitted. By temporarily fitting the panel, the length of the extension spindle required to suit the handspan knob may be found. The spindle should then be cut to this length.

At this stage, the variable capacitor should be mounted permanently on the board, making whatever adjustments which may be necessary to ensure that the spindle passes through the centre of the hole in the front panel. With the front panel in position, you should have a clearance between the end of the extension spindle boss and the inside face of the panel of between 1 and 2mm. It is necessary to make electrical contact at this point between the boss and the panel. We took a flat washer and dished it so that when it was dropped over the spindle and the front panel fixed in place, the washer should make a sliding contact as required.

With the variable capacitor installed, the rest of the leads from the board to the components on the panel may be added. In the case of the AF output, a 0.1uF capacitor is run between the board and the socket, while a 150uH RF inductor is run from the +12V DC input socket to the board. Another point is that the -12V DC lug on the socket is connected to the earth point on the board, as shown in the wiring diagram.

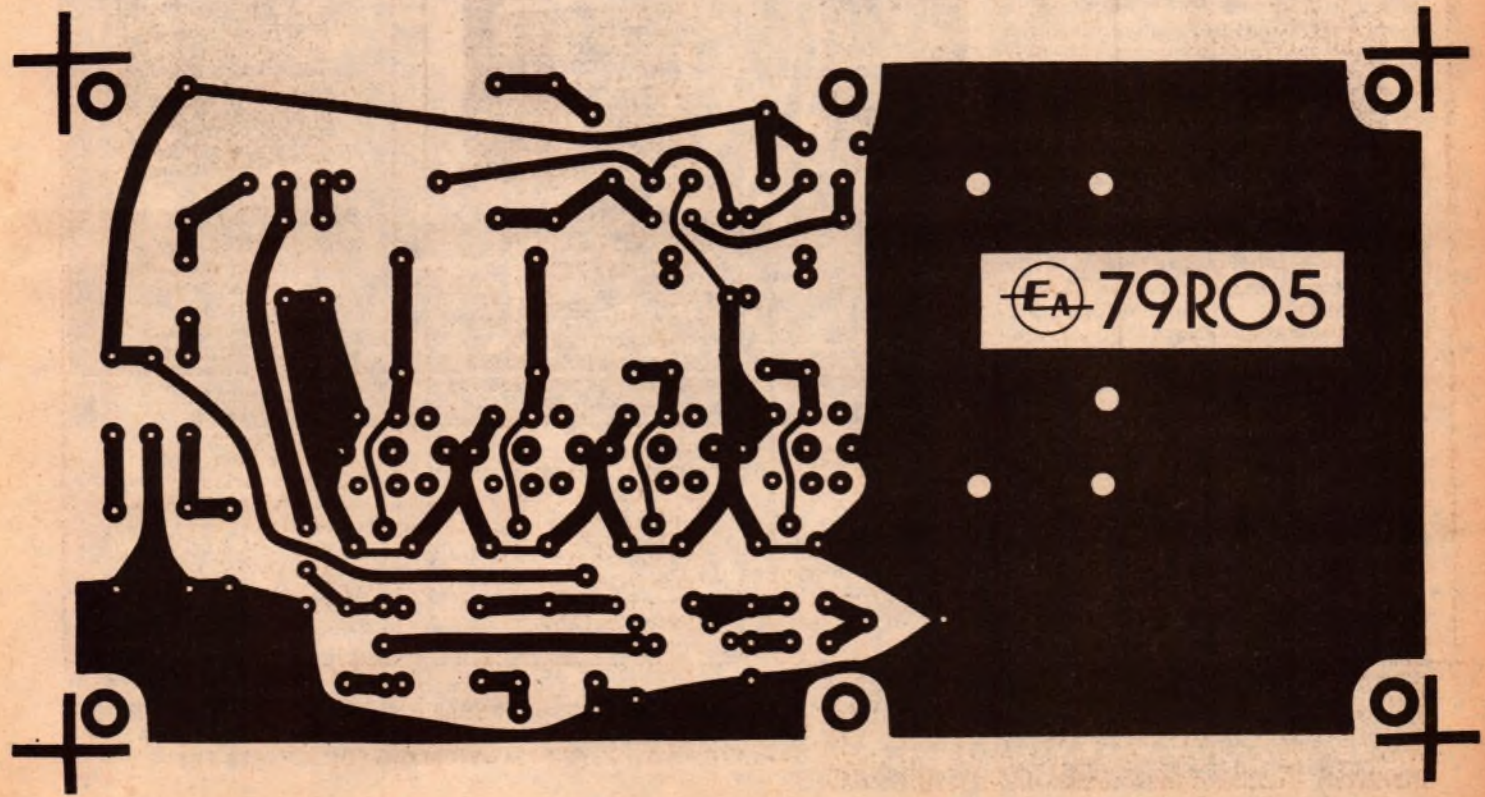
With the instrument completed, a power supply is needed. Any suitable source of 12 to 14V DC should be satisfactory. It is a good idea to shield the positive lead and some audio type coaxial lead will achieve this. This precaution should help to keep RF leakage to a minimum.

A convenient power source is the Ferguson Power Point Adaptor, type PPA9DC. With the load involved here this unit gives between 12 and 14V into the oscillator. An equivalent Plug Pak made by A & R Transformers should also be satisfactory, although we have not tried one at this stage.

Preliminary checks should be made to ensure that all is well before switching on. After switching on the power supply, it should then be established that the unit is working properly by listening on a suitable receiver. Assuming that signals may be heard at various frequencies on the receiver, the instrument is ready to be calibrated.

If you are fortunate enough to have access to a frequency counter or a well-calibrated RF signal generator, then either could be used for calibration. An alternative method, and one which is possibly not so accurate, is to calibrate against the dial on a broadcast and short wave receiver.

Below is an actual size reproduction of the PC pattern.



RF oscillator

For the purposes of calibration we will assume that you are using a copy of the front panel used on the prototype, with its calibration markings. Before starting the calibration process, make sure that the line on the dial knob is lined up with the scale base line, with the capacitor fully meshed.

All calibrations must be carried out by taking readings with the unit in its box — the panel fixing screws are omitted for this operation. The unit must be removed from its box each time to make adjustments to the appropriate slug or trimmer. The reason for this inconvenience is that no holes have been provided in the box to gain access to these adjustments, in order to keep RF leakage to a minimum.

To calibrate with a frequency counter, turn the modulation off and feed the output of the oscillator into the counter. Start with the low frequency end of band "A" and set the oscillator dial to 455kHz. The slug in the appropriate coil is adjusted until the correct reading is obtained. Now set the dial to the other end of the band, to 1.5MHz, and adjust the appropriate trimmer until the correct reading is obtained. This process must be repeated at each end of the band until both readings are correct. The three subsequent bands are treated in the same way.

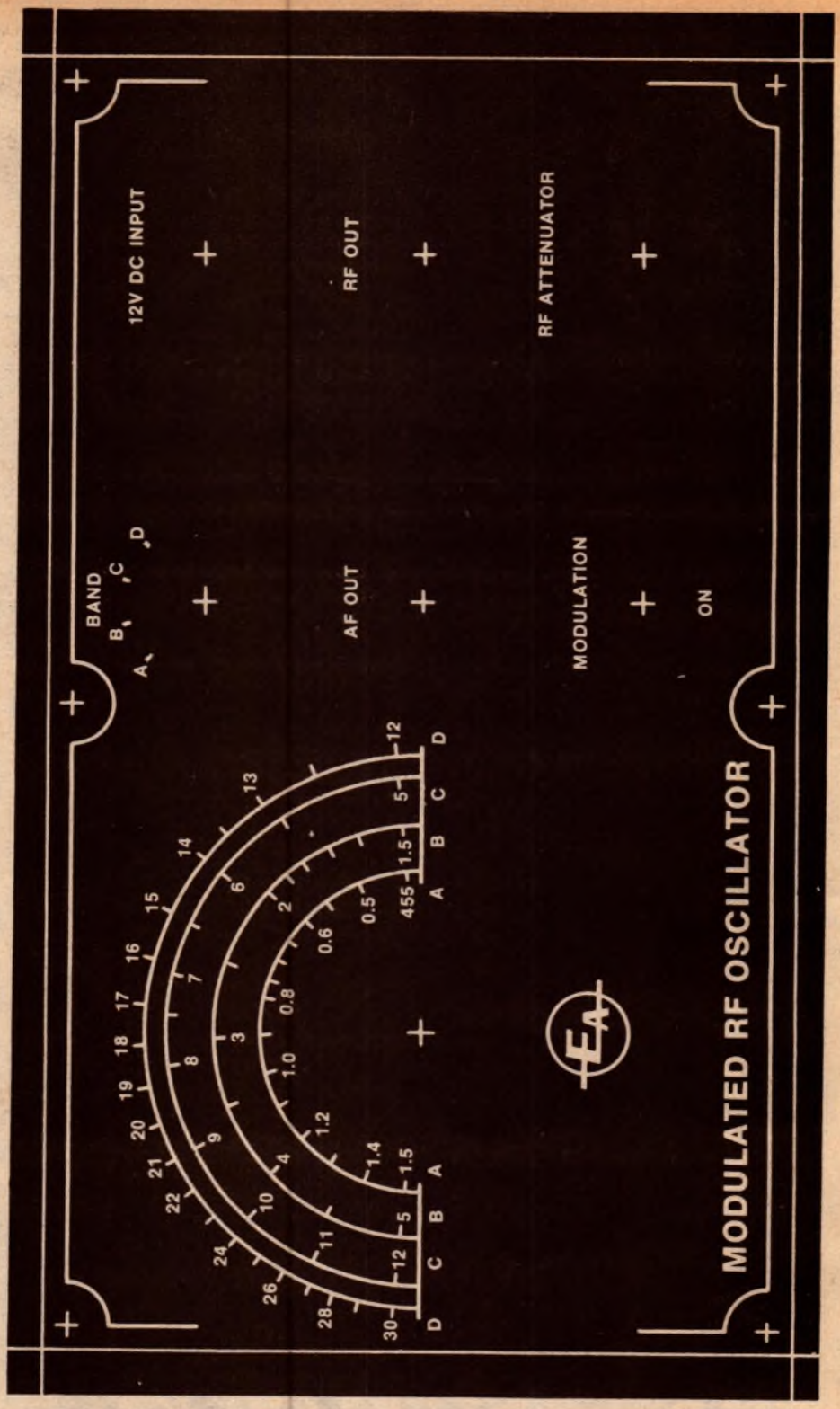
You may run into a problem up on the higher frequencies, where there may not be enough output from the oscillator to give a reliable reading on the counter. This may generally be avoided by taking the output temporarily from the junction of the 1mH RF inductor and the drain of the 2N5485.

If you wish to do the calibrating against a good RF signal generator, then a receiver covering the full range will be required. The RF generator output and the output of the oscillator will need to be loosely coupled into the aerial terminal of the receiver. This will need to be determined experimentally. The RF generator is set to the wanted frequency and tuned on the receiver. The oscillator, also set to the wanted frequency is adjusted with the slugs and trimmers in turn, until zero beat is obtained. The overall procedure is then the same as for the frequency counter.

Before proceeding, there is one point which must be considered with the above method. Very few receivers can be tuned to 455kHz and the method of calibrating 455kHz against such a receiver is to use the second harmonic. The receiver is tuned to twice 455kHz, or 910kHz and the 455kHz point is calibrated in this way.

To calibrate against a receiver, similar to the one mentioned above, the slugs and trimmers of the oscillator should be adjusted as previously described, so that the calibrations on the oscillator dial correspond with those on the receiver. To make sure that you are tuned to the signal from the oscillator, the modulation may be switched on and off to give this assurance.

When using a receiver for calibration purposes, it will more than likely be a superheterodyne. This being the case the possibility of errors due to "image" responses should not be overlooked. The two receiver responses are separated by twice the IF of the receiver. In the usual case of a 455kHz IF, the two responses will be 910kHz apart. The true or wanted response is usually that which corresponds to the lower oscillator frequency, or the higher of the two receiver dial readings.



Here is an actual size reproduction of the front panel.

CHESS CHALLENGER-10

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		Won	Drawn	Lost	
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2nd	SARGON (TRS-80)	6	5	1	8½
3rd	BORIS	7	2	3	8
4th	MICROCHESS 2.0 (PET)	3	4	5	5
5th	CHESS CHALLENGER-3	2	5	5	4½
6th	MICROCHESS 1.5 (TRS-80)	0	5	7	2½
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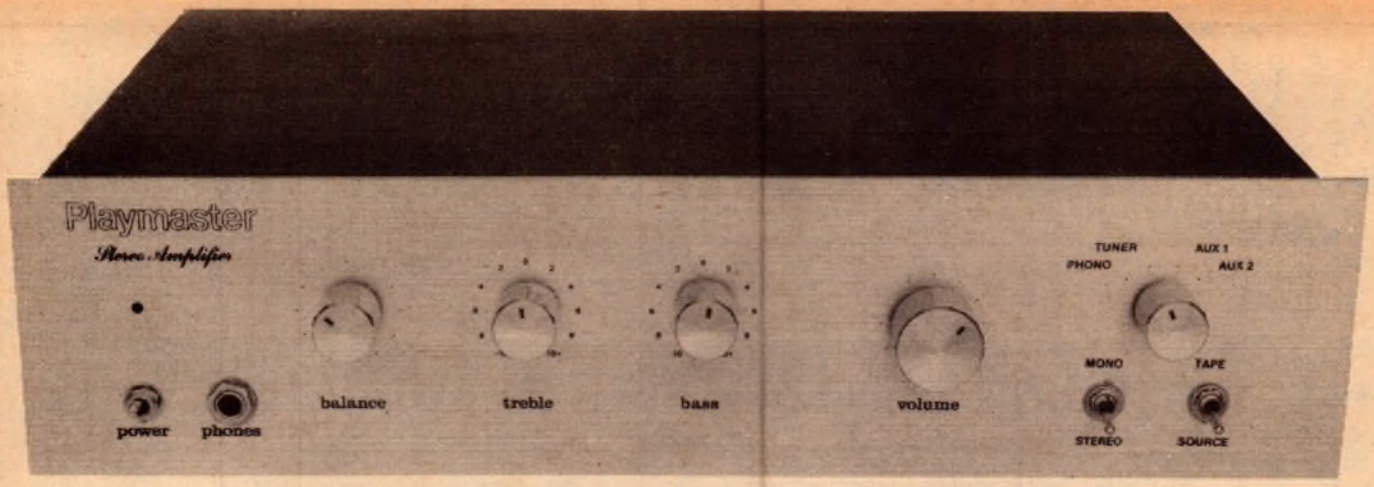


Combining high performance with modest power & cost . . .

A Playmaster Amplifier for flats and home units

Here is a new stereo amplifier which offers a lower cost alternative to our earlier — and still current — Twin-25 and Twin-40 watt Playmasters. With an output of about 10 watts per channel, it could provide an excellent basis for a good quality system scaled to the more modest needs of many flat and home-unit dwellers.

by RON De JONG

In these days of high power amplifiers, 10 watts RMS per channel, or 20 watts total, may seem a rather modest figure but, in fact, it represents a lot more power than most listeners use most of the time in an average home. Used with efficient loudspeakers, this new amplifier can make a surprising amount of noise!

While it could, of course, be mated with expensive peripherals, more logically we can imagine the constructor watching the advertisements for an attractively priced belt-drive turntable with magnetic cartridge and perhaps an attractively priced cassette deck. Add a couple of speaker systems like the Playmaster 3/26L and you could have some nice sound for not too much money.

In seeking to scale down the cost of an amplifier like the Twin-25, one does not have too many options if the basic input and control facilities are to be retained. However, in opting for a lower power output rating, one can specify a scaled-down output stage and a less costly power supply configuration. It's simply a matter of not paying for watts that you may never use!

One should hasten to add that, in scaling down an ouput stage, it is not necessary to scale up its distortion, noise, hum or non-linearity in terms of frequency response. As we shall see later, a modestly powered amplifier can be designed with the same care as one with much higher ratings.

In building up the prototype, we took the easy road by adapting existing metalwork, knobs and panel. Looking at the amplifier from the front, you would never know it from its bigger brothers. Nor, for that matter, would you be likely to pick the difference in sound, short of pushing it to the limit where one starts to clip and the other doesn't.

However, in the quest for lower cost, a less expensive front panel could be provided, while the resourceful constructor could produce his own sleeve casing from wood or particle board, suitably polished, lacquered or covered. We must leave that up to individual suppliers and constructors.

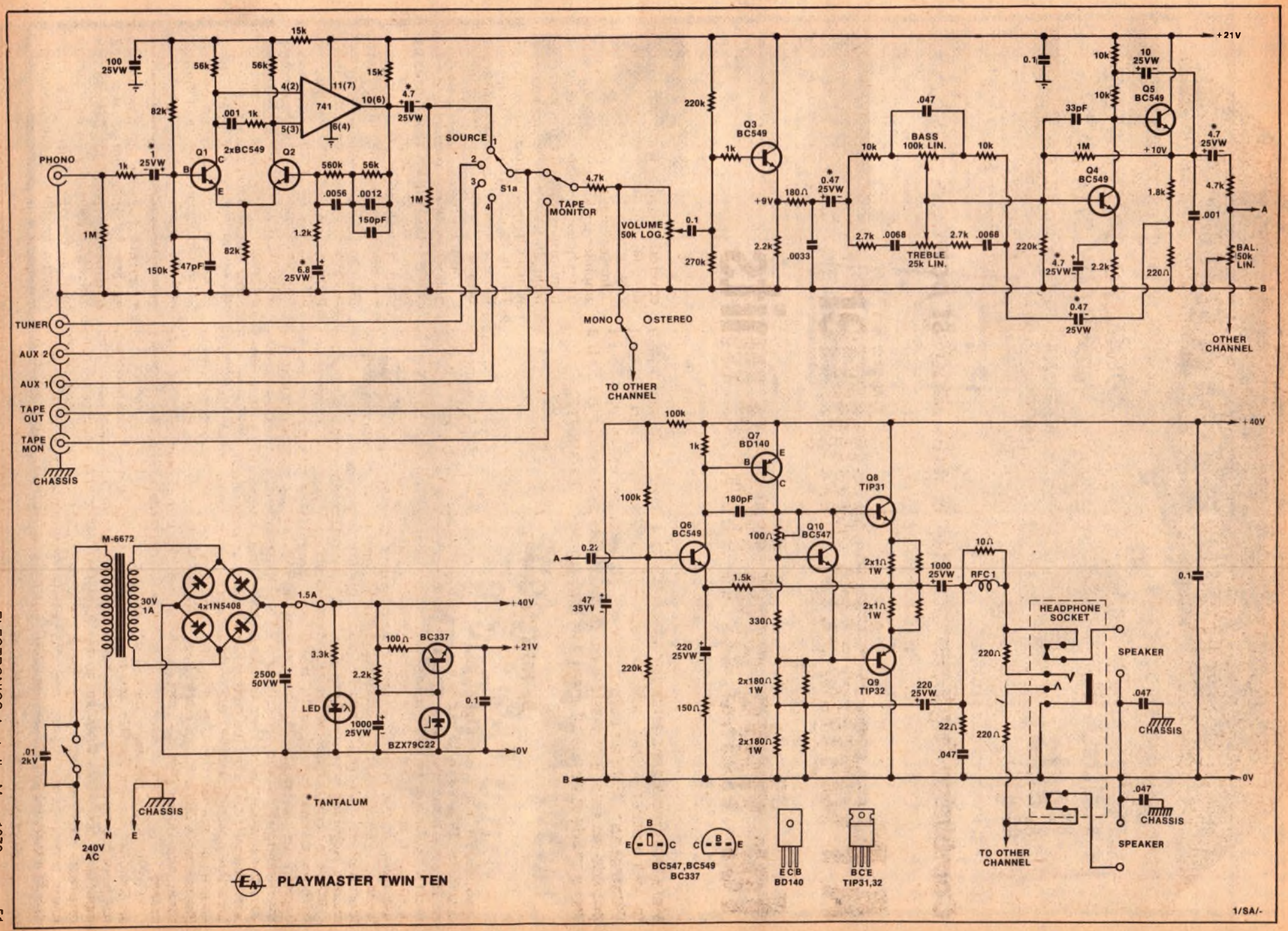
Now for a look at the basic design:

In seeking to simplify the power amplifier section and the power supply, our choice fell on a type of mains transformer which is currently available from at least two sources and from which can be obtained up to 30VAC at 1A. It is considerably cheaper than those specified for the twin-25 and twin-40 watt versions.

This transformer is used in conjunction with a bridge rectifier and a single large filter capacitor to provide a nominal 40V DC supply for the output stage. The supply is unregulated but it has the advantage, in this context, of maximising the voltage available to the output transistors when handling program material. This is simply another way of saying that, while the power output under sine-wave conditions (both channels driven) is nominally 10W per channel, the amplifier has considerable "headroom", and a clipping level of about 12W per channel on program.

The unregulated nature of the supply and its ripple content presents no

As pictured above, the new amplifier can use the same front panel as already sold for the Twin-25 and Twin-40. Alternatively, some suppliers may opt for a less ambitious finish. The circuit diagram for one channel is shown on the opposite page.


PHONO
TUNER
AUX 2
AUX 1
TAPE OUT
TAPE MON
CHASSIS
SOURCE
S1a
TAPE MONITOR
VOLUME 50k LOG.
MONO
STEREO
TO OTHER CHANNEL
OTHER CHANNEL
BASS 100k LIN.
TREBLE 25k LIN.
BAL. 50k LIN.
Q1
2xBC549
Q2
741
Q3 BC549
Q4 BC549
Q5 BC549
Q6 BC549
Q7 BD140
Q8 TIP31
Q9 TIP32
Q10 BC547
+21V
+40V
+10V
+9V
0V
M-6672
30V 1A
4x1N5408
1.5A
2500 50VW
3.3k
2.2k
100Ω BC337
LED
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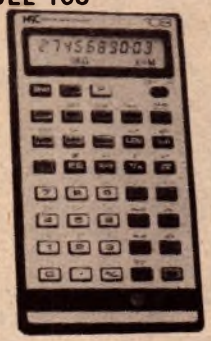

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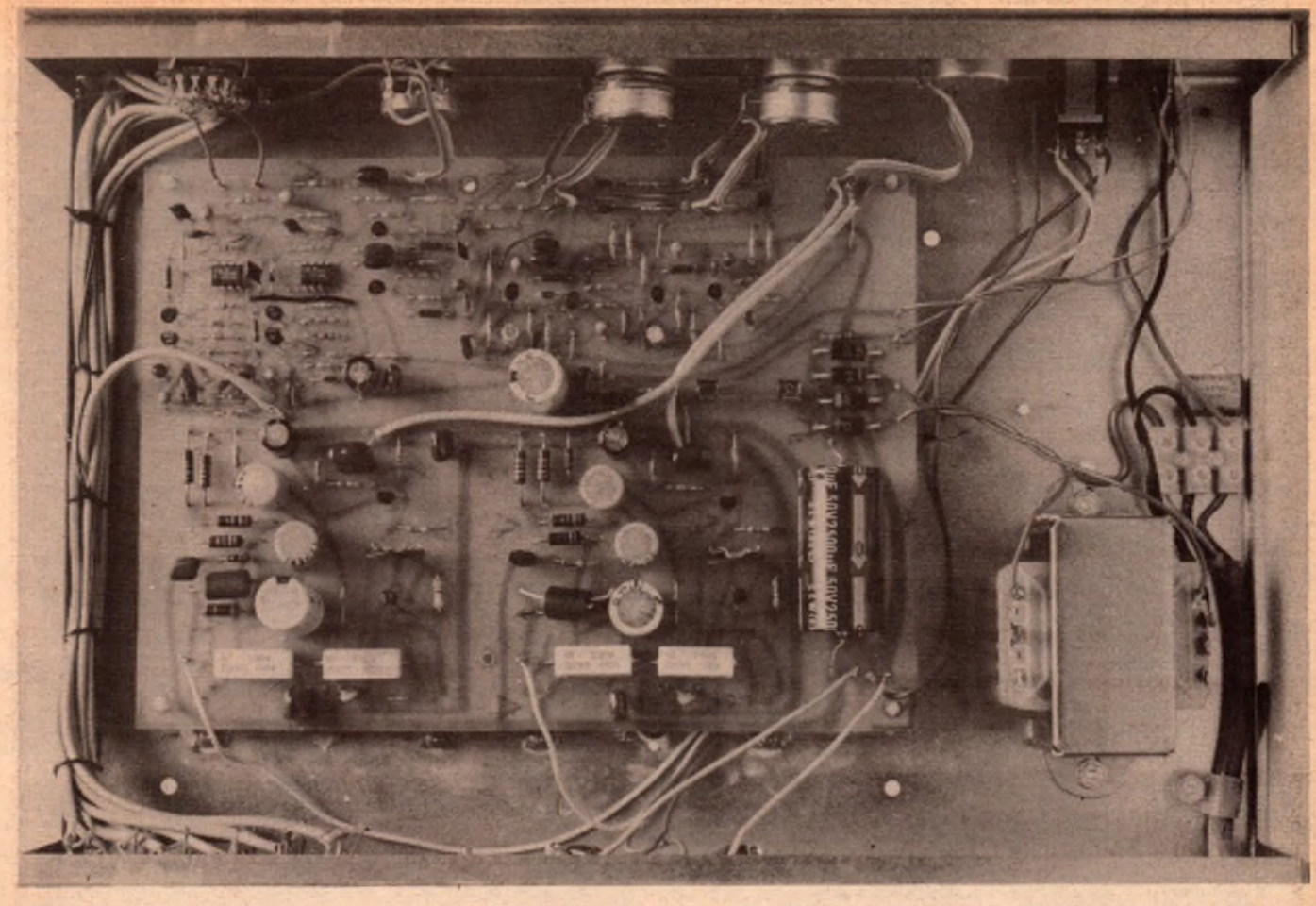


A NEW PLAYMASTER AMPLIFIER — continued

problem with the output and driver stages but a separate regulated and filtered source is necessary for the lower level stages. This is shown as a 21V line and is provided by a simple zener-referenced series pass regulator.

The 100-ohm resistor in the collector circuit of the BC337 pass transistor serves to protect it in the event of an accidental short circuit across the 21V line. In the base circuit, the 2.2k resistor serves to hold the zener at the mid-point of its plateau region while, at the same time, providing sufficient base drive to the transistor. It ensures that the zener will not come out of conduction, either as a result of mains fluctuations or of peak demands by the output stage on the 40V line.

So much for the power supply.

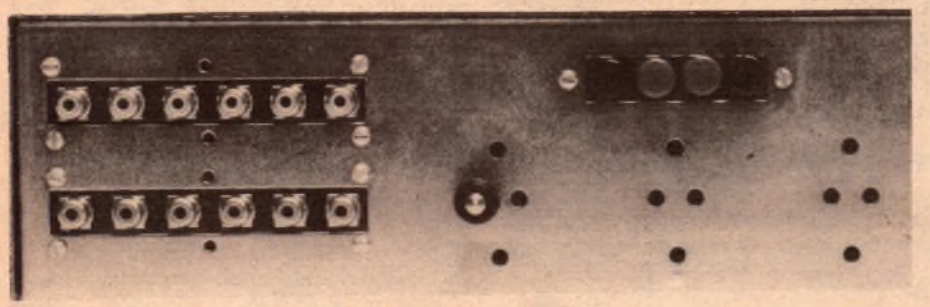
The magnetic pre-amp and tone control circuitry are similar to that in the Twin 40 except that the pre-amp no longer operates from a split supply. To make possible single supply operation, the first transistor of the differential pair is biased at about half the 21V supply voltage. To prevent noise or hum from entering the amplifier at this point the bias and supply voltages to the differential pair are heavily decoupled with a 15K resistor and 100uF capacitor.

A low-pass filter consisting of a 1k resistor and a 47pF capacitor is included at the input of the phono preamp, to attenuate any RF component which might otherwise penetrate the amplifier via the input leads. Of concern here are not just signals from nearby transmitters but RF pulses on the power lines initiated by switching transients.

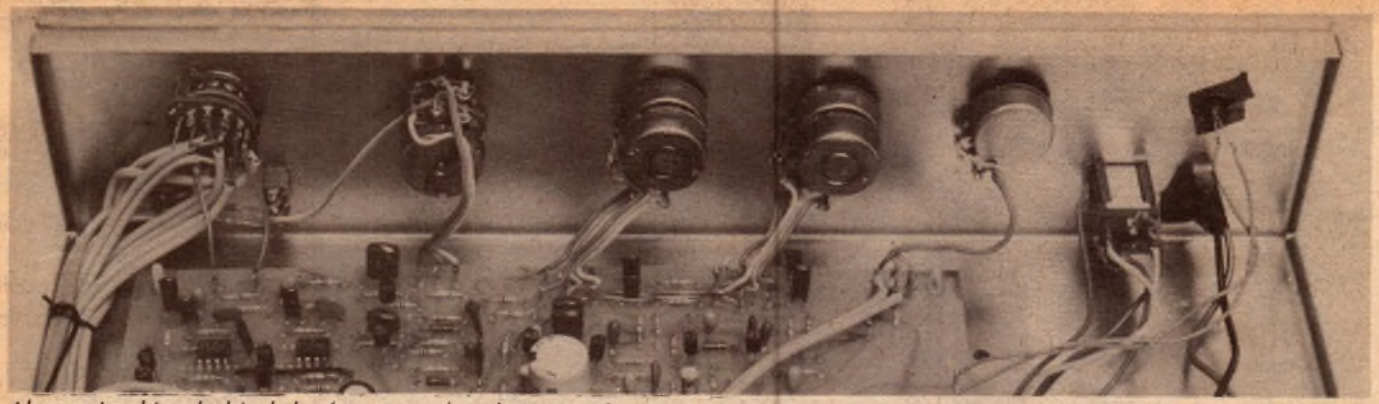
The additional complexity of a discrete differential stage preceeding the 741 is justified by improved noise performance and open loop gain over that of the op-amp alone. The collector current of the differential pair was selected to minimise noise, and the collector-to-emitter voltage was made as small as possible to reduce leakage noise.

Since the input stage is no longer referenced to earth potential, a 1M resistor has been included at the input of each pre-amp to prevent any charging current from entering the magnetic cartridge if it is connected while the amplifier is turned on.

The RIAA phono equalisation network bridging the 741 IC has been slightly modified to conform to the new IEC recommendation for roll-off at very low frequencies.

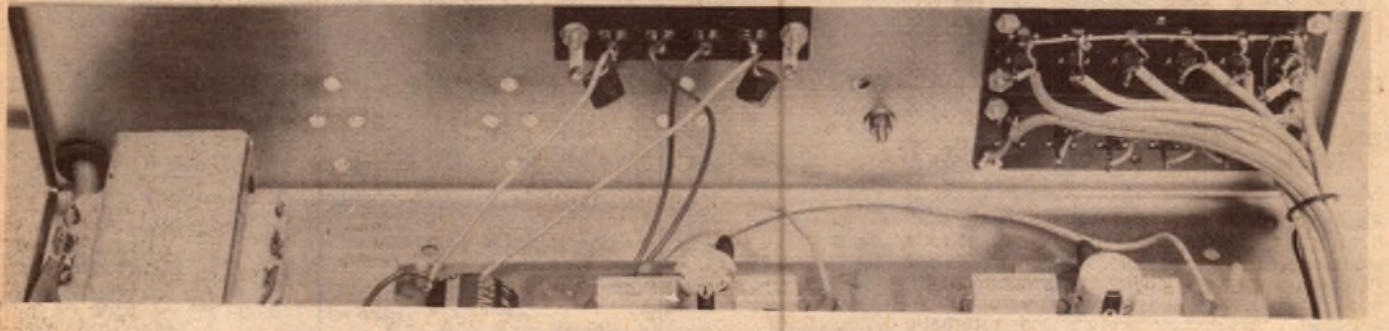


At the top of the page is a plan view looking into our new "Twin Ten" Playmaster amplifier. The uncrowded layout should make for easy construction. The partial back view shows the input sockets (left), the loudspeaker terminals (right) and an earth terminal for possible connection to the phono player deck. If the amplifier is built on the twin-25, Twin-40 metalwork, the output transistor mounting holes will remain unused.



Above: Looking behind the front panel at the controls and associated wiring. On the left is the selector switch and, almost hidden below it, the stereo/mono and tape monitor switches. The sequence of the other controls can be deduced by comparison with the front view on the title page. Note the use of lacing and of ribbon leads to the controls, in the interest of neatness.

Below: The input and output connectors on the rear panel are available as ready-assembled strips. It is important to note that, while certain of these terminations are ostensibly "earthy", the only connection to chassis should be that adjacent to the phono input to the rear panel. Full wiring diagrams, along with parts list and specifications will be presented next month.



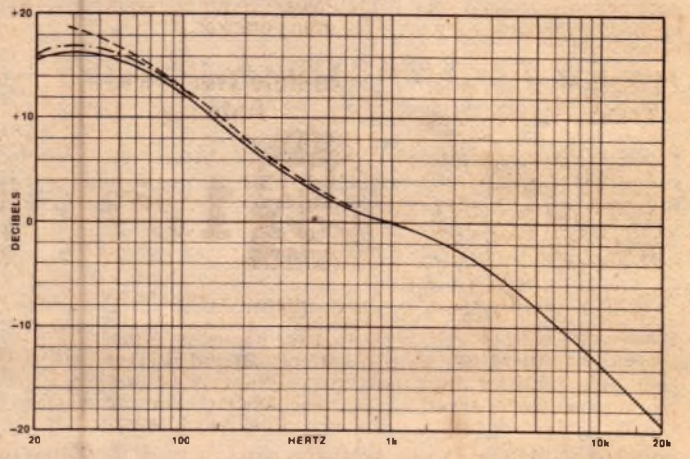
As originally set down, the RIAA equalisation curve calls for very high gain in the playback amplifier at very low frequencies — with the risk of amplifying turntable rumble. It is for this reason that most magnetic phono preamps include extra time constant components in the bass boost network to limit its effect below about 30Hz. The IEC is now recommending a time constant of 7950uS for this limiting action and this is provided by the 1.2k resistor and 6.8uF capacitor in the base circuit of Q2.

The equalisation curve obtained experimentally from the magnetic preamp is shown in the accompanying diagram. The response is within 1dB of the standard RIAA curve, except around 20Hz, where the low frequency (IEC) roll-off can be observed.

The output of the pre-amp along with inputs from the tape, tuner and auxiliary inputs are brought together at the source select switch. From there the selected signal passes to the Stereo/Mono switch and the volume control, and thence to an emitter follower. The high input impedance of the emitter follower stage minimises loading on the volume control, so preserving it's logarithmic response.

In normal stereo useage, the impedance presented by the amplifier to the various high level sources is about 40k, which can be regarded as an acceptable and convenient figure.

The emitter follower stage preceeding the tone control circuitry has also been modified from the original 40/40 circuit. The ferrite bead used in the base lead of transistor Q3 is replaced by a 1k "stopper" resistor which, in combination with the internal base emitter capacitance, inhibits any tendency to high frequency instability.



Above about 800Hz the magnetic phono compensation characteristic corresponds exactly with the RIAA curve. Below 800Hz it lies close to the new IEC curve (broken line). The old RIAA curve is shown dashed.

As explained in the article on the Twin-25, the tone controls have a constant turnover, variable slope characteristic, providing a subjectively smooth range of control for the user. Frequency response is flat when the potentiometers are electrically centered.

The associated amplifier involves a common emitter stage (Q4) and an emitter follower (Q5). A combination of emitter (or self) bias and collector biasing is specified for Q4, so that the DC operating point of its collector is very stable; it is set at half supply voltage.

The emitter follower imposes only minimal loading on Q4. Moreover, because of the 10uF "bootstrapping" capacitor from the emitter of Q5 to the junction of the 10k resistors, the effective collector load for Q4 is also very large, resulting in high gain.

The gain is proportional to the effective collector load and is limited only by the inherent output resistance of the transistor. The total available signal passes through Q5 and thence to the Balance Control network and to the power amplifier system. However, about one tenth of the signal at the emitter of Q5 is fed back to the tone control network.

(To be continued)

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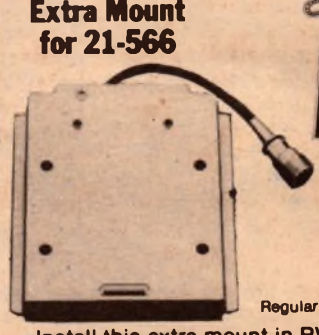

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Playmaster stereo Graphic Equaliser

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by LEO SIMPSON

Most readers would agree that while the average modern stereo amplifier or receiver appears to have a plethora of controls, most of these are relatively coarse and inflexible in operation. This applies particularly to the tone controls, which generally make a large adjustment to a major part of the audible spectrum.

While typical tone controls are adequate for making slight overall changes to the tonal values of a program, they are almost useless for correcting typical deficiencies of listening rooms and loudspeakers.

situation is a tribute to its outstanding ability to integrate!

With the advent of the graphic equaliser, the high fidelity enthusiast has a great opportunity to effect a positive improvement in his overall system. In fact, for the money spent, it is fair to say that a graphic equaliser, skillfully used, can provide a system benefit which far outweighs its modest cost. Note that proviso "skillfully used".

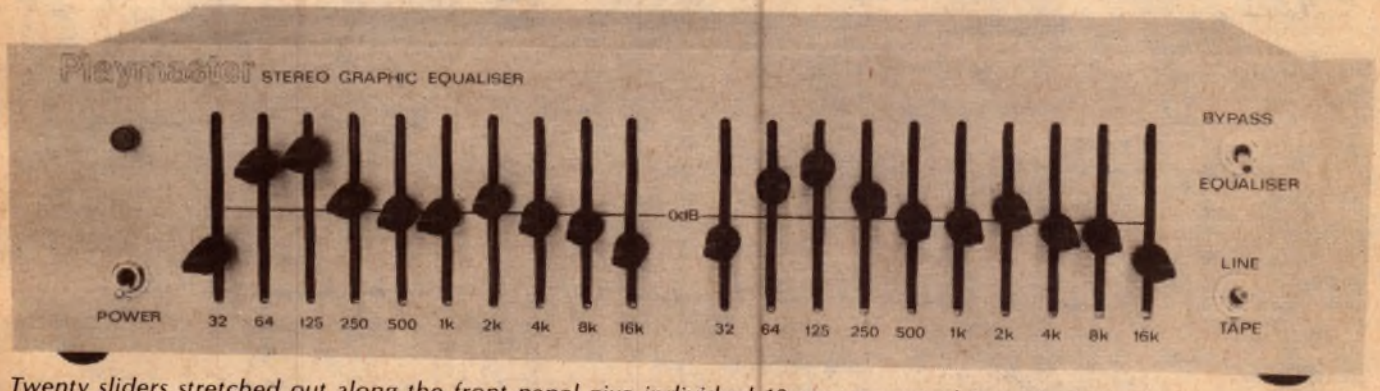
Since the frequency response of a typical loudspeaker has many deep troughs and high peaks, a graphic equaliser, by nature of its segmented

of the slider knob positions shows the approximate tonal correction provided by the equaliser.

Our Playmaster Equaliser, in common with the better examples of graphic equaliser, splits the audio spectrum into 10 octave bands, each centred on what have become the standard frequencies: 32Hz, 64, 125, 250, 500, 1k, 2k, 4k, 8k and 16kHz. Each band can be adjusted up or down in amplitude by approximately 13dB.

In all, there are 20 slider controls, 10 for each channel. This provides an enormous degree of flexibility in tonal control. Apart from providing a very useful tool in correcting room and loudspeaker deficiencies, a graphic equaliser is a boon to the keen tape recordist as it can provide a wealth of special effects. The Playmaster Equaliser is eminently suitable for either use.

When used for correcting room and loudspeaker deficiencies, the Playmaster Equaliser can be connected to a stereo amplifier or receiver in two



Twenty sliders stretched out along the front panel give individual 10-octave control in each channel.

In typical high fidelity systems, the loudspeakers and the listening room interact to produce a frequency response which is very rough and ragged. By comparison, a profile of the Andes would look like a series of gentle inclines! In fact it is a marvel that human ears can derive much pleasure from systems which are patently so non-linear. That the human ear does succeed in extracting pleasure in such a

response characteristics, is far more able to provide a suitable correction than the usual coarse bass and treble tone controls. The majority of graphic equalisers are also referred to as "octave equalisers". The two names are explanatory. Octave refers to the effective region of response adjustment provided by each control knob. Graphic refers to the pictorial effect of the slider control positions. The overall contour

ways. First, it can be interposed in the "Tape Monitor" loop provided on most amplifiers and receivers. The Playmaster Equaliser duplicates this loop facility, so that it can still be used in conjunction with tape decks or noise/ambience signal processors. Alternatively, where possible, the equaliser may be interposed between preamplifier and power amplifiers.

When used for enhancing tape

recordings, the Playmaster equaliser is connected in series with the recording input to the tape deck.

In any of the above cases, the Playmaster Equaliser will produce negligible degradation in signal quality in terms of signal to noise ratio, dynamic range or distortion performance. With a dynamic range of well over 100dB and harmonic distortion typically less than 0.05%, the Playmaster Equaliser will be compatible with almost any system.

There is a catch of course. This fine performance and value for money will initially be available only to those who can build the instrument themselves. However we have made this job as simple and as rewarding as it could possibly be. For a start, the front panel matches the fine finish obtained with the recent Playmaster amplifiers and AM/FM tuner (available from Dick Smith Electronics). This panel will be precision punched with a large die similar to that used for the AM/FM tuner panel. It enables the production of consistent high quality panels.

Black knobs for the sliders complement the champagne-finished panel and provide a high degree of control visibility.

The chassis and wrapover cover have the same overall dimensions as the Playmaster equipment mentioned above.

Inside, virtually all the wiring is taken care of by the easily assembled PC boards. There are three PC boards, one for the 20 slider pots, one for the power supply and one for the actual equaliser circuitry itself. These three boards are soldered together, to completely eliminate inter-board wiring.

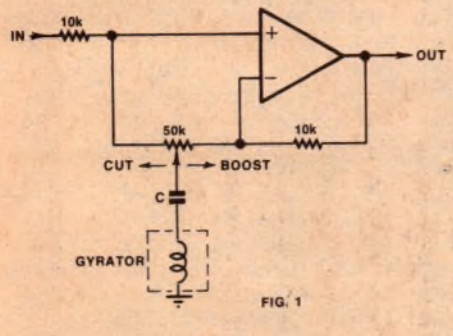


FIG. 1

The Equaliser has minimal power consumption. In fact, we used the smallest readily available transformer which was suitable. Combine the visual effect of the small transformer and the compact PCB assembly in the relatively large chassis and the Playmaster equaliser looks remarkably uncomplicated. And so it is.

The circuit is based on a simple principle which is illustrated by Fig 1. This shows an operational amplifier connected in the non-inverting mode, with negative feedback to the inverting input. The circuit is simplified in that it shows only one of the 10 slider controls and its associated circuitry.

Performance of prototype

FREQUENCY RESPONSE

Equaliser out	Flat
Equaliser in (all controls centred)	10Hz to 10kHz ± 0.25dB and —1dB at 20kHz

SIGNAL HANDLING

Gain	Unity
Maximum input and output voltage (with 10k load)	9 volts RMS
Boost and cut	±13dB

SEPARATION

	100Hz	1kHz	10kHz
with respect to 1V RMS and 4.7k across undriven input	-93dB	-74dB	-55dB

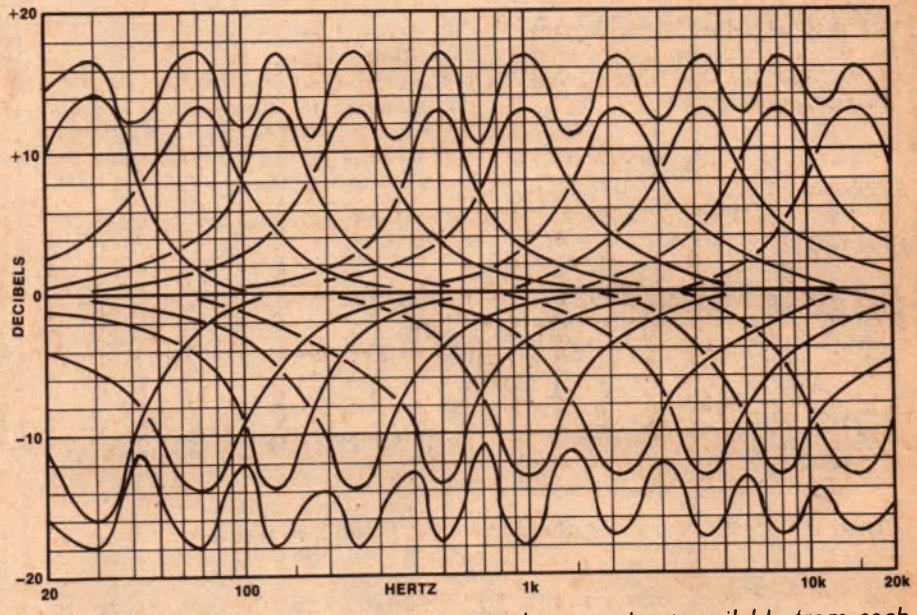
DISTORTION

	100Hz	1kHz	10kHz
with respect to 1V RMS	0.027%	0.03%	0.04%

SIGNAL-TO-NOISE RATIO

with respect to 1V RMS	94dB unweighted
with respect to 100mV	74dB unweighted

INPUT IMPEDANCE	100k
OUTPUT IMPEDANCE	1k



The overlapping curves show the maximum boost and cut available from each slider; the upper and low curves show the response "ripple" with all controls set at maximum or minimum.

The circuitry connected to each pot acts like a series tuned circuit, so that is how it is shown in Fig. 1. With the slider control centred, the op amp provides unity gain and the tuned LC circuit has negligible effect. When the slider pot is set to the boost end, the negative feedback signal tends to be shunted to ground by the tuned LC circuit which increases the gain at the resonant frequency. With the slider set to the cut end, the negative feedback is at maximum and the gain is at a minimum, at the resonant frequency. As might be

imagined, the multiple tuned LC networks tend to produce some interaction with each other, but this has been kept to a reasonable limit in our circuit.

First generation equalisers of a few years back did actually use inductors in this circuit configuration. These worked well, but the inductors are expensive and tedious to wind, and can be prone to hum induction. More modern designs use gyrators, as we have used.

As used here, the word "gyrator" refers to an op amp circuit which effectively transforms a capacitor into an inductor. This is illustrated in Fig. 2.

Consider an AC voltage source, Vi, connected to the op amp circuit of Fig. 2. This forces a current Ic through the capacitor, which develops a proportional voltage across R1. The voltage across R1 is reproduced at the output of the op amp. The voltage across R2 is equal to the difference between Vi and Vo and this causes current Io to flow through R2 and into the input voltage source!

An analysis of the phases of these currents and voltages will show that while Ic leads the voltage Vi, as would be expected for a capacitive circuit, the net input current, which is the vector sum of Ic and Io, actually lags the voltage Vi. So, in effect, capacitor C has been transformed into an inductor by

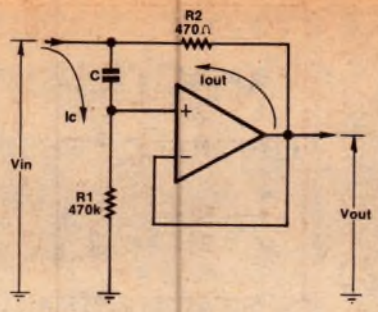


FIG. 2

the op amp. The inductance is given by the formula

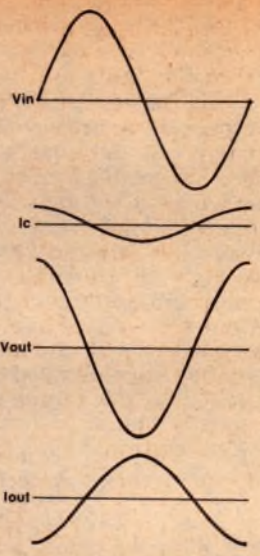
L = R1 x R2 x 3,

where C is in Farads, and R is in ohms and L is in Henries.

When you consider the fact that more than one op amp can be fitted into an integrated circuit package, the gyrator application can replace bulky inductors with very compact circuitry.

Now refer to the main circuit diagram.

We have used Fairchild uA4136 quad operational amplifier ICs. These op amps can be regarded as upgraded 741 op amps, with superior noise characteristics. This last factor is most important because it allows the Playmaster equaliser to be used in the Tape Monitor circuit of amplifiers where the signal level is nominally



about 100 to 200 millivolts or so.

IC1/3 functions as an input buffer stage while IC/1/4 performs the function described in Fig. 1. Six uA4136 quad op amps provide the entire active device complement for the complete equaliser.

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

$95

This includes sales tax.

Because the 4136 op amps have good supply ripple rejection, the power supply can be simple and inexpensive. Two half-wave rectifiers provide positive and negative supply rails, which are further filtered and decoupled via 47 ohm resistors and 100uF capacitors. Six 0.1uF capacitors on the main circuit board provide high frequency decoupling.

A light-emitting diode (LED) fed from the positive supply rail via a 1k resistor functions as the front panel pilot. The supply has fuse protection. Mains switch-off transients are suppressed by the .0047uF/250VAC capacitor across the transformer primary. The chassis is earthed via the mains, but does not connect to any part of the signal circuitry, to avoid earth loops.

Now to the construction. We have used slider pots imported by Dick Smith Electronics. Besides arranging for the supply of well finished front panels and chassis, as mentioned above, Dick Smith Electronics have also obtained a supply of matching black knobs, of suitable size and shape.

Construction is quite a straightforward process. Start with the slider pot board. This is drilled with suitably large holes to take the slider pot terminals. The PCB thus provides a firm

EQUALISER PARTS LIST

CHASSIS & HARDWARE

1 plated steel chassis, 370 x 80 x 245mm, with wrapover cover or timber sleeve
1 front panel
20 knobs to suit slider pots
3 miniature DPST switches
1 LED for pilot light
2 6-way RCA socket panels, Ralmar M421 or equivalent.
1 4-way insulated terminal block
6 25mm tapped nylon spacers (see text)
1 grommet
1 cord clamp
1 solder lug
1 .0047uF/250VAC capacitor
4 rubber feet
1 3-pin mains plug and three-core mains cord
1 transformer, Ferguson 2851, A&R 6474, DSE 2851 or similar with 12.6VAC centre-tapped secondary
Plus: screws, nuts, washers, shielded cable, hook-up wire, shrink tubing, tinner copper wire.

SLIDER PCB

1 PCB, 296 x 73mm, 79eq2a.
20 slider pots to suit, 50k linear taper.

MAIN PCB

1 PCB, 296 x 70mm, 79eq2b
6 uA4136 quad op amps
6 pc pins

CAPACITORS
(10% tolerance)
Tantalum: 2 x 10uF, 2 x 2.2uF 4 x 1uF
Metallised polyester (greencap): 2 x 0.47uF, 2 x 0.27, 8 x 0.1, 2 x .068, 2 x .056, 2 x .033, 2 x .027, 4 x .015, 2 x .0082, 2 x .0068, 4 x .0039, 2 x .0033, 2 x .0018.
Polystyrene: 2 x 820pF, 2 x 470pF, 2 x 220pF, 2 x 150pF, 2 x 120pF.

RESISTORS
(¼W, 5% tolerance)
2 x 1M, 20 x 470k, 4 x 100k, 4 x 10k, 2 x 1k, 20 x 470 ohms, 4 x 330 ohms.

POWER SUPPLY PCB

1 PCB, 78 x 70mm, 79eq2c
2 fuse clips, Swann FC1 (part no 1397-01-18)
1 250 milliamp 3AG fuse
2 1N4001 silicon diodes
2 1000uF/25VW electrolytic capacitors
2 100uF/16VW electrolytic capacitors
Resistors (¼W): 1 x 1k, 2 x 47 ohms.
4 pc pins.
NOTE: Capacitors and resistors with higher ratings may be used, if physically compatible. Other substitutions are not recommended.

mounting and precise location. Mount each slider pot flush against the PCB, bend the terminals over to hold it and solder. To enable flush mounting of each pot it will be necessary to bend over the vestigal lug associated with the wiper terminals (the inner pair).

With the slider pot PCB completed, put it away where it will be safe from being dropped on the floor or otherwise seriously stressed — it is a fragile assembly at this stage. The power supply and main PCBs are equally straightforward and require little comment regarding their assembly.

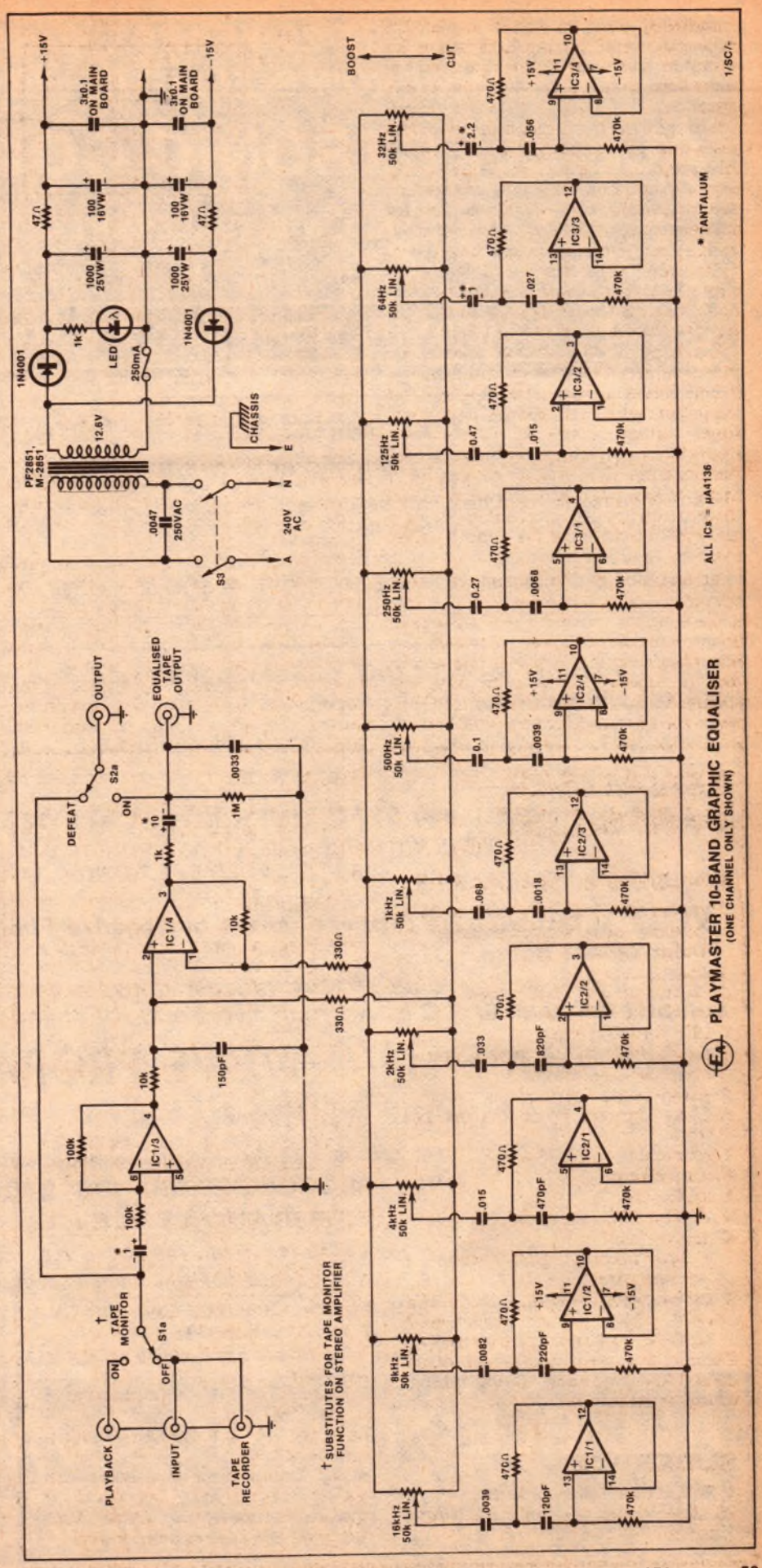
Use PC pins for the input and output connections. Those with square shanks are the most suitable.

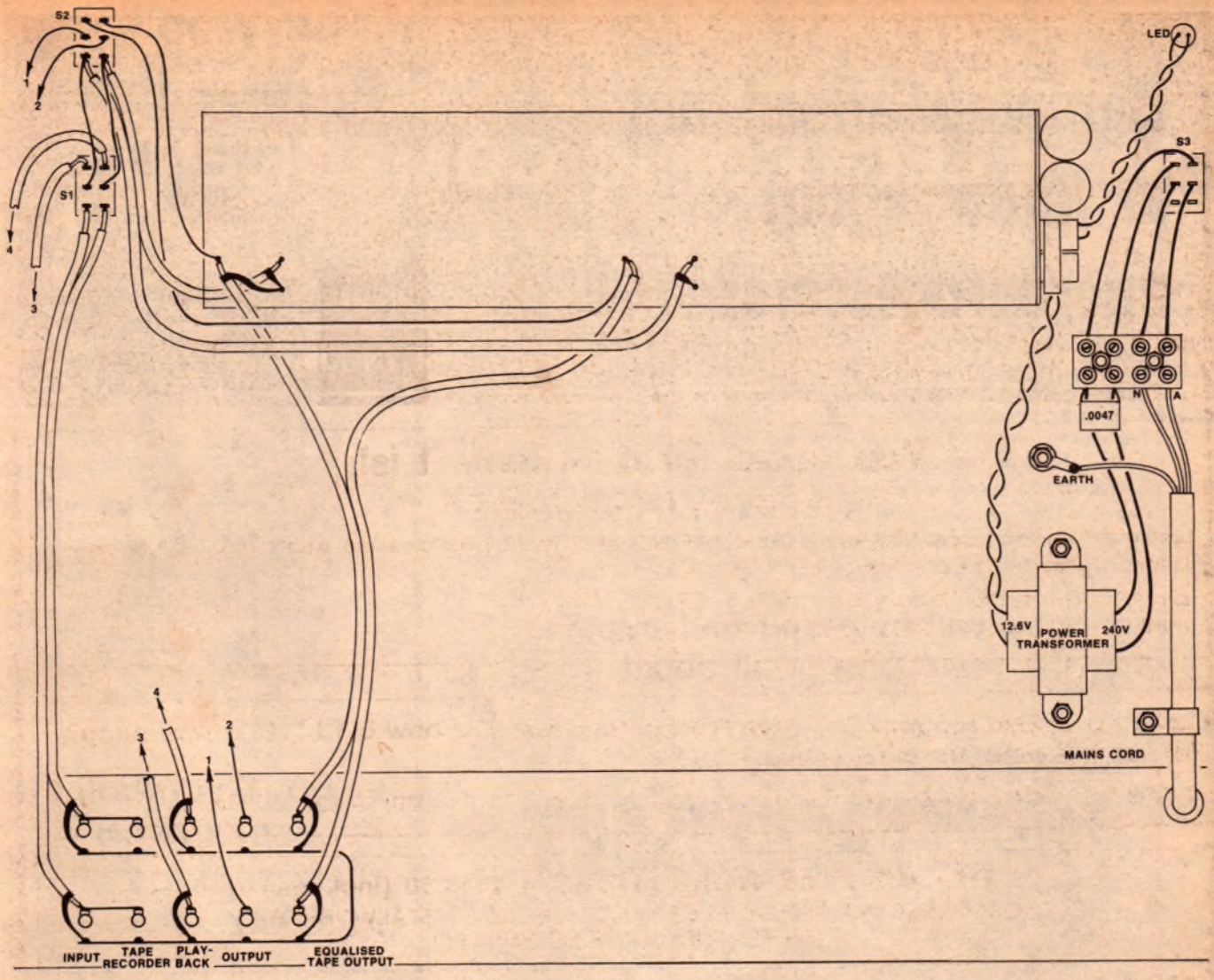
With all PC boards completely assembled, soldered and inspected for soldering defects, they are ready to be soldered together. The slider pot PCB should be firmly supported on a small carton, vyce or other mount so that its copper side is horizontal. Now sit the main PCB on the slider pot PCB so that it is perpendicular and its front edge lines up with the index marks on the slider pot PCB pattern. With both boards held in this position, use a soldering iron and solder to "tack" the boards together at several places along their length. This will hold them temporarily while each of the respective pads is soldered together. With the task complete, solder the power supply PCB to the end of the PCB assembly. The three output pads on the supply PCB contact the corresponding three pads on the main board to complete the supply connection.

The complete PCB assembly is supported from the front panel of the chassis via six insulating spacers which are 20mm long. Since we could not obtain spacers of this length we purchased six tapped nylon spacers 25mm long and cut them to the desired length of 20mm. Fix the spacers to the PCB assembly first and then mount the complete assembly in the chassis using countersunk screws.

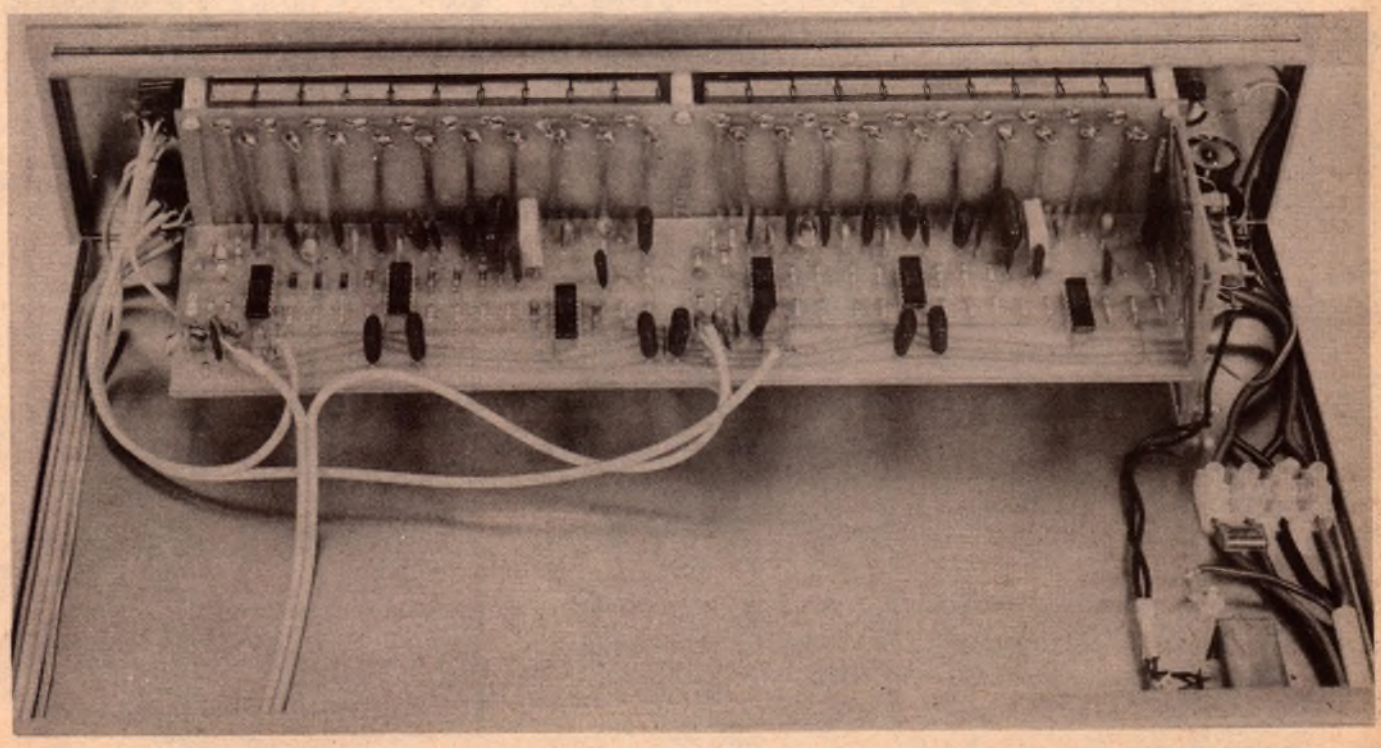
Do not fit the front panel at this stage. Instead, temporarily mount the toggle switches and complete the wiring inside the chassis. These details are shown in the chassis wiring diagram. Note that the mains and power supply wiring is kept as far as possible from the signal circuitry. Dress the mains leads to the on-off switch away from the power supply electros and sheath the switch with a piece of shrinkable plastic tubing for safety.

Similarly, sheath the mains connections to the power transformer and make sure that all other mains wiring and connections are safe. Do not fit the LED pilot at this stage. If you desire, it can be temporarily wired across the appropriate pins on the power supply. Now you are ready to switch on. Having checked all connections, apply power and check voltages. Make sure that approximately plus and minus 15 volts is





There is relatively little wiring within the chassis as this diagram and accompanying photograph show.



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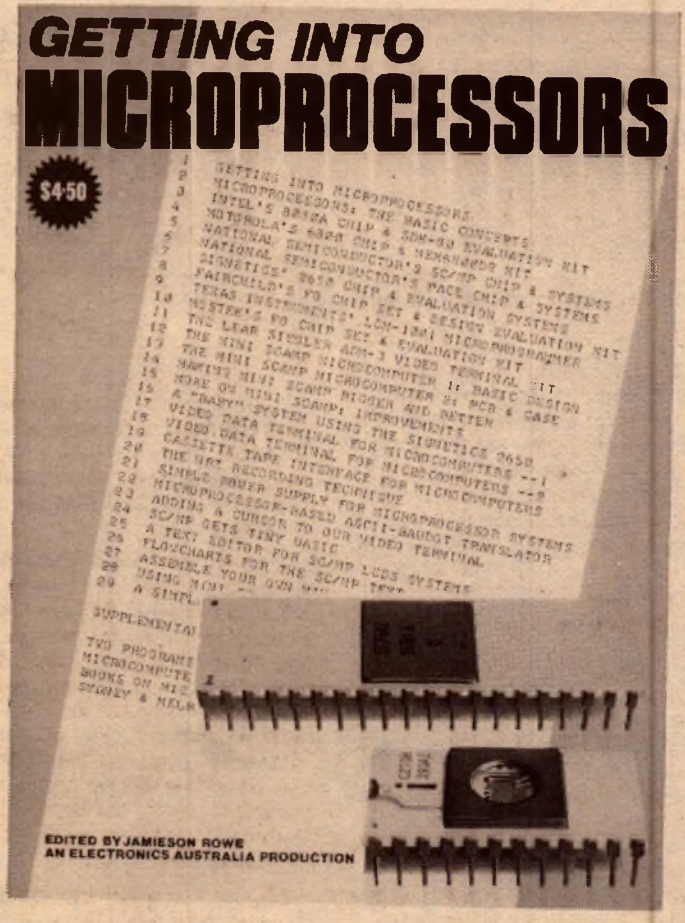

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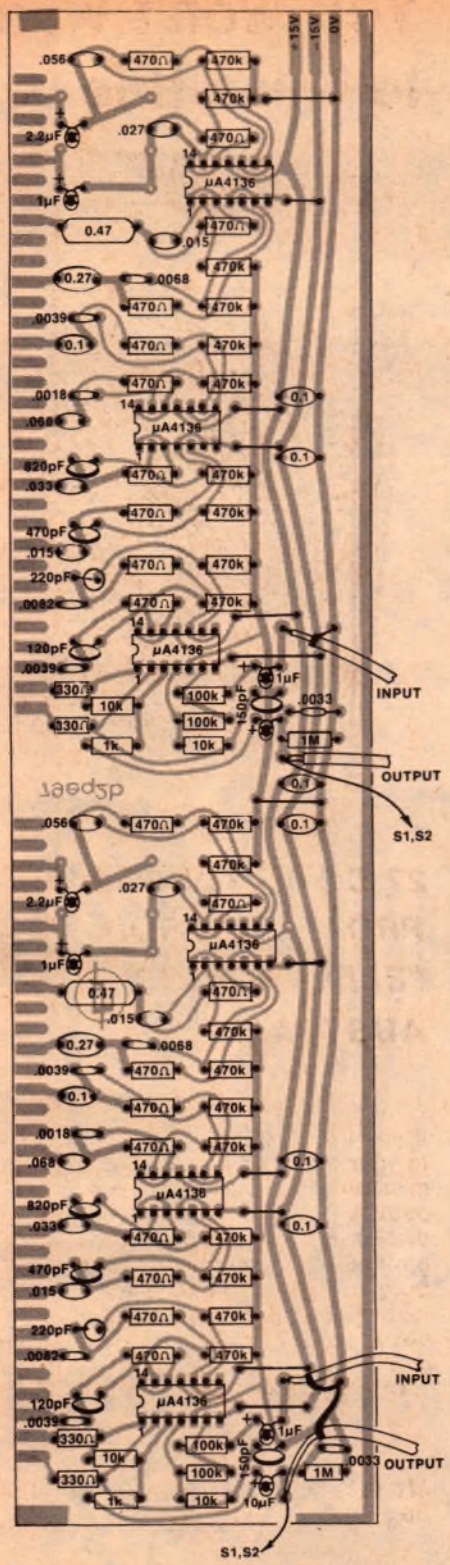
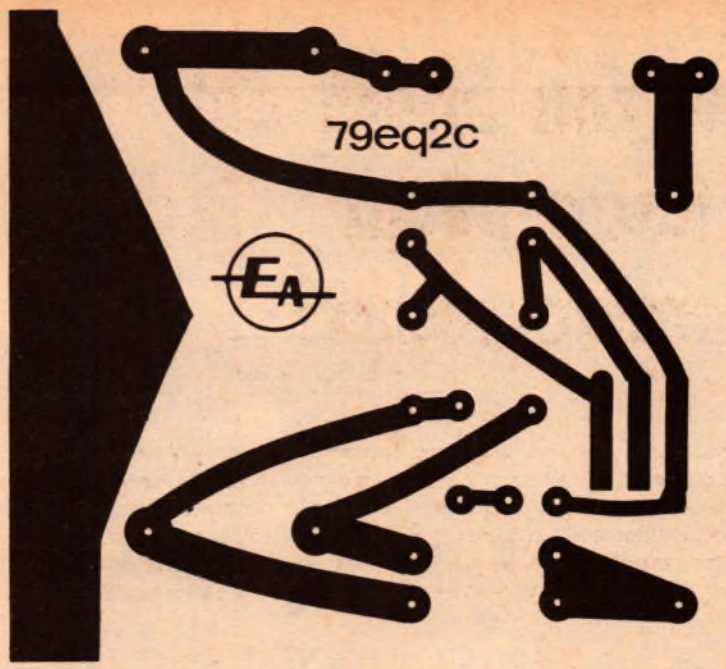




present at pins 11 and 7, respectively, of each 4136 IC.

Then check that each op amp output is close to zero volts. From the circuit, these are pins 3, 4, 10 and 12 and they should be within ±100mV of OV. If a particular op amp output is not within that narrow range, check that its inputs are at OV. Unless there is a PCB fault, this should be case anyway since all the inverting inputs are tied to the outputs and all non-inverting inputs (with the exception of IC1/4 in each channel, which is biased from IC1/3) are tied to and biased from OV.

If the voltage checks are okay, the time is ripe for a listening session. Connect the Equaliser to the Tape Monitor terminals of your amplifier and turn on. The volume control should be turned well down to start with. Feed a music signal in and check that each slider has an appropriate boost and cut effect.

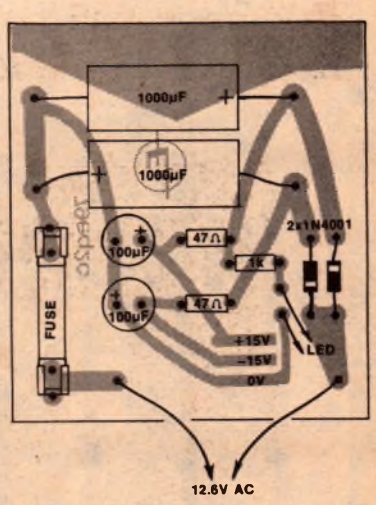
If a particular slider has no boost or cut, check that the wiper is not open circuit, or shorted to one terminal of the pot.

With all the sliders accurately centred, there should be negligible difference in sound quality whether the Equaliser is switched in or out of circuit. A slight difference in apparent sound quality is possible though, because the Equaliser will not have exactly unity gain, due to component tolerances. With all the sliders centred, the frequency response of the Equaliser is very flat except for a slight roll-off at the high frequency end — which amounts to 1dB at 20kHz.

With the volume control well advanced and no signal applied to the amplifier, listen to the residual noise of the amplifier. With most good amplifiers the residual noise of the Equaliser will be comparable with that of the amplifier. This can be confirmed by switching the Equaliser in or output of circuit. When each slider is set for boost or cut, there will be an increase in noise and it will take on a "formant" quality which is to be expected as the overall frequency response changes.

(The word "formant" is usually applied to the shaping filters used in electronic organs and synthesizers.)

Avoid switching the Equaliser on or off while the amplifier volume control is set at a high level, otherwise there

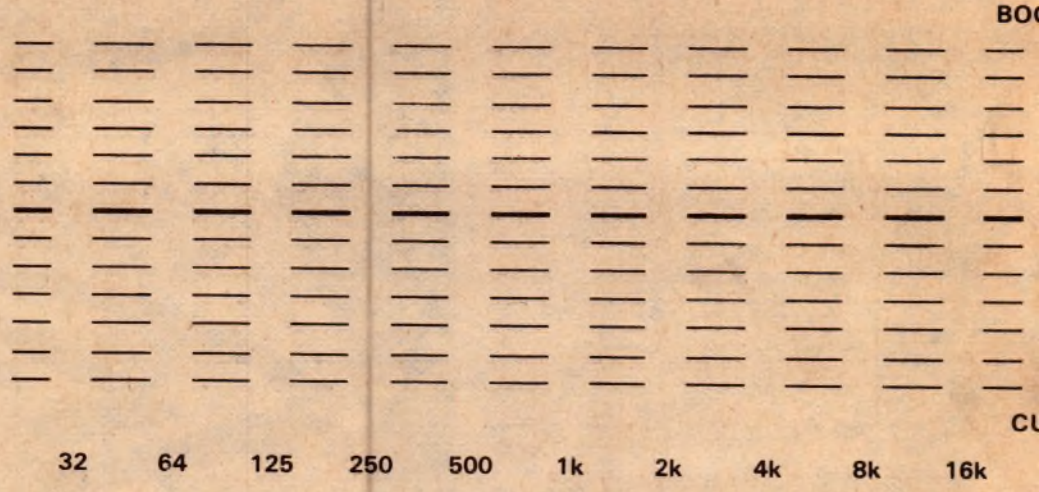


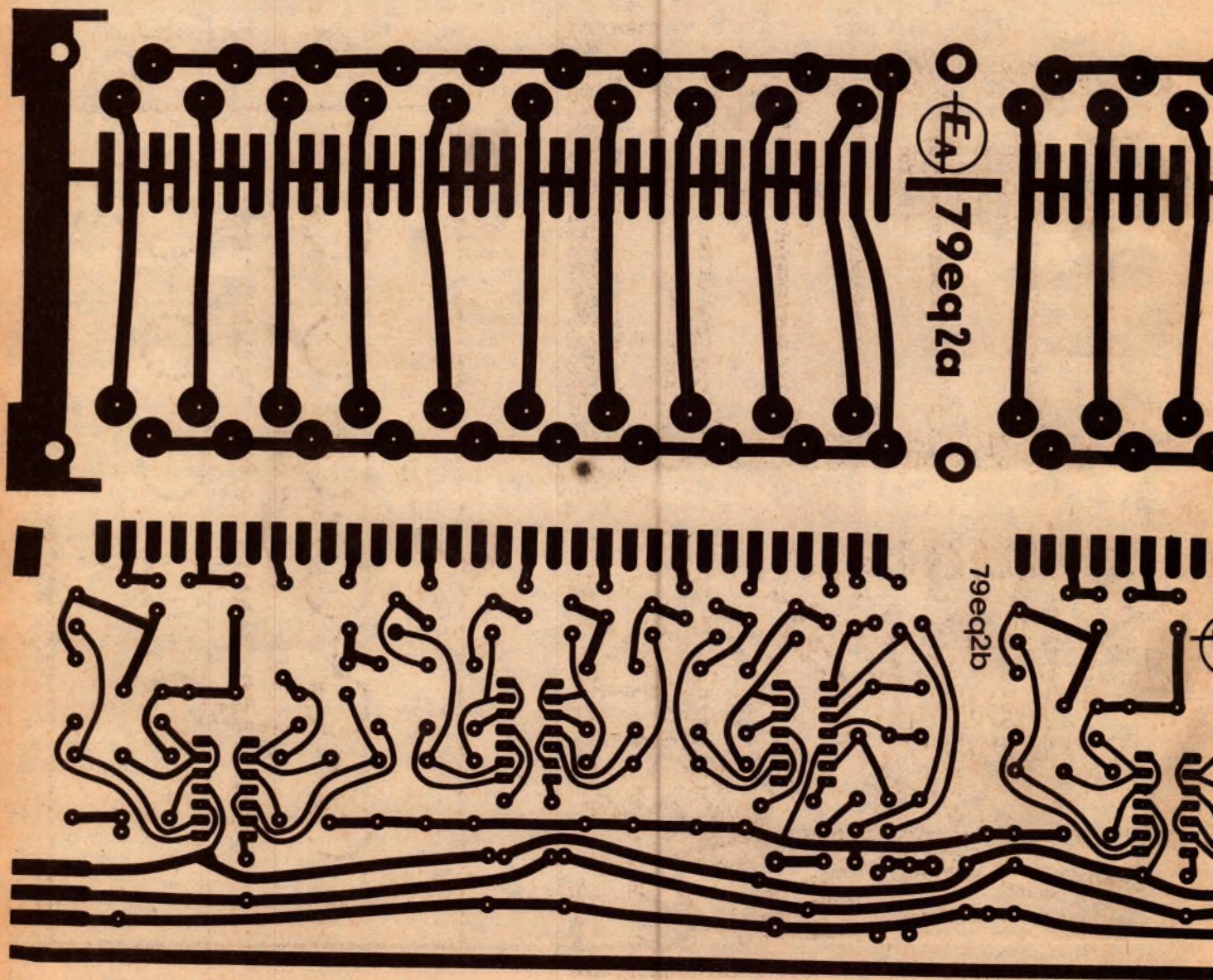
will be quite a loud turn-on thump from the loudspeakers and not as loud but more disconcerting, a "chirp" from the loudspeakers about two seconds after turn-off. (This is quite normal, by the way.)

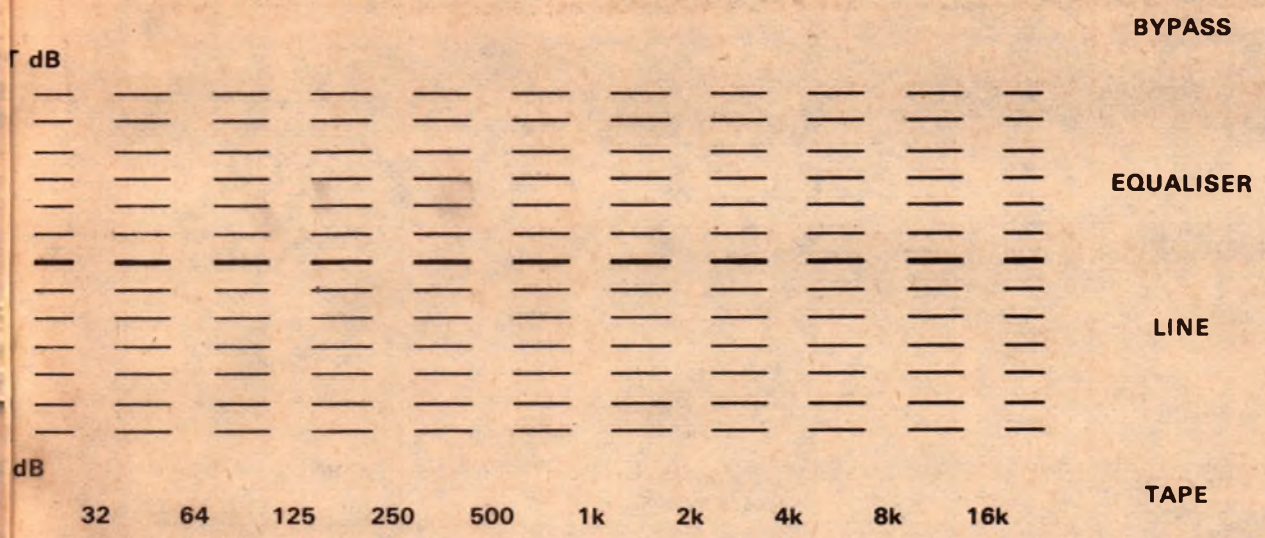
One other effect may be noticed when the amplifier volume control is fully advanced. There may be a noticeable hum difference when the Equaliser is switched into circuit. Note that this should not be noticeable at normal listening levels. This is actually a fault or characteristic of the amplifier concerned, and is due to the input of the amplifier being connected to its common earth point via a low impedance (eg, the source impedance of the Equaliser).

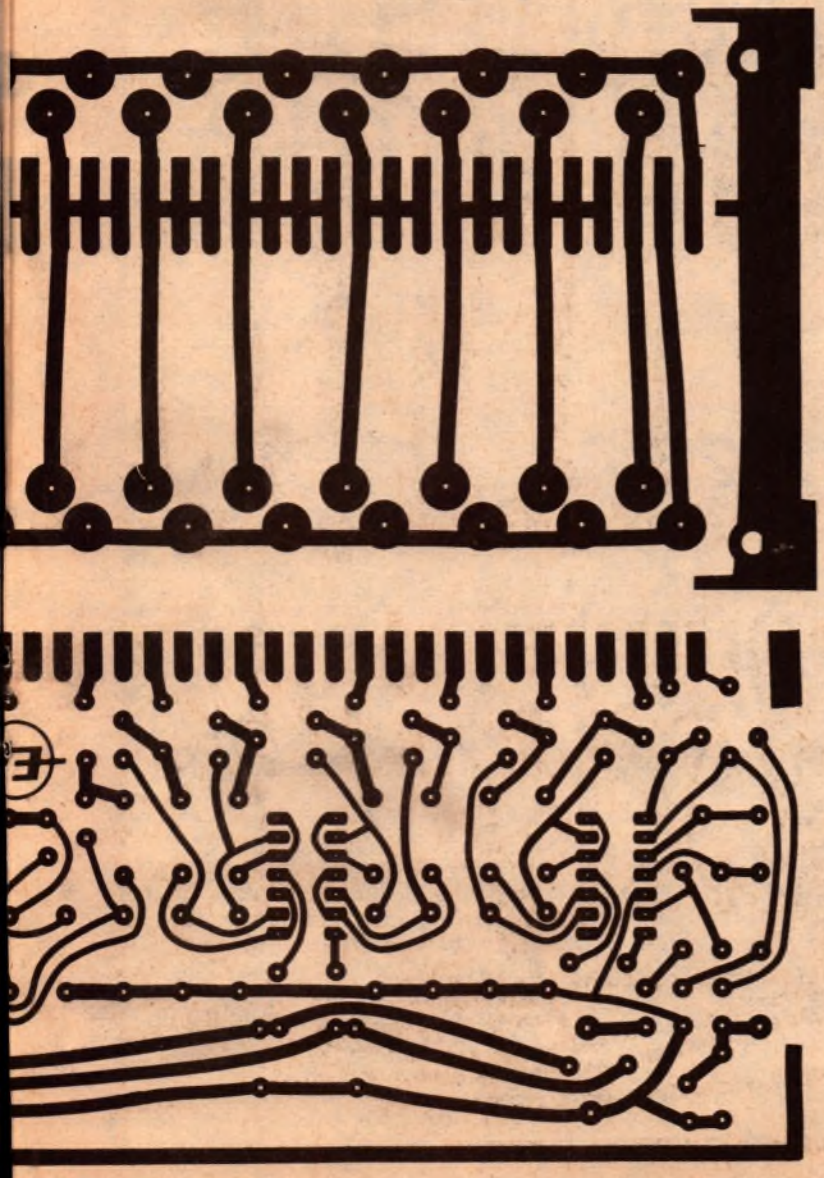
The effect may be duplicated by shorting the high level inputs of the amplifier. The effect can be mitigated by connecting a 10k resistor in series with the inputs of the amplifier or more conveniently, in series with the output of the Equaliser. Most people will find this modification unnecessary. We

Playmaster STEREO GRAPHIC EQUALISER

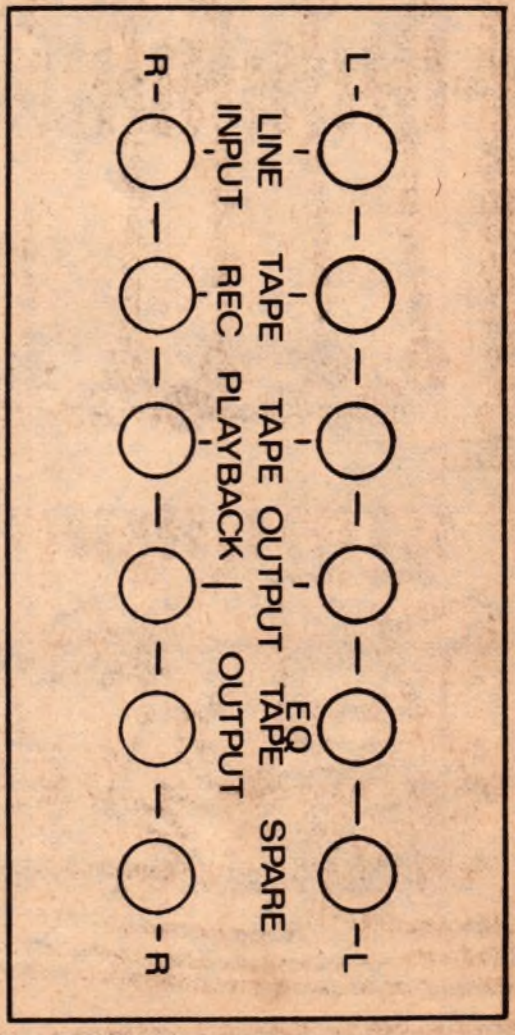


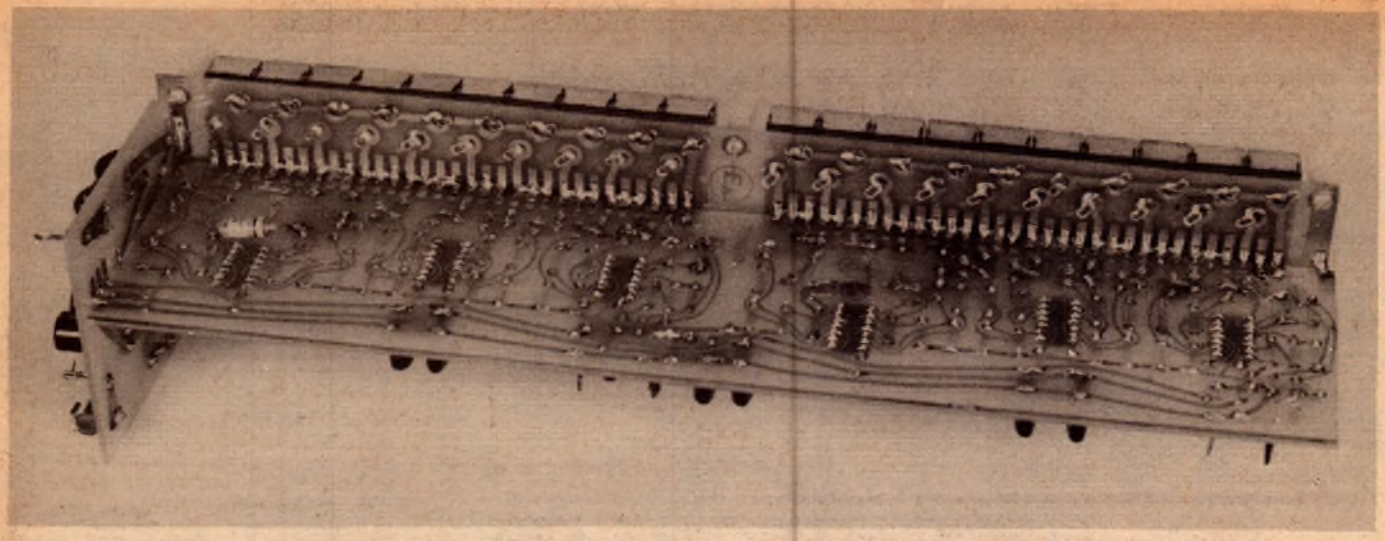




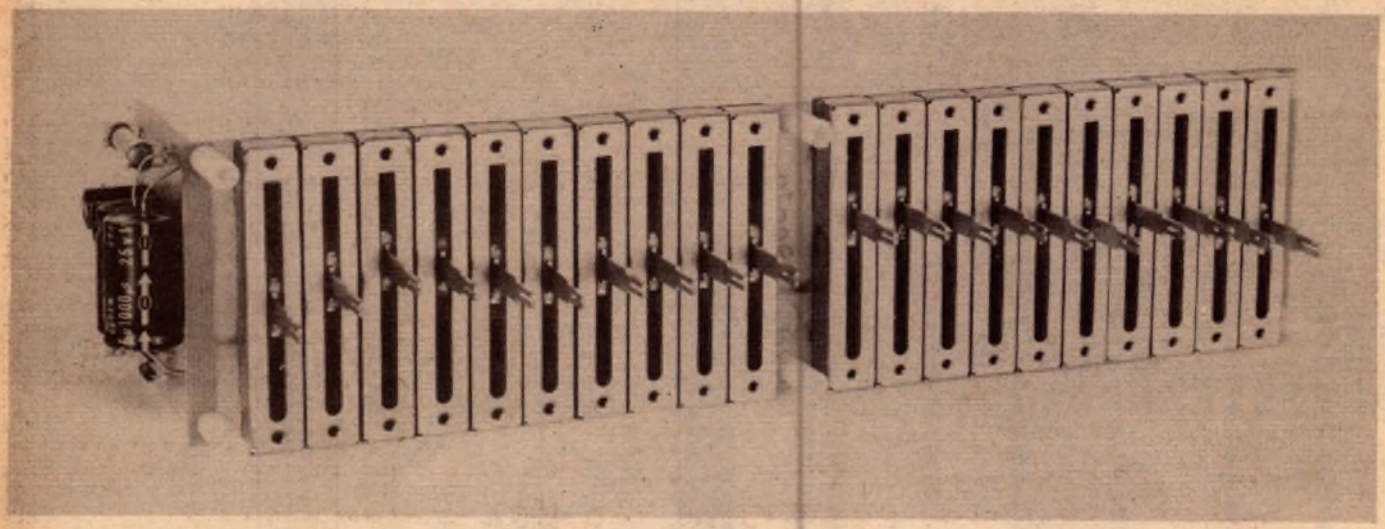


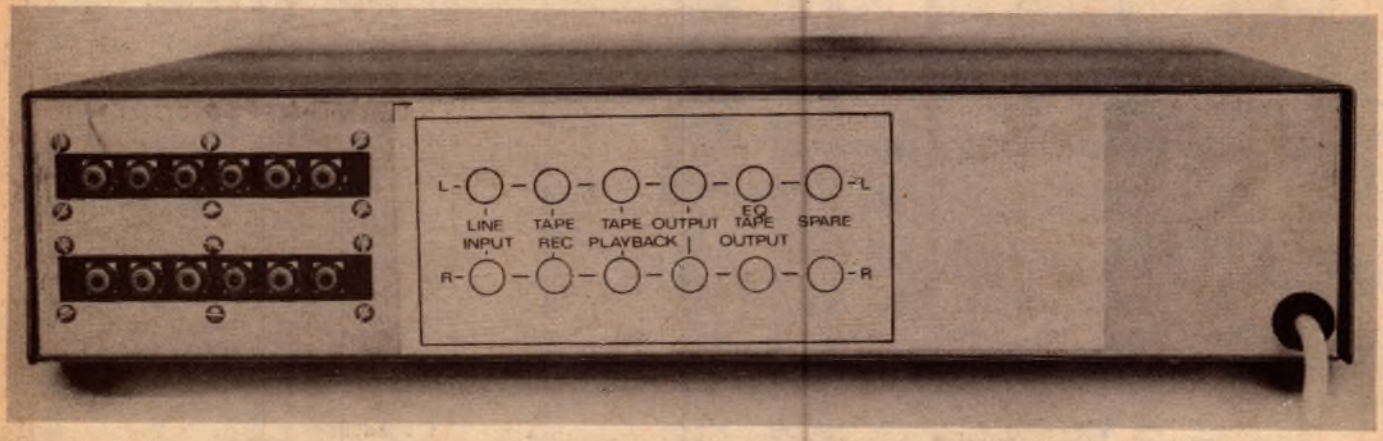
Displayed on these two pages is the full size artwork for the front panel, stick-on rear label and the two large PC boards.





These two photos show the PCB assembly before installation in the chassis. Note that the six standoff spacers are fitted.





A stick-on label is affixed to the rear panel to identify the input and output sockets.

mention it to avoid having constructors concluding that their Equaliser has a fault!

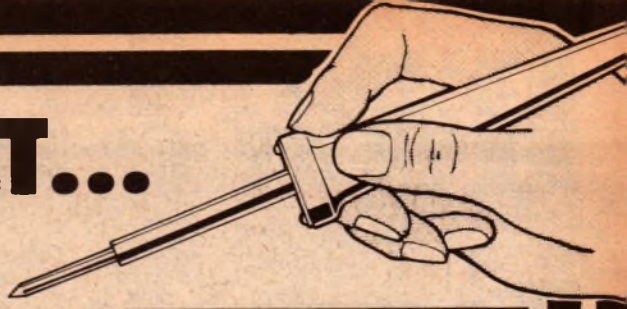
With the foregoing checks complete, the Equaliser front panel may be fitted and the rear panel label stuck on.

The front panel is secured to the chassis via the nuts of the three toggle switches. Make sure that the sliders mate well with the front panel before finally securing it. The LED pilot light (as supplied by Dick Smith Electronics) is a push-fit in the front panel. Our prototype actually used a Cliplite LED bezel which snaps into a ¼-inch hole. It is supplied by C&K Electronics (Aust) Pty Ltd.

Do not fit the knobs to the sliders until you are quite sure that the Equaliser is complete and operating properly. The knobs are quite easy to push on to the sliders, but are very difficult to remove and there is a risk of marking that expensive panel.

We think that most people will agree that the Playmaster Equaliser with a cost of less than $100 is a real bargain. Add that to the fact that we plan to produce a matching Octave Analyser to enable users to get the best out of their systems, and you have an attractive and interesting path to improved sound quality.

BUILD A PROJECT...
from a Dick Smith kit



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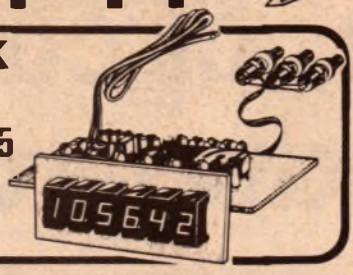
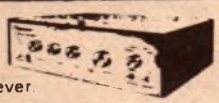


AUDIO AND AMPLIFIERS



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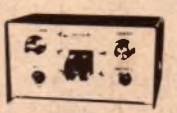

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DICK SMITH ELECTRONICS

PRACTICAL ELECTRONICS

Tagstrips, circuit boards and breadboards

Printed circuit boards are great, particularly where a circuit must be built up in large numbers. But if you're building up a circuit and a PC board isn't available, you don't necessarily have to design and produce one yourself. There are quite a few alternative approaches, which can be faster and easier.

by GREG SWAIN

The popular method for building electronic projects is to mount the components on a printed circuit board (PCB). So before discussing some alternative building aids, let's first take a refresher course on PCBs.

A printed circuit board is a thin sheet of insulating material which carries a pattern of bonded copper tracks. The copper tracks are usually on one side of the board only, and act as "electrical wiring" between the components to connect them according to the circuit diagram.

Two main types of insulating material are used for PCBs:

1) Epoxy bonded fibreglass — often called epoxy or glass for short; and
2) Synthetic resin bonded paper (SRBP).

Holes drilled through the PCB allow the electronic components to be mounted. As a rule, the component leads are pushed through from the non-copper side of the board, and their leads soldered where they pass through the copper on the other side. Excess lead lengths are then snipped off using a pair of sidecutters.

When mounting components such as resistors, capacitors, diodes and wire links, the leads generally have to be bent at right angles to the axis of the components body. The leads must be bent at the correct points, so that the component will span the space between the allotted holes.

When should you use a PCB? In short, whenever one is available for the project you wish to build, or when the circuit is to be built in such numbers that the effort to create a new PCB is justified. It will not only make the job easier, but will also give the finished article a professional appearance.

And because the wiring connections are automatically taken care of by the copper tracks, you'll be far less likely to make mistakes!

What if a PCB isn't available?

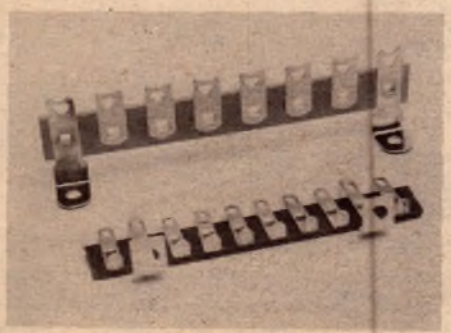
One way around the problem of not being able to get a PCB is to design your own. However, where only one or two units are to be made, the effort may not be worthwhile. What's more, you may be in a hurry to get the circuit built, or you might not feel too confident about designing a board of your own.

Don't think that you've come to a dead end in these circumstances. There are many alternatives to the PCB that will allow you to get on with the job.

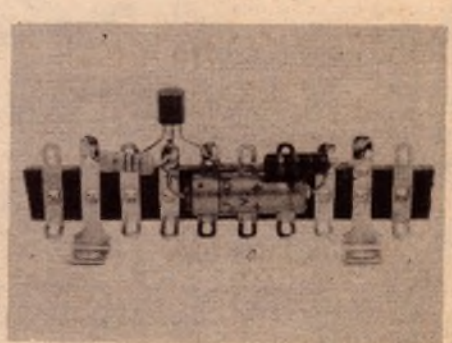
These alternatives may be thought of as general purpose wiring aids. As with the PCB, they serve to hold and support the various components. But unlike the PCB, the builder must work out component placement and wiring details for himself.

Let's take a closer look at some of the more common general purpose

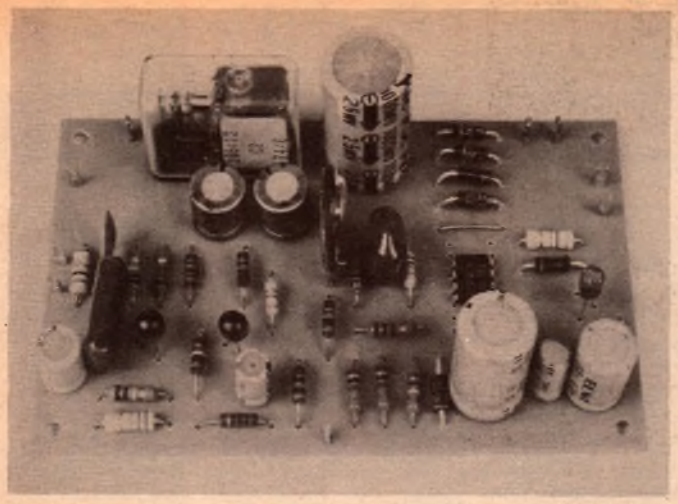
A printed circuit board. The copper tracks form the wiring connections.



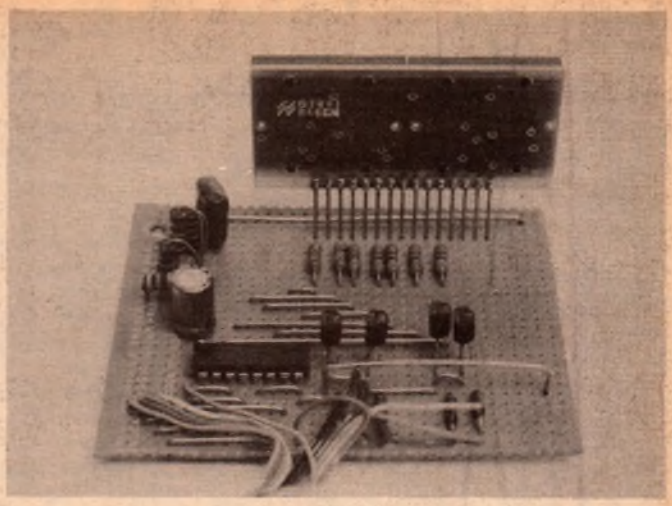
Two versions of tagstrip. The feet allow screw fixing to a chassis or case.



View showing how electronic components are wired to tagstrip.



An assembled PC board. Component leads are pushed through holes and soldered to the copper tracks on the reverse side.



A circuit assembled on Veroboard. Note use of wire links to make wiring connections across the board.

wiring aids. These are:

- Tagstrip and tagboard
- Perforated board
- Laminated stripboard
- Breadboards & IC boards
- Prototyping aids

Tagstrip & tagboard

One of the oldest (and most popular) wiring aids is tagstrip. This is still found in many old radio and TV sets, particularly those employing valves.

Physically, it consists of a strip of SRBP fitted at regular intervals with metal tags. Component leads and interconnection wires are soldered directly to the metal tags, which serve as multiple connecting points. Some of the tags are extended with feet to allow screw fixing to a chassis or case, and these provide convenient earthing points.

Various versions of tagstrip exist, and long strips can be cut to size with a small hacksaw. Advantages of tagstrip include low cost, ease of component placement, and the accessibility of the connection points.

A variation of tagstrip is tagboard. This may be thought of as a double row of tagstrips on a single piece of SRBP. Components are usually mounted across the board and connections between components made by wiring between the tags.

Another variation is printed mounted strip. This is like tagboard except that it uses copper pads in place of the metal tags.

Perforated board

Perforated board, often called matrix board, is a thin sheet of fibreglass or SRBP with a regular pattern of holes. It is available with the holes on either 2.54mm or 3.8mm centres, and in a range of standard sizes. Non-standard sizes can be obtained easily by cutting with a hacksaw.

Components can be mounted on either or both sides of the board, and connections between the components made by means of the component leads and other wiring. Plastic sleeving can be used to insulate the component leads to stop them from touching each other.

The main advantage of perforated board is that it is re-usable.

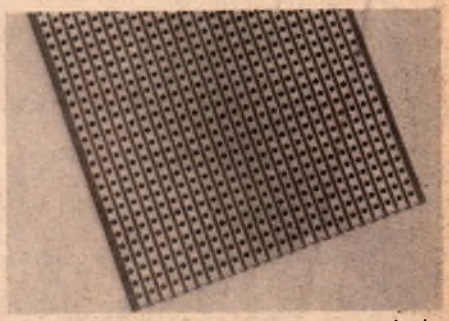
Laminated stripboard

Stripboard is similar to perforated board, but with parallel strips of copper bonded to one side of the board. The holes are drilled along the copper strips, and are on either 2.54mm or 3.8mm centres. The 2.54mm pattern will directly accept integrated circuits.

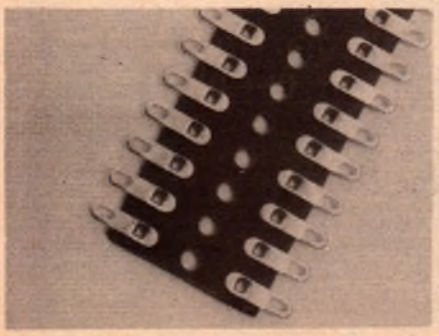
As with a PCB, the components are mounted on the non-copper side of the board. The component leads are passed through the holes and soldered to the copper strips. The strips can be joined with wire links and/or cut to suit the required circuit configuration.

Cuts along the copper strips can be made with a drill bit. The drill bit is placed in the hole closest to the required break point and twisted so as to cut away the copper.

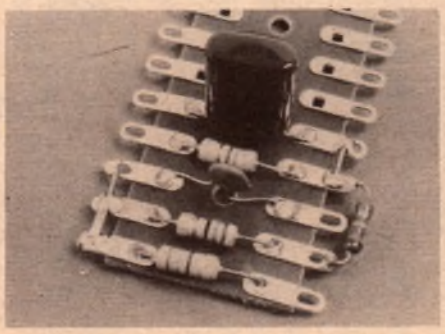
The best known version of stripboard is called Veroboard. Another version is called Verostrip, which has the copper tracks divided along the middle. Verostrip is especially useful when working with integrated circuits, as they can be directly mounted on the board without the need to cut tracks.



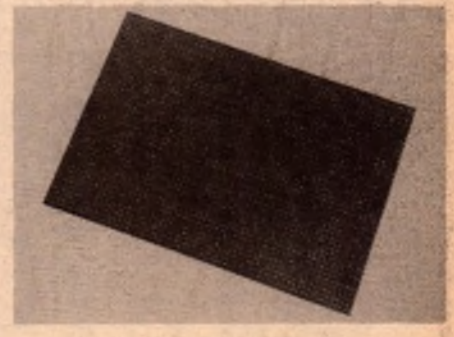
Laminated stripboard with 2.54mm hole spacing.



Tagboard has two rows of tags mounted on a single piece of SRBP.



Components on tagboard are usually wired across the board.



A sheet of perforated board. Note regular pattern of holes.

Tagstrips, circuit boards and breadboards etc . . .

If the required size for a particular project is non-standard (as is likely), the required piece may be cut from a larger sheet. Once again, this is best carried out with a small hacksaw, and the edges then filed smooth.

Breadboards & IC boards

Included under this heading are quite a number of general purpose PCBs, designed especially for integrated circuits. They are sold under such trade names as Multi-Dip Board, DIP Board, Blob Board, DIL Board, and Dick Smith Design Beadboard.

Multi-Dip Board was designed by "Electronics Australia", and has positions for eight integrated circuits. Two of these positions can hold 24-pin devices with the wide 15.24mm pin spacing, as well as standard size ICs. The other six positions are for devices with 16 pins (or less), and using the standard 7.62mm pin spacing only.

Other components are added by soldering their leads to the copper pattern. Copper strips running the full length of the board provide convenient power supply rails. The components may be mounted on either side of the board. As sold board is not drilled.

Blob Board, DIL Board and Dick Smith Design Breadboard are used in much the same way as Multi-Dip Board. The DIL Board can hold up to five 8-pin integrated circuits, while the Dick Smith Design Breadboard is especially useful for mounting transistors. The latter two boards come pre-drilled, and components are mounted on the non-copper side of the board.

DIP board is designed to hold a large number of ICs — up to 20 14-pin DIL (dual-in-line) devices in fact. The board has a pattern of shaped copper pads and is perforated with holes on 2.54mm centres. Two power supply rails run between the copper pad format for easy link up to the ICs.

Each of the copper pads covers three holes, allowing other components and lengths of hook-up wire to be added as required. The board is available in a number of basically similar versions, one version being equipped with gold-plated edge pads so that it may be plugged into an edge connector socket.

Prototyping aids

Prototyping aids are used mainly for building and checking a circuit before it is built in more permanent form. They can generally be used with all types of components, including integrated circuits, and consist of a plastic base containing rows of spring contacts.

The most popular prototyping aids have the contacts divided into two lots of five rows. The five contacts within each vertical column are electrically connected together. Integrated circuits may be plugged directly into the contacts, giving four free contacts per IC pin (assuming standard size ICs).

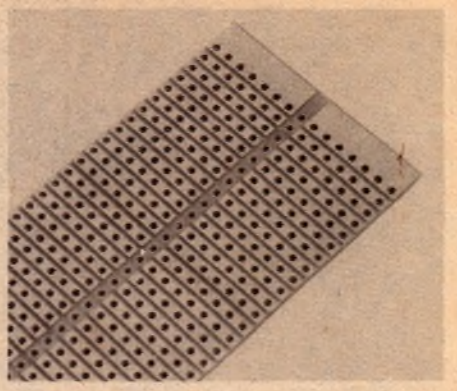
The component leads are simply pushed into the contacts to make the connections. There is no need to solder, and components can be quickly added and removed, as required. Wiring connections are made with single strand wire, preferably insulated.

Three popular prototyping aids are CSC "Experimentor", CSC "Proto Board 6", and "Bimboard". The CSC Experimentor is the cheapest. It comes in several sizes, has a plastic base, and is fitted with tabs to allow individual units to be locked together.

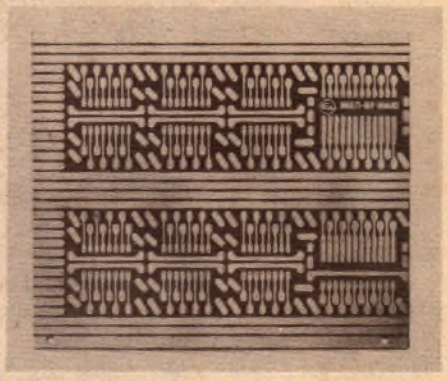
Proto Board 6 and Bimboard have some extra features. Proto Board has a metal baseplate fitted with four terminals, while Bimboard has a clip-on plastic backplate which can be used for mounting switches, controls and terminals.

The building aids featured in this article by no means form a complete list. Many other products are available. What it means is that whatever your project, you should have little trouble finding a circuit board to build it on.

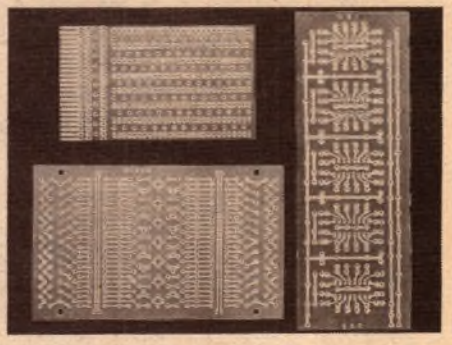
FOOTNOTE: The circuit building aids featured in this article were supplied by Radio Despatch Service, 869 George St, Sydney 2000; and by Dick Smith Electronics Pty Ltd, PO Box 747, Crows Nest 2065.



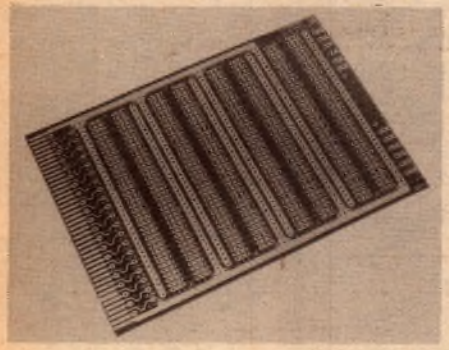
A section of Verostrip. It is useful when working with integrated circuits.



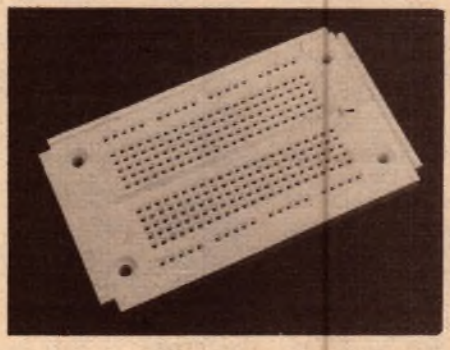
Multi-Dip Board can accept up to eight integrated circuits.



DIL Board (left), Dick Smith Design Broadboard (top right) and Plug-in IC Board.



DIP Board is especially useful when working with large numbers of ICs.



CSC "Experimentor" allows circuit prototyping without soldering.

A prototype electronic circuit made up on Proto Board 6.

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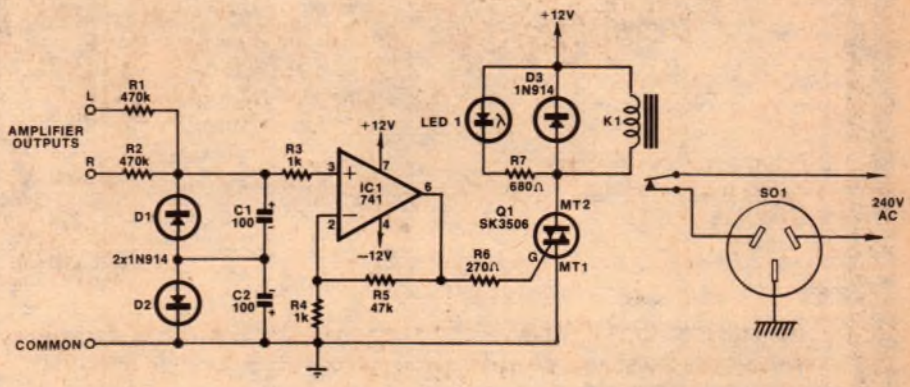
Circuit & Design Ideas

Conducted by Ian Pogson

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

Protection for DC coupled speakers

There are advantages associated with DC coupling, but there is also a danger. In the event of a collector-to-emitter short in an output transistor, the speaker voice coil will quickly burn out. This circuit can save your speakers by removing the AC supply from the amplifier if a DC level appears across the speaker outputs.



Signals from the amplifier are coupled to the protector by R1 and R2. AC signals will not cause any charge on C1 or C2, but a positive DC level will cause C1 to charge. A negative CDC level will alternatively cause C2 to charge. Diodes D1 and D2 protect the electrolytic capacitors.

An unbalanced charge results in a positive or negative voltage across the series connection of C1 and C2. This voltage is applied to IC1 via R3. The output voltage of IC1 triggers Q1, which conducts and energises K1. The relay then interrupts the AC power source to the amplifier. A LED indicates that the circuit has been activated.

A Triac was selected because the latching characteristic of the thyristor keeps the relay energised even after power has been removed from the amplifier. Also, although the device need only conduct in one direction (implying the suitability of an SCR), it must be able to latch on when triggered by either a positive or negative pulse of gate current.

The unit and a suitable power supply should be mounted in a suitable enclosure, taking care to avoid shock hazards. C1 and C2 are specified as tantalum types. This was done to avoid the wide tolerances of ordinary electroytic components which would disturb the symmetry of the input circuit. It may be difficult to find 100uF tantalum capacitors but this can be overcome by paralleling smaller values, say, two 47uF capacitors. It is not critical to have 100uF; smaller values will work well but will reduce the time constant of the RC input network.

Connect an incandescent lamp across the active and neutral of socket SO1 and apply power to the circuit. The lamp will glow. Using two flashlight batteries in series, apply 3V DC across either the left or right channel protector input. After three to five seconds,the relay will be energised, a click will be heard and the lamp will darken. The glowing LED will also indicate that the Triac has been triggered. Do not test the circuit while the speakers are connected because flashlight batteries do not like the low resistance.

Next, disconnect the speaker protector from its power supply, remove the batteries from the input and discharge C1 and C2. Reverse the polarity of the batteries and connect them to the same input as before and apply power to the protector circuit. After a short delay, the same sequence of events will occur as descried earlier. Repeat this test procedure fr the other channel input.

The speaker protector is now ready for use. Remove the test lamp and plug the audio amplifier into socket SO1. Reconnect the speakers making sure to observe proper phasing.

(By Jerald M. Cogswell, in "Popular Electronics".)

Transistor lead identification

It is well known that NPN and PNP transistors may be identified out of circuit by observing the polarity for which the base-collector and base-emitter resistances are low, i.e., base positive for NPN, base negative for PNP, with respect to the other electrodes.

But how are emitter and collector distinguished from each other? This required one further careful observation.

In modern silicon planar epitaxial transistors the collector region has a larger area than the emitter region. Hence the base-collector resistance is slightly LOWER than the base-emitter resistance.

In practice, the difference between base-collector and base-emitter resistances is not very large because the resistivity of the collector is made high to obtain a high breakdown voltage.

For example, for the BC549, an NPN transistor, Rb-e = 6.39k, Rb-c = 6.32k; for the BC558, a PNP transistor, Rb-e = 6.34k, Rb-c = 6.24k.

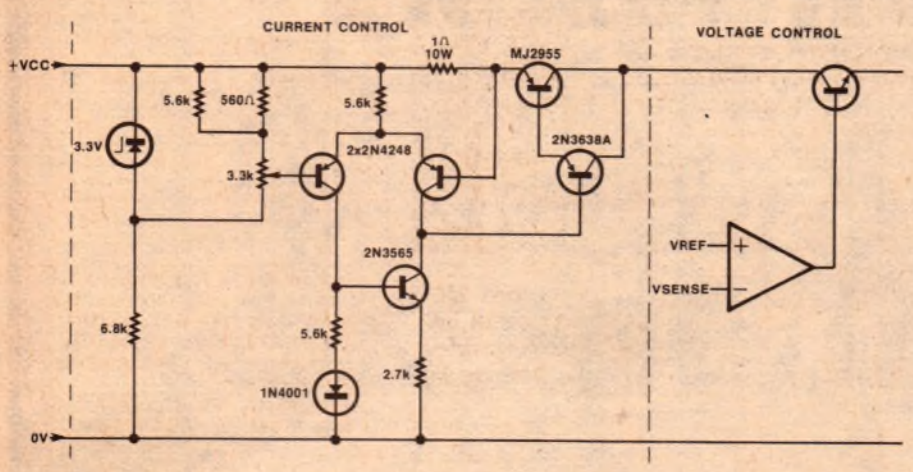
Thus, by comparing these resistances carefully the emitter and collector may be identified. The base, of course, is the third terminal to which the above resistances are referred.

(By Mr G. S. Shell, M.Sc, P.O. Box 40, Yenda, NSW 2681).

Editorial note: The above suggested method of checking transistor leads, while quite simple, should perhaps be best regarded as a standby to be used when one does not have access to a transistor tester. Having found the base lead, the device may then be checked with a tester by randomly placing the collector and emitter leads. If the gain is very low and improves when the two leads are reversed, then the latter position identifies the leads.

Mr Shell's test may hold good for many types of transistor but there may be special cases where the base-collector resistance is higher than the base-emitter resistance.

Variable current limiter for power supplies



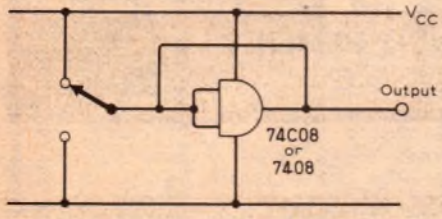
The variable current limiting circuit is intended to be fitted in regulated supplies between the normal voltage regulation circuitry and the output of the rectifier.

As may be seen from the circuit, it is a standard DC amplifier "upside down". It uses one transistor as a collector load driving a PNP Darlington pair, so as to compare a variable reference voltage with the voltage drop across a series resistor. It can be fitted into most 0-30V, 1A power supplies but space will have to be found for the front panel control. Also, the power transistor must be fitted with a good heat sink.

To set the current for any particular situation, wind up the voltage control so as to have 4 to 5 volts of requirement and then set the current control to the desired value. As shown, the circuit gives limiting from approximately 10mA to 1.2A. The circuit could have uses in Ni-Cd battery charging and in repair and development work.

(By Mr J. R. Orr, "Moto", Lot 99, Rockvale Road, Armidale, NSW 2350.)

Simple bounce-free switch



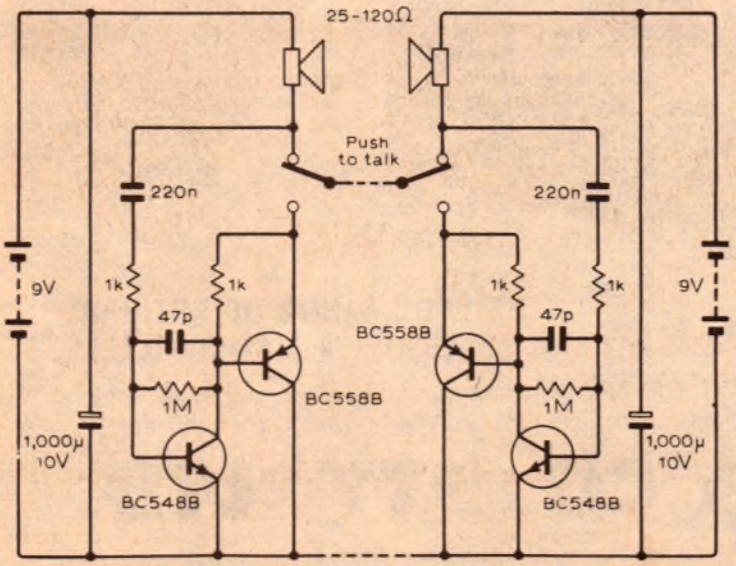
A single non-inverting gate or buffer wired as shown forms a bistable circuit, because the positive loop gain is greater than unity. Whilst the switch is in the up position, the output will be high. When the switch leaves this position and is in transit, the output remains high because the input is still high.

When the switch first makes contact with the lower position, the output of the gate is momentarily shorted. This situation is however remedied within a few nanoseconds because the input is also taken to ground which drives the output of the gate low. Thereafter, if the switch contact bounces, the output will stay low because the input is low.

This single non-inverting gate arrangement is simpler than the usual SR flip-flop, and the annoying pull-up resistors are eliminated.

(By P. Seligman, in "Wireless World".)

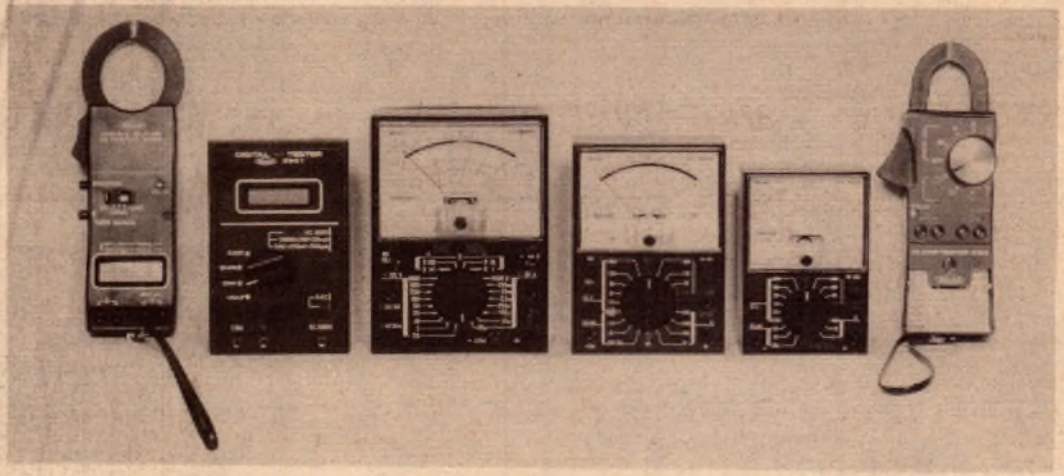
An interesting two-wire intercom



The circuit shows a simple battery powered two-station intercom which does not dissipate any standby power. If NiCd batteries are used, trickle charging at one station will also charge the other through the loudspeakers.

(By Ole Holmskov, in "Wireless World".)

Hioki Dependable Multitesters



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50μ A/25/250mA ±3%
10/50/250/500/1000V AC 9kΩ/V ±3%
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10/50/250/1000V AC 13.5kΩ/V ±3%
10A AC ±4%
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10/50/250/1000V AC 10kΩ/V ±3%
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L.F. Output —20 to +36dB

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10μ A/100μ A/1/10/100/500mA/10A ±3%
10/50/250/500/1000V AC 10kΩ/V ±3%
10A AC ±4%
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The Serviceman

Batteries that go "bang": new twist to an old problem.

Once upon a time the care and feeding of accumulators was an essential part of a serviceman's training, and a very practical part of the country serviceman's day-to-day routine. While this branch of our activities is now — thankfully — largely in the past, we are still expected to deal with these devices on odd occasions.

The incentive to write something on this subject came from an article in "Telepower News", a technical house journal of Telecom Australia. (While this is not normally available to the multitude, my tame telecommunications technician often passes one on to me when nobody is looking.)

The article made me realise that, for the very reason that these things are no longer commonly encountered in our day-to-day work, some vital facts about them may have been forgotten by us older hands, and perhaps never learned by the younger generation.

On the other hand, as servicemen, we are usually expected to "know all about everything" so that, when a customer encounters trouble with his car battery, he is just as likely to turn to us for what he feels will be unbiased advice. For this reason alone, it is as well to keep reasonably up to date on such matters. In addition, many servicemen still use a battery in the workshop to power car radios and other 12V devices.

In greater detail the "Telepower News" article presented a new version of an old problem: the exploding battery. And, if you don't already know it, lead-acid batteries are potentially explosive devices when on charge because they generate hydrogen and oxygen gas by electrolysis of the water in the electrolyte. Hydrogen gas and air can make a highly explosive mixture, but hydrogen and oxygen is just that much better — or worse, depending on how you look at it!

Nor is this some vague academic possibility. The risk is very real and the result can be very violent.

I know — because it happened to me!

I have told this story before in these notes, more years ago than I care to think about, but I feel that it is worth re-telling for the benefit of a whole new generation of readers who have come into the game since then.

It was when I was very young — and inexperienced — and while I was working for a serviceman in a large country town. A regular part of our business was charging batteries for the farmers in outlying districts, and for this purpose we used one of the old-fashioned "Tungar" chargers.

These had a current rating of only a few amps, but could deliver 30V or more. So, when several batteries had to be charged at the same time, the simplest arrangement was to connect them in series and let them all charge at a couple of amps for as long as was necessary.

The boss also insisted that the filler plugs be removed; a common practice, although one about which I had always had some reservations.

When the time came to remove a battery from charge the easiest way was to simply unhook the two clips from the terminals, then connect the clips together to restore the circuit for the remaining batteries. And, as you have probably guessed, we never bothered to turn the charger off before doing so.

Came the fateful day and it fell to my lot to remove a battery from the string. It was, as the textbooks say, "gassing freely" and probably should have been taken off charge sooner. Anyway, as I unhooked one of the clips there was a bright blue flash and an almighty "bang". When I recovered I realised that I had staggered back several paces, was liberally sprayed with acid, and that all that was left of the battery was the naked plates dripping acid all over the charging shelf and other objects beneath it.

In fact, I had been extremely lucky. While my face was stinging with acid, none had reached my eyes. I suspect that the flash may have saved me in this regard, causing a reflex closing of the eyelids before the acid reached my face. Anyway, a rinse of water and a few dabs of bicarbonate of soda on the worst spots soon gave relief, but the thought that I might easily have lost my eyesight was a very sobering one.

The damaged maintenance free battery, with as many of the pieces as could be collected, alongside a good battery of the same type. Note the crack in the right hand corner of the case. Photo by courtesy of "Telepower News".

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BA EL 3

Once satisfied that I was not injured, the boss gave me a good ticking off which, in fairness, I deserved. Quite apart from exposing myself, and others, to serious injury, I had seriously damaged a battery, created an unholy mess, and come close to doing a lot more damage with the acid.

Fortunately, when we had cleaned up the mess we realised that it had done little real damage, though it had been rather too close to a couple of expensive radio sets nearby, which had missed out by sheer good luck. The battery case had been shattered into dozens of pieces — we never did find all of it — but we were able to get a new case for the battery and get it back in service.

And that should have been the end of the story, with all concerned having learned an important lesson. So would you believe that, two days later, the boss almost did the same thing again?

In this case the whole system had spontaneously gone off charge; a common enough occurrence, invariably due to corrosion on one of the clips causing a bad connection to the terminal. Again, the boss followed what had become common practice; to go along the row of batteries and wiggle each clip in turn until the system came good.

In this case, like the fellow looking for a gas leak with a lighted candle, he found the fault all right, but rather wished he hadn't. It was my story all over again; the blue flash, the "bang", the naked plates, the dripping acid, and a very dazed and frightened victim. And, again, the face had been splattered, but the eyes had escaped.

Naturally, I was still smarting somewhat from being ticked off. I would dearly have liked to point the finger of scorn and say something dignified but to the point, like "Yah, who came a gutser this time?"

But he was the boss, and diplomacy prevailed.

To many this will be a classic story, heard many times before, and, therefore, hardly worth dragging up again. Others may be inclined to shrug their shoulders and say, "It can't happen to me." I suggest that both bear with me a little longer.

Earlier I mentioned that the "Telepower News" story presented a new version of this situation, and it does. The difference is that it involves a relatively new type automotive battery; the so-called "maintenance-free battery".

These batteries are sealed. According to the manufacturers there is no need to add distilled water during the battery's anticipated lifetime and, indeed, there is no way this can be done, even if one wanted to. And, by the same token, there is no way that a specific gravity reading can be taken.

The idea of a completely sealed battery is intriguing, to say the least. It seems to go against all we know about battery behaviour under typical conditions. And, while advertisements for these batteries in both local and overseas journals have been lavish in their superlatives, they have been strangely coy when it comes to any kind of factual explanation of how this seemingly impossible feat is achieved.

However, piecing together snippets of information from here and there, the story seems to go something like this:

(1) The most significant factor appears to be the use of antimony-free grids from which the plates are constructed. In the past, some antimony was added to the lead to improve the physical characteristics of the grid, particularly its rigidity.

But this increases the amount of gas — hydrogen and oxygen — produced by the plates during charge. As nearly as I can determine, this is because the antimony functions in the manner of an inert electrode; it does not react significantly with the electrolyte, but still contributes to the generation of gas. Thus, even if the battery was charged at a rate calculated to provide maximum chemical reaction with the active material (and therefore minimum generation of gas) the antimony grids would still generate significant quantities of gas.

(2) The batteries are designed to accommodate somewhat more electrolyte than a conventional battery, thus allowing for what losses do occur.

(3) The fact that the battery is sealed prevents loss by evaporation.

(4) And, very importantly in the context of this discussion, the battery is intended to be used in an automotive electrical system designed to provide a near constant-voltage/tapering current type charge.

(As well as the "maintenance-free" batteries there are other versions referred to as "minimum-maintenance" or in similar terms. These use the antimony-free grids, but are not completely sealed. Their behaviour would have to be considered separately.)

The report which prompted these comments appeared in "Telepower News" for September 1978, and concerns a battery explosion in one of the Telecom workshops. It was one of several maintenance-free batteries purchased for use as starter batteries for small power plants in remote areas. At the time of the explosion the battery was being used in the workshop, and was on "trickle charge".

The explosion occurred when a lead was unclipped from one of its posts. A member of the staff received superficial burns to the eyes, but was fortunate in that one of his workmates immediately man-handled him under a nearby shower and thoroughly flushed away the acid, preventing more serious injury.

My immediate reaction on reading the report was to ask what was meant by a trickle charge; a term used rather

loosely to imply something less than the normal rate of charge, but which could be anything from milliamps to amps in this context. In fact, I learned unofficially that it was probably between two and three amps in this case.

I was also puzzled as to why such a battery should explode anyway. If they are designed to generate an absolute minimum of oxygen and hydrogen, and they are sealed, what was there to explode and how was it ignited?

In fact it turns out that they are not completely sealed. They are fitted with a microcellular vent which is designed to relieve pressure within the cell, but is fine enough to prevent flashback into the cell in the presence of a flame or spark.

So what went wrong? Careful inspection of the remains by the Department's Material Inspection Branch suggests that excessive gassing saturated the microcellular filter and the resulting pressure build-up lifted the filter from its seat, thus releasing the explosive gas mixture and providing a flame path back inside the cell.

And what caused the excessive gassing? Simply the rate of charge which, while moderate by most standards, even for a fully charged battery, was excessive for the "sealed" maintenance-free battery.

In simple terms it all comes back to item (4) above. These batteries are designed to be charged in a precise manner, as provided by typical automotive electrical systems and which would not normally allow a fully charged battery to be charged at anything like this rate.

Or, looking at it another way, these batteries are not suitable for the rather free and easy approach, common in the past, whereby a battery was hooked up to the nearest charger and charged at two or three amps until someone remembered to check it and turn it off — often some time after it had reached full charge.

With the benefit of hindsight, there may be a temptation to criticise whoever abused the battery in this way, on the basis that he should have known better. But should he? I wonder how many of us would have worked that one out for ourselves in a similar situation. No doubt the battery manufacturers were aware of the risk but, significantly, the article refers to a "... communication open circuit somewhere between the manufacturer and the user."

So, if you have any ideas about using a maintenance-free battery as a bench battery, think about it very carefully. At the very least it will be necessary to provide a charging system having similar characteristics to those of an automotive system and, even then, there could be problems. After all, few of us run our car engines for 24 hours a day, yet a bench battery can easily be left on for such periods, or even longer.

It may also be reasonable to ask what happens to these batteries if they are used in a car in which the charging system is incorrectly adjusted, giving an excessive charge rate. (Such a situation is not unusual with new cars.) I'm not sure, but I have heard rumours of a few cases where maintenance free batteries have exploded, apparently spontaneously, while in the cars. Once again, it would seem that some care needs to be exercised.

STOP PRESS. Having read the above story an EA staff member confessed that he had purchased one of the same maintenance free batteries some 10 months ago. At the time he noted, through the translucent case, that it "was full to the brim with electrolyte".

But a visual check a few weeks ago showed that the electrolyte in several cells was down almost to the top of the plates. So he promptly returned it to the dealer from whom he brought it.

The salesman confirmed the situation and took the battery into the workshop. He returned with it in about five minutes, all cells now full, and fitted it to the car. (No charge!)

But how was a sealed battery topped up? Closer examination (later) revealed that there is a plate, almost undetectable, over the vents, and that this had been prised loose. In fact, it could now be lifted quite easily.

Which seems to make the maintenance free battery little different from the more conventional type.

Another explosion risk, involving the more conventional battery, is likely to occur when one dashes to the rescue of a fair damsel in distress at the local supermarket parking lot because of a flat battery.

As you proudly produce a set of jumper leads, in the best Boy Scouts' "Be Prepared" tradition, and prepare to parallel your battery with hers, stop and think for a moment. There is at least a chance that one of the batteries, probably yours, may have recently generated some gas. Connecting the two batteries together invariably produces a spark — quite a fat one sometimes. And an explosion at this juncture could turn you into a very bedraggled Sir Galahad — and poorer by the price of a battery!

The trick is to first connect the two active battery terminals together and then complete the chassis connection via a portion of the chassis, say behind the bumper bar, which is well away from the battery. This need be on only one car, but must be the last connection — ie, the one that completes the circuit.

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Designed especially for beginners

DREAM 6800

Talks directly to your TV and is programmed in a high-level language!

Are you one of the many people who have been turned off microprocessors and computers by all the complexity and never-ending jargon? Well, here is your chance to really start learning about the subject. This simple and easy to build computer costs around the $100 mark, yet talks directly to your TV without the need for a costly video terminal.

One of the other big features is the built-in cassette interface which means you can store your programs on any cassette recorder. And there is a whole raft of sample programs to get you started. All you have to do is punch them in via the hexadecimal keyboard. In no time you'll have a whole library of your own programs, easily accessible on cassettes.

So start reading now. We've even provided a comprehensive glossary to help you wade through all the jargon which is inevitable in this new and exciting field. The title of the computer is itself a bit of jargon: DREAM 6800, which stands for "Domestic Recreational and Educational Adaptive Microcomputer . . ."

Now we'll let the designer, Michael Bauer, of the Division of Computing and Mathematics at Deakin University, tell his story. . .

Surprising as it may seem, there are very few so-called "hobby computers" which inexpensively satisfy the needs of recreational home computing. The choice is between an "evaluation kit" (eg, 6800-D2, KIM-1, Mini-scamp etc.) or a BASIC system with CRT terminal, 8k memory, etc. The latter will set you back a few hundred dollars, while the evaluation kit doesn't give you enough capabilities. And besides, a hobby is supposed to be pleasurable, not give you headaches. There are much easier, less expensive ways to produce a headache, other than sitting up all night for days on end, hand assembling a ridiculous machine-code program to play "Lunar Lander" (with a 7-segment LED readout), or trying to write an animated video game in a high-level language like BASIC which wasn't invented for that purpose in the first place for a terminal that only displays alphanumerics.

Here's what the "DREAM 6800" home video computer has to offer:—

1. Lower cost: the parts should come to about $100.

2. A more useful display: Chunky graphics output to your colour or B&W TV giving a 64 x 32 dot matrix display.

3. Better software: As well as the usual operating-system or monitor (used for memory examine and deposit, tape load and dump, go to user program, etc), CHIPOS incorporates a high-level language interpreter, CHIP-8, which was specifically invented for video games, graphic displays, simulations, etc. Further, CHIPOS supports machine-language programs as well, for those applications where CHIP-8 is inadequate.

4. Wider appeal: People not into electronics or computing will also find the DREAM 6800 fascinating. Lots of TV games and other programs have already been written in CHIP-8, so you'll be able to impress your "non-believer" friends right away. And you won't hear the old: "Oh yeah, but what does it do?" and similar phrases. This is a fun computer!

5. There are hundreds of applications: TV games; advertising displays; teaching young children elementary arithmetic; practising morse code; timing events in the kitchen; hex/binary (variable base) calculator; metric conversions; bar charts; simulations (like LIFE); data communications experiments; etc. Educational institutions will find it highly motivational for introductory machine-level programming courses. It's also a serious computer!

HARDWARE SPECIFICATION

- ☆ *Processor: Motorola M6800.*
- ☆ *Clock: M6875 with 4.00MHz crystal.*
- ☆ *RAM (On-card): 1K x 8 (2 x 2114) Off-card expansion to 32K.*
- ☆ *ROM (CHIPOS) 1K x 8 (2708).*
- ☆ *Display: 64 x 32 dot matrix; each dot is 4 TV lines square. Uses 256 bytes of RAM at loc. 0100 for refresh by DMA.*
  Video output: 1Vp-p @ 75 ohm.
- ☆ *Input/Output: One M6821 PIA controls:*
  — Hex keypad (16 keys in 4 x 4 matrix) plus 2 extra keys, Function & Reset.
  — Tape I/O: 300 Baud; 2400/1200Hz FSK; Out: 0.5Vpp; In: 300mV — 3Vpp.
  — RTC timer interrupt: 50Hz (frame sync.).
  — Audio bleeper: 2400/1200Hz (8 ohm spkr).
  — Display/DMA enable-disable line.
- ☆ *Add extra PIAs, ACIAs, etc, without any additional logic.*
- ☆ *Power requirements (worst case): +5V (1A), —5V (100mA), +12V (100mA).*

NOTE

Power supply, keypad and TV RF modulator are off-card extras.

Right about now the sceptics will be saying: "But there's only 1K of RAM and the video refresh buffer's got to be in there somewhere, and a scratchpad, and a stack or two. . .good grief! there won't be enough left for a program! In

Sungravure staffer Adriane Hill puts our prototype DREAM 6800 through its paces with a random number display.

fact, there are 640 bytes free. That's either a damned long machine-code program to hand-assemble, or a 320 statement CHIP-8 program. Most users will find this more than adequate. CHIP-8 is a lot more memory-efficient than BASIC, assuming the application is graphics oriented and does not require any heavy number-crunching, or text manipulations.

For experimenters, there are a few spare I/O lines on the PIA and the system bus is terminated on two 16-pin sockets allowing memory and I/O expansion.

Most hobby computer designers take advantage of the increase in sophistication and lower cost of hardware to produce a more powerful system for the same price as earlier designs. The DREAM-6800 philosophy is to retain the meek processor power and small memory size of past generations, but at a much reduced cost, and to more effectively utilise the available memory. This is not to imply that the '6800 lacks power; it is a superlative 8-bit MPU in every respect.

SOFTWARE DESCRIPTION — CHIPOS

Q: "When is a computer not a computer?"

A: "When there's no software to go with it."

CHIPOS packs about as much into 1024 bytes as is possible. The monitor and interpreter share many subroutines, such as the keypad encoder and display routines. There are four commands, selected by the function key (FN) followed by a hex digit, viz:—

[FN] [0] for memory modify ("memod"): allows RAM contents to be examined or changed. First, a 4-digit hex address is keyed in and appears in the display readout. The [FN] key is used to step through memory, each byte being displayed one by one. To write data into RAM, a 2-digit number (one byte) is entered, and the address is incremented automatically.

[FN] [1] for tape load. First, "memod" (above) is used to enter the beginning and ending locations of the block to be loaded (or dumped), at 0002 and so on.

[FN] [2] for tape dump.

[FN] [3] for "GO". First, a 4-digit starting address is entered; eg C000 to run a CHIP-8 program. (This address is remembered for subsequent runs, unless memod is used in the meantime.) At any time, the reset key [RST] may be used to regain monitor control

That's it; you've learned just about all there is to know in order to enter, verify, save, load and run any program. Details of how to write and debug your own CHIP-8 programs will be given later.

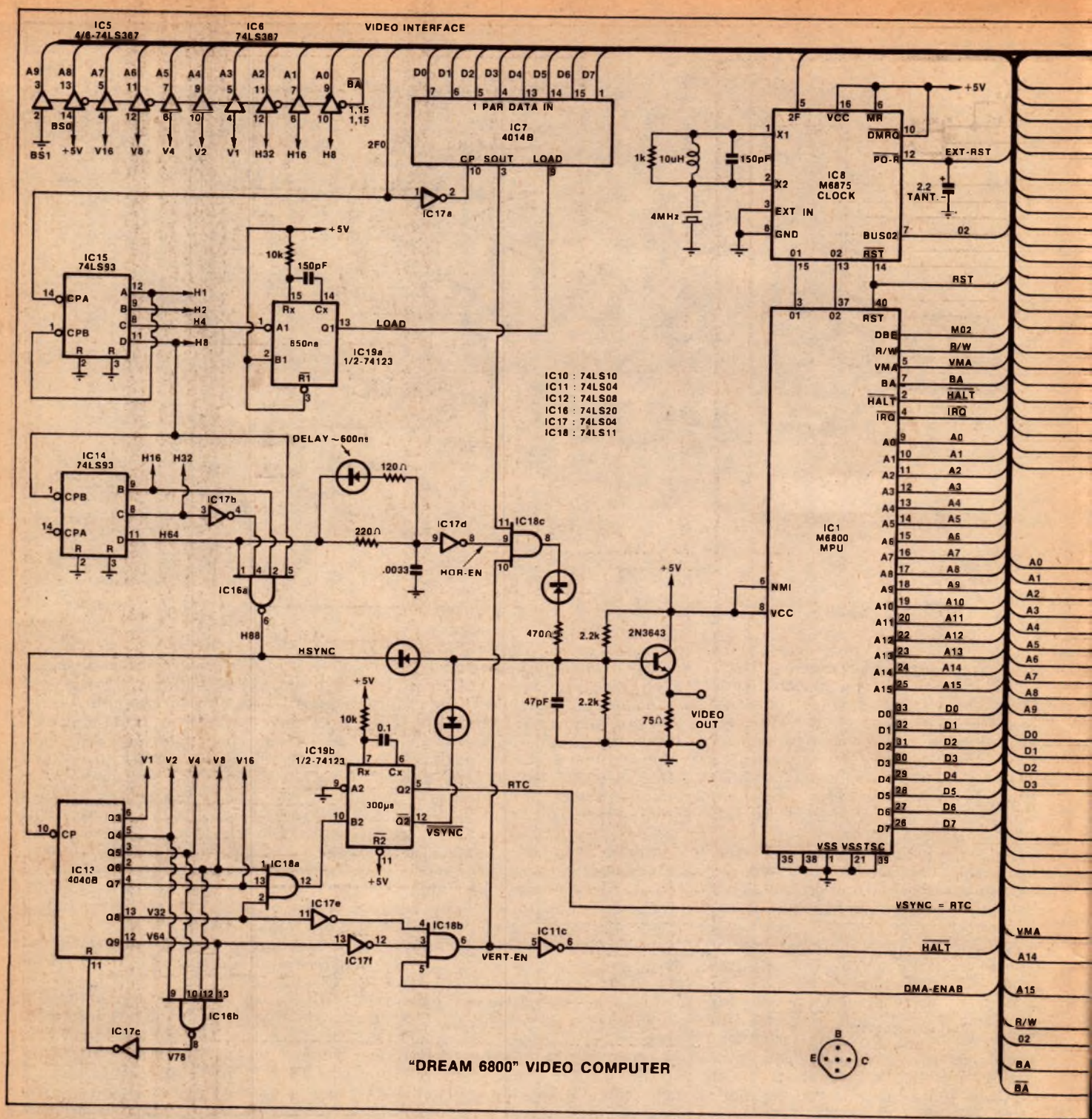
For advanced users, CHIPOS has been written with flexibility in mind. Calls to over 17 useful CHIPOS subroutines can be made from a machine-code program; eg, erase the screen, fill the screen, get random byte, display hex digit, convert byte to decimal, show a user-defined symbol up to 8x16 dots, set display coordinates, turn screen on/off, input a key-code, make a bleep, delay 3.33 milliseconds, test keypad status, input byte from serial I/O line (tape port), output same, wait for frame sync interrupt, return to monitor, etc. A user can load his own machine-language debugging utility (DREAMBUG!) in RAM at 0080. A software interrupt causes a jump to this address. A typical debug routine would then display all register contents. Further, the IRQ vector is in RAM, so that a user can supply his own interrupt service routine. This feature is handy if you want to program your DREAM-6800 as an "intelligent alarm clock", or if you want the keypad to be interrupt driven.

Don't worry if the last paragraph made little sense to you, because most of those subroutines, and many additional ones are far easier to utilise via the CHIP-8 interpreter, which uses a two-byte "macro" instruction to perform any given task. Add a few more instructions to do arithmetic and logic, perform conditional branching, and do loads/stores on the variables, and presto — you've got a high-level computer language.

CHIP-8 LANGUAGE SUMMARY

CHIP-8 was originally developed by Joe Weisbecker at RCA Labs (USA), primarily to allow users of low-cost microcomputers to write their own video game programs without the tedium of hand assembling machine language programs.

CHIP-8 does not use an expensive video terminal like BASIC, but rather a low-cost interface to the processor



Here is the complete circuit of the DREAM 6800 minus the power supply.

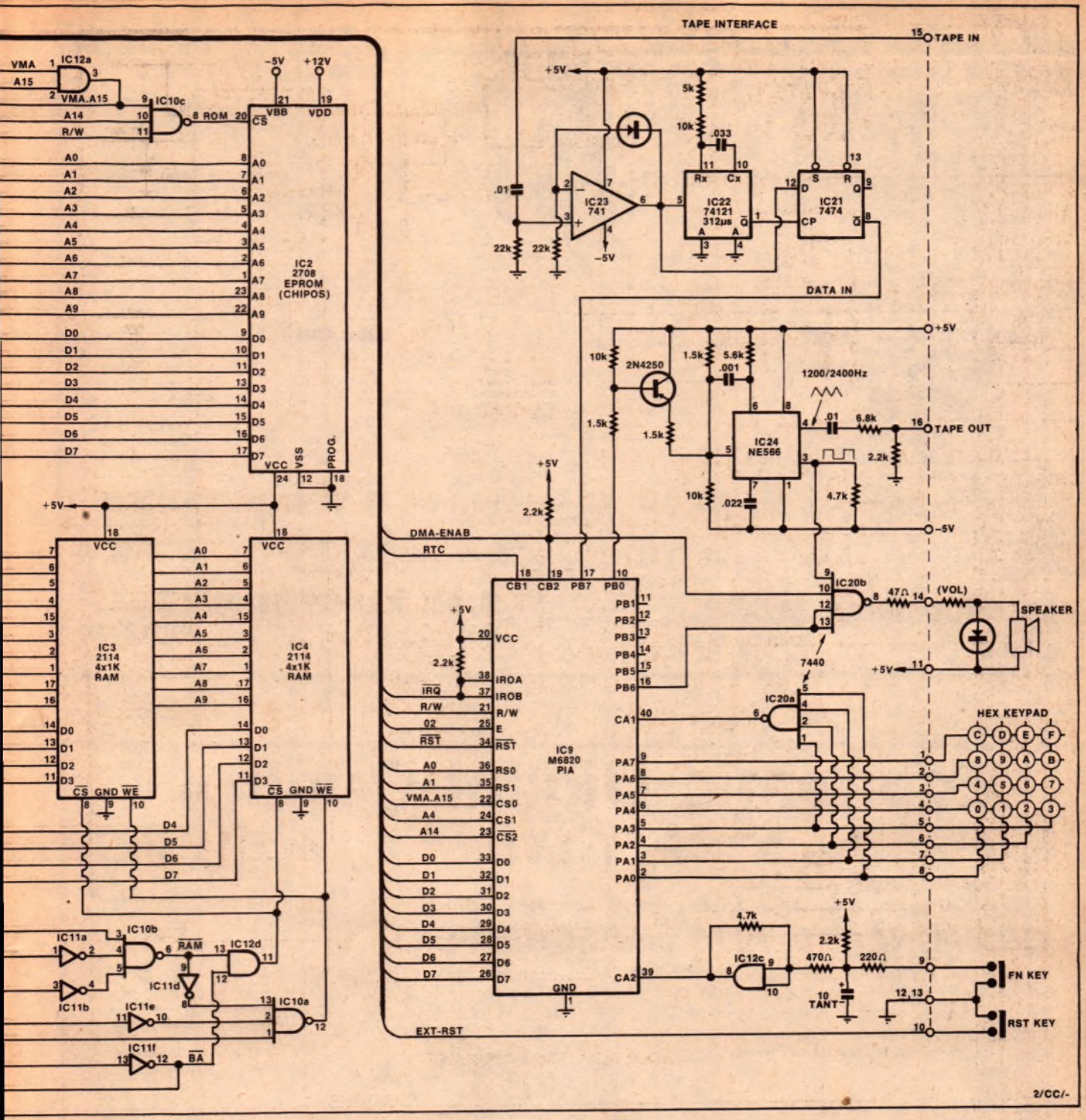
which produces a matrix of dots (64x32) on a TV screen, each dot being a bit in the system's RAM. Nor is a full typewriter-style keyboard required, since all instructions are coded in hexadecimal, and entered via a hex keypad.

CHIP-8 produces quite compact programs for video games, graphics, advertising displays, animations, simulations, educational tests, drills, and so on. A fascinating video kaleidoscope program requires only 60 instructions. An animated UFO/missile intercept program, with on-screen decimal scoring, requires only 104. A tank battle game easily fits into the minimum (1K) system.

CHIP-8 is an interpreter, ROM-resident with the operating system. The user's program instructions reside in RAM, starting at 0200. Each statement is stored as 4 hex digits (2 bytes) which are designed to be easily encoded by hand. There are 33 instructions in the set, including No Operation (0000) and STOP (F000).

The language provides 16 one-byte variables, V0 thru VF, which can be manipulated with a variety of arithmetic/logic and conditional branching instructions. A 12-bit pointer (I) indexes memory locations for load/store and display instructions. This allows multiple sets of variables or array processing. CHIP-8 is limited to the first 4K of memory, because of the 3-digit (12-bit) memory operands.

The SHOW instruction takes N bytes from the location at I, and writes them vertically into the display refresh buffer, using the values of any two



variables as the x,y coordinates of the symbol. If an attempt is made to write dots on top of existing dots, then the overlapping area is erased and variable VF is set to 1.

A hex numeric digit (contents of any variable, LSD) can be displayed by preceding a SHOW instruction (DXY5) with an I=DSP, VZ (FZ29). The MI=DEQ,VZ instruction stores the 3-digit (unsigned) decimal equivalent of variable VZ in memory at I.

Additional instructions let you make a bleep of variable duration in the speaker, preset or test a timer (a variable which is decremented every 20 milliseconds), input a digit from the keypad, or simply test to see if a given key is being pressed.

Subroutine nesting to 12 levels, and calls to machine-language programs are catered for. CHIP-8 subroutines may call machine-code subroutines.

THEORY OF OPERATION

The design is centred on the video interface, which shares both RAM and time with the processor. The picture is active for 128 out of a total of 312 TV lines, which is about 40% of the frame. During this time, the MPU is halted and the video display generator (VDG) has sole access to the memory, which is held in read mode. Therefore, no intermediate buffer storage is required, such as a recirculating register, for display refresh.

The compromise is between picture size and processor throughput. The chosen format of 64 x 32 dots has several advantages apart from VIP compatibility. Some of the "coincidences" are incredible; eg:—

1. The clock frequency worked out to be 1.998 MHz (for 50.00Hz field freq.), and the M6875 has an auxiliary 2.00MHz output.
2. 64x32 = 4096 bits = 256 bytes = 1

page; ie one of 256 bytes can be selected with an 8-bit address, thereby grossly simplifying the display driver software.

3. In order to produce square dots, the width of each dot had to be 0.5 usec (hence 2MHz clock), but a standard video line is 64 usec making the total line 128 dots wide — a binary multiple, thus simplifying the horizontal counter circuitry.

Carving 40% off the M6800's effective speed makes negligible difference in this application. In fact, the 6800 CHIP-8 interpreter runs faster than the Cosmac VIP. To keep everyone happy, the VDG can be turned on and off under program control to allow maximum, uninterrupted MPU speed when requiried.

Video is produced by loading a parallel-in/serial-out shift register (IC7) with a byte of RAM, via the data bus. The bits are then clocked out and combined with sync signals to produce composite video. A set of counters (IC's 15, 14, 13) are responsible for producing sync pulses, and for supplying the RAM address for each byte. This address is applied to the system bus via a set of tristate buffers (IC5,6), which are enabled by the bus-available (BA) control line. BA is put HIGH by the MPU after a HALT request, telling that the address and data busses from the MPU are floating (high impedance state), and can be used by other devices (eg the VDG).

Horizontal timing is produced by counting dots (2MHz pulses). When the counters are reset, the first byte is being addressed. This byte is the upper LHS of the active picture, where a sync pulse is NOT required. So a gate (IC16a) looks for a set of conditions which will tell when a horizontal sync pulse is needed. By a welcome coincidence, the pulse out of this gate is 4 usec long, which is near enough to the desired 4.7 usec for HSYNC. The pulse occurs on the 88th dot after the start of the active portion of the picture. Now we need a way to blot out the unwanted part of the picture. Only 64 of the 128 dot positions are valid picture dots.

The counter output called H64 changes state every 64 dot positions, and thus can be used for a gating signal to enable the picture during the first 64 dots.

Here's where complications set in. We have to allow 450 ns RAM access time, and allow for the propagation delay in the shift register, between the instants of supplying a valid address and receiving valid data. This problem was solved by delaying the H64 signal with an RC delay network.

Due to the low threshold of TTL different rates of charge and discharge were necessary, hence the extra resistor and diode. Having delayed and inverted H64, a suitable "horizontal-enable" signal (HOR-EN) has been derived. (Refer timing diagram.)

Vertical timing is derived by counting HSYNC pulses. A field is composed of 312 lines, which is 78 rows of dots. Only the first 32 rows are valid picture, so a vertical enable signal (VERT-EN) can be formed by gating V32 and V64. Field sync is derived by looking for the 56th row (IC18a) and using this transition to fire a one-shot (IC19b) of about 300 usec. The vertical counter (IC13) is reset on the 78th row by another gate (IC16b).

The vertical enable signal serves two tasks. Firstly it masks out the unwanted part of the picture in the field, and secondly it serves to HALT the MPU during the time that display refresh is required. Note that VERT-EN can be prevented from going HIGH altogether, by the DMA-ENAB signal, allowing software enable/disable of the screen.

Let us now focus our attention on the Input/Output interface, controlled by an M6821 Peripheral Interface Adaptor. Whoever designed this device is a wizard! For starters, every individual bit can be set up to be either an input or an output, under program control, including two control lines. Next, the B side port is Tristate (the lines float when programmed as inputs), and the A side has internal 5k pullups for versatility. The control lines can be programmed to be flags, senses, interrupts or strobes. In this particular application, the data and control lines are all functioning independently.

The tape interface is a simple frequency-shift keyed (FSK) modem, which uses the "Kansas City Standard" frequencies and data rate (2400/1200Hz @ 300bits/sec). The modulator is a 566 function generator (IC24) which free runs at 2400Hz, unless the serial data out line (PB0) is LOW. Then, the control voltage on pin 5 is changed to produce 1200Hz, by turning on the transistor. This transistor is wired in the "inverse switching mode" (upside-down!) to get a lower Vce(sat). The triangle waveform changes gracefully from one frequency to the other, thereby producing an ideal FSK output for taping.

Using supply voltages +5V and —5V on the 566 gives TTL compatability for both voltage control and square wave output. This output drives a speaker when its enable line (PB6) is HIGH. The speaker is inhibited during tape I/O, by using the same line that inhibits the display (CB2). The main use for the speaker is as a "bleeper" to acknowledge valid keystrokes.

The tape demodulator consists of a comparator (IC23) to square up the incoming signal, followed by a pulse-width discriminator (IC22,21). The input signal from the tape deck should be in

TABLE OF CHIP-8 INSTRUCTIONS

Stored Code	Mnemonic	Description
1MMM	GOTO MMM	Jump to instruction at location MMM.
BMMM	GOTO MMM + VO	Computed GOTO; Jump to MMM + VO.
2MMM	DO MMM	Do CHIP-8 subroutine at MMM.
00EE	RETURN	Return from CHIP-8 subroutine.
3XKK	SKF VX = KK	Skip next instruction if VX = KK (hex).
4XKK	SKF VX ≠ KK	Skip if VX NOT = KK.
5XY0	SKF VX = VY	Skip if VX = VY.
9XY0	SKF VX ≠ VY	Skip if VX NOT = VY.
EX9E	SKF VX = KEY	Skip if key down = VX; no wait.
EXA1	SKF VX ≠ KEY	Skip if key NOT = VX; no wait.
6XKK	VX = KK	Assign hex constant KK to variable.
CXKK	VX = RND.KK	Get random byte; AND with KK.
7XKK	VX = VX+KK	Add (2's comp.) KK to VX.
8XY0	VX = VY	Copy VY to VX.
8XY1	VX = VX!VY	Logical OR VX with VY.
8XY2	VX = VX.VY	Logical AND VX with VY.
8XY4	VX = VX+VY	Add VY to VX; If result >FF, VF=1.
8XY5	VX = VX-VY	Subtract VY; If VX <VY, VF=0, else 1.
FX07	VX = TIME	Get current timer value.
FX0A	VX = KEY	Input hex keycode (wait for keydown).
FX15	TIME = VX	Initialize timer; 01 = 20 millisec.
FX18	TONE = VX	Bleep for 20 x VX milliseconds.
AMMM	I = MMM	Set memory index pointer to MMM.
FX1E	I = I+VX	Add VX to memory pointer.
FX29	I = DSP, VX	Set pointer to show VX (LS digit).
FX33	MI = DEQ, VX	Store 3-digit decimal equiv. of VX.
FX55	MI = VO:VX	Store VO thru VX at I; (I = I + X + 1).
FX65	VO: VX = MI	Load VO thru VX at I; (I = I + X + 1).
00E0	ERASE	Clear the screen.
0MMM	CALL MMM	Call machine-code subr. (MMM > 200).
DXYN	SHOW N@VX, VY	Display N-byte pattern at (VX, VY).
0000	NOP	No Operation.
F000	STOP	Jump to monitor (CHIPOS).

(X,Y,N and M are arbitrary hex digits, O to F.

Last month we sent this letter TO ALL ADVERTISERS . . . We feel that readers should see it also!

ELECTRONICS Australia

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P.O. Box 163, Beaconsfield N.S.W. 2014
Telex 25 021

27th March, 1979.

Dear Advertiser,

When - and if - you see a copy of "Electronics Today International" for April 1979, you may come across an item on Page 7 headed "15,000 More?"

In this item, the writer agonises about an unspecified "apparent contradiction" in the audited circulation of E.T.I. which appears to put it at a severe disadvantage with respect to its "nearest competitor".

After some rather pointless talk about overseas editions and overseas sales, the writer concludes with the sentence:

"Within Australia the sales of E.T.I. are, on average, substantially similar to those of our nearest competitor ."

The competitor is not specifically named but, just in case you think it might refer to "Electronics Australia", here is an actual distribution breakdown for the two magazines, based on the latest figures available from the Audit Bureau of Circulation

Electronics Today International (Australian Edition)

Total paid circulation (ABC)	28,376+
Sold in New Zealand (Publisher's statement)	1,500 "or so"
Sold in Australia	26,876 +

Electronics Australia

Total paid circulation (ABC)	43,500 +
Sold in New Zealand (avg. same 6 months)	3,654
Overseas other than New Zealand	876
Sold in Australia	38,970 +

What this means in actual, proven figures:

E.A. leads E.T.I. (Aust.) in overall sales by	15,124	or 53%
E.A. leads E.T.I. in the N.Z. market by	2,154	or 143%
E.A. leads E.T.I. within Australia by	12,094	or 45%

So there you have it. No waffle, no contradictions, no mystery.

We welcome the opportunity to set the record straight.

Cordially yours,

W.N. Williams
Editor in Chief

S. Sayers
Advertising Manager

the range 300mV to 3V peak-to-peak (100mV to 1V rms). The square wave output from the 741 triggers a one shot whose period is 3/4 cycle at 2400Hz, ie 312 usec. The same square wave is sampled by a D-type flip-flop when the one-shot times out. If the signal was low at this instant, then it must be 2400Hz, but if it was still HIGH, it must be 1200Hz (see diagram). Hence the demodulated signal is the inverse output from the flip-flop. Note that the Schmitt-trigger facility of the 74121 is exploited, for added noise immunity.

The task of converting 8-bit parallel data to an asynchronous serial bit stream at 300 Baud, and vice-versa, is done by software in CHIPOS. Thus the tape modem may be disconnected, and PB0,PB7 used as a serial data communications port, if such an application is envisaged (eg "smart" terminal).

Operation of the hex keypad is very simple from a hardware point of view. Normally, the rows (PA4 to PA7) are outputs, held LOW, while the columns (PA0 to PA3) are inputs, held HIGH by internal pullups. If any key is pressed, one column must go LOW causing a rising edge at CA1. The software encoding routine then can determine which column went LOW, then reverse the roles (ie data directions) of the rows/columns to determine which row is active. This program incorporates debounce and error-checking sequences, ensuring ultra-reliable functioning.

The [FN] key posed a special problem: how to detect closure of an SPST contact without getting bounce or noise, and without introducing an extra chip. The final solution was a Schmitt-trigger made from a spare AND-gate with feedback.

DREAM 6800 GLOSSARY

ACIA: Asynchronous Communications Interface Adaptor; Motorola's answer to the UART, or Universal Asynchronous Receiver Transmitter; it provides the data format and control to interface serial asynchronous data to bus organised systems.

ADDRESS: The label, name or binary number specifying a particular location in memory.

ALPHANUMERIC: Refers to numbers and letters of the alphabet; ie, an alphanumeric code represents numbers and letters.

AND-GATE: A digital logic element with output logic value related to the AND logical function; ie, with all inputs 1, the output is 1 but all other input combinations result in 0 output.

ARRAY: A named group of related variables or constants. Items in the array may be located in consecutive memory locations or they may binked.

ASYNCHRONOUS: Refers to a system or circuit whose elements are not arranged to change state in synchromism.

BASIC: One of the ligh-level programming languages which is user-readable.

BAUD: Used as a measure of serial data flow. 10 baud normally equals 10 bits/second.

BINARY: Refers to the number system with base 2 and expressing all quantities by the numerals 0 and 1.

BIT: Binary digit, either 0 or 1. The minimum amount of information.

BRANCH: An instruction in a program which causes the processor to execute a step not in the usual sequence. A branch can be unconditional or conditional, based on the magnitude or state of some value. Branch is synonymous with Jump.

BUFFER: refers to an amplifier which is interposed between two circuits to avoid undue loading effects. "Buffer" can also refer to an area in computer memory which is used as a work area or to store data for an input/output operation.

BYTE: A group of consecutive binary bits, usually eight, which are operated upon as a unit. A byte can also be a subset of a computer word. Additionslly, byte is a unit of memory size: the Dream/6800 has 1K (1024 bytes) of memory in RAM.

BUS: A circuit or group of circuits which provide a communication path between two or more devices, such as between processor, memory and peripherals. The "S100" bus is based on that originally used in the MITS/Altair 8080 computer and which subsequently became a USA industry standard.

CAI: Computer-aided instruction.

CLOCK: A pulse generator which provided timing signals to which all system operations are synchronized.

CONDITIONAL: See Branch.

DMA: Direct Memory Access; a method of transferring data directly between an external device and system memory without the need for processor intervention. This method significantly increases the data transfer rate and hence system efficiency.

D-TYPE: a particular type of flipflop which, when a clock pulse arrives, stores or latches the logic level at its D-input.

DEBUG: A diagnostic program which helps locate hardware malfunctions in a system or to identify coding errors in newly developed programs.

DISABLE: Use a control voltage to halt system operation.

ENABLE: Use a control voltage to start a system or circuit, or to allow it to function.

ENCODER: A digital circuit which accepts information in uncoded form and generates corresponding coded data.

FLAG: An indicator, usually a single binary bit, used to indicate a condition for a peripheral device or a later stage in a program.

FLIPFLOP: A family of digital circuits capable of assuming either of two stable states and therefore capable of storing one bit of information.

FIELD: Refers here to one vertical scan of a television picture, which occurs 50 times a second.

FSK: Frequency-shift keyed; refers to a digital mode of data transmission wherein the two logic levels are transferred as two distinct frequencies. In the case of the "Kansas City Standard" which resulted from a symposium organised by USA magazine BYTE, logical 1 is a 2400Hz tone while logical 0 is 1200Hz.

GRAPHICS: A system of producing pictorial or graphical information on a video monitor, television screen or chart recorder.

HARDWARE: In this context means the electronic circuitry of the computer and its peripherals.

HEX: Nasty spell placed on person trying to debug a program; also abbreviation for Hexadecimal.

HEXADECIMAL: A number system with base 16 using numbers 0 to 9 and A,B,C,D,E,F to represent its 16 digits. Two hexadecimal digits can be used conveniently to represent 8 bits, or a byte.

I/O: Input/Output. An I/O Port is connection to a processor to provide a data path to or from external devices suchas keyboard, display or cassette recorder. An I/O port of a microprocessor may be input or output or it may be bidirectional.

INSTRUCTION: A set of bits which defines a computer operation and is a basic command understood by the processor.

INTERFACE: A device which transfers data from one system to another.

INTERPRETER: A program that fetches, translates and controls execution of instructions written in a higher-level language.

INTERRUPT: The suspension of a normal program routine of a computer or microprocessor in order to handle a sudden request for service, usually by a peripheral device.

JUMP: See Branch.

LANGUAGE: A set of symbols and expressions used to express a computer instruction or program. More commonly the term is used to describe higher-level languages, or programs expressed in symbolic form for convenience of

DREAM 6800 GLOSSARY . . .

human beings. Programs written in this form must be translated into machine code form before they can be executed by a computer.

LOAD: To store binary information, generally into a processor register.

MACHINE CODE (or language): The binary numeric form of instructions actually understood by a processor.

LOOP: A sequence of instructions so arranged that upon execution the processor is forced to execute the sequence repetitively a certain number of times.

MODEM: Modulator-demodulator; used for transferring digital information over a communications path.

MONITOR: Can refer to a "video monitor" which displays video signals without the need for an RF demodulator; more commonly, in this context, refers to a specific program allied to the processor which looks after communications between the software and system hardware.

NESTING: The technique of cascading program loops or subroutines. In the case of loops, nesting involves loops-within-loops-within-loops, and so on. In the case of subroutines, nesting involves a subroutine calling another subroutine, which in turn may call another subroutine, and so on (see Subroutine).

PIA: Peripheral Interface Adaptor (See text).

PARALLEL: A method of simultaneously transferring each of a contiguous set of bits over separate wires, one wire for each bit in the set; an eight-bit system requires eight wires.

PROGRAM: A set of computer instructions arranged to control the processor in executing a certain complex task. A program may consist of a linear sequence of instructions, one or more loops, one or more subroutines, or more usually a combination of all of these.

ONE-SHOT: A monostable multivibrator; a logic circuit which delivers just one pulse on reception of a control signal.

OPERAND: Can be the result of a computation, a constant, a parameter, the address of any these quantities or of the next instruction to be executed.

PULL-UPS: Internal or external resistors designed to "pull" a logic output (or input) towards the more positive supply rail when the output is turned off.

POINTER: Registers in the processor or memory that contain memory addresses; i.e., they are used to "point" to memory locations.

PORT: See I/O.

PROCESSOR: Also CPU (Central Processing Unit) or Microprocessor; the major portion of a computer incorporating an arithmetic-logic unit (ALU) to gether wijth various registers and timing circuitry.

RAM: Random-access memory.

ROM: Read-only memory. A memory device in which the stored data is effectively permanent in normal operation and can only be read out, not overwritten.

REGISTER: A device used to store or manipulate numbers of other data; usually a group of flipflops.

ROUTINE: A program or program segment designed to accomplish a single function.

SCHMITT TRIGGER: A controlled switching circuit whose threshold for rising inputs differs from that for falling inputs; usually used for "squaring up" pulses or pulse waveforms. The difference between the two input thresholds is known as hysteresis.

SCRATCH-PAD: Designates an area of memory used for many quick data transfers. It is the most frequently used memory segment. Some microprocessors have simplified instructions which can only be used in a certain part of the memory (say, the first 256 bytes) where the most significant byte of the address is zero. The scratchpad is usually placed in such a location.

SERIAL: A method of sequentially moving a contiguous set of bits (data) over a single wire.

SKIP: An instruction which causes the processor to omit the next instruction in the sequence.

SOFTWARE: Generally refers to all the programs and routines available for a particular computer or microprocessor. More specifically, it refers to those programs which are alterable by the user. Those programs and routines that are not user-changeable, ie, burned into ROMs, are often referred to as Firmware.

STACK: A sequence of registers or memory locations used in Last In First Out (LIFO) fashion. A "stack pointer" specifiers the last-in entry.

STORAGE: Any device in which data can be stored.

STROBE: System of rapidly reading registers or memory in sequence.

SUBROUTINE: A short program segment which performs a specific function and is available for use any number of times by other programs and routines.

SYNC: Describes the pulse trains which synchronise the line scan (15,625Hz) and field rate (vertical sync, 50Hz) for television and video monitors. Sync also refers to the trace synchronising pulses used in oscilloscopes.

TTL: Stands for Transistor-transistor logic. One of several logic systems.

TRI-STATE: Registered trade mark of National Semiconductor Corporation, USA. Describes gates and other circuits which can not only have their outputs at logical 1 or logical 0 levels but can also assume a high impedance state. The latter state allows other gates connected to the same bus system to "talk" alternatively.

UFO: Unidentified flying object. Nothing to do with computers or microprocessors.

VDG: Video Display Generator.

VIP: The RCA microcomputer system bases on their Cosmac microprocessor.

VARIABLE: A named memory (RAM) location which is given some consistent meaning in the program and which may contain different data values during the execution of the program.

(Continued next month)

Discount Components

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LM317K	$2.90	309K	$1.50	10 7490	$3.00
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IN4003	7c	10 4011	$2.00	LED CLIPS	2c
IN4002	7c	10 74LS00	$2.00	10 723	$4.50

LINEARS

301	40
307	65
308	1 25
309K	1 90
311	80
317K	2.90
318	3.25
324	1 25
325	4 60
339	85
348	1 60
349	2 25
356	1 65
377	2 75
379S	6.95
380 14 Pin	1 30
381	1 95
382	1 95
387	1.90
386	1.90
555	35
556	85
565	1 90
566	2 40
567	2 60
709	70
723 (VR)	50
741	30
747	90
3900	85
3909	1 20
CA3028	2 90
CA3046	2.10
CA3130	1 95
CA3140	1 95
RL4136	2.90

REGULATORS

7805	1.00
7806	1 20
7808	1.20
7812	1.00
7815	1 20
7818	1.20
7824	1.20
7905	1 50
7906	1.50
7908	1 50
7924	1 50
7912	1.50
7915	1.50
78L05	40
78L12	40
78HGKC	8 50
78H05	7 90
78H12	7 90
723	50
309K	1 90
317K	2 90

OPTO

FND357 C.C.	1 30
FND500 C.C.	1 25
FND507 C.A.	1 40
FND800 C.C.	3 50
TIL209 Leds	20
RED LEDS	18
100 for	13 00
YELLOW	30
GREEN	30
Mounting Clips	3

DIODES

1N4148	5
100 for	4 00
1N4002	7
1N4003	8
1N4004	9
100 for	7 00
1N5625	50

RESISTORS

1/2 Watt 1 R H Metal Glaze 1 ohm to 1M (E24 Values). 1-99	3
100-999	2 5

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BC547/8/9	15
BC557/8/9	20
BD139	55
BD140	55
2N3055	85
MJ2955	95
BC337	25
BC338	25
BF115	85
BF180	75
PN3643	25
PN3645	25

BRIDGES

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MDA3502 35A 200V	4 20
MDA3504 35A 400V	4 50
WO4 1.5A 400V	80

SCR

C103YY 8A 60V	80
C106A1 4A 100V	95
C106D1 4A 400V	1 30
C122D1 8A 400V	2 50
C122E 8A 500V	2 60

I.C. SOCKETS

8 PIN	25
14 PIN	33
16 PIN	35
18 PIN	50
20 PIN	60
22 PIN	75
24 PIN	80
28 PIN	90
40 PIN	1.00

TTL

7400	25
7401	25
7402	25
7403	25
7404	35
7405	35
7406	50
7407	50
7408	32
7409	32
7410	25
7411	35
7413	55
7414	90
7416	60
7417	60
7420	25
7421	50
7422	30
7426	45
7417	45
7430	30
7432	40
7437	50
7438	50
7440	30
7441	1.50
7442	70
7447	95
7448	95
7450	35
7451	35
7453	35
7454	30
7460	35
7470	65
7472	45
7473	60
7474	65
7475	65
7476	45
7480	1.25
7483	1 25
7485	1 45
7486	65
7489	1 90
7490	50
7491	1.00
7492	65
7493	65
7494	1.10
7495	95
74100	2.45
74107	65
74121	50
74123	90
74132	1.25
74150	1.60
74151	1.10
74153	1.10
74154	1.70
74157	1.10
74160	1.55
74161	1.75
74164	1.55
74165	1.55
74173	2.75
74175	1.65
74180	1.35
74192	1.40
74193	1.40
74197	1.50
74221	1.50
74251	1.50
74367	1.20
74368	1.20

74LS

74LS00	25
74LS01	30
74LS02	25
74LS03	30
74LS04	35
74LS05	35
74LS08	30
74LS09	30
74LS10	25
74LS11	30
74LS12	30
74LS14	1.00
74LS15	35
74LS20	30
74LS21	30
74LS22	35
74LS26	40
74LS27	30
74LS28	40
74LS30	30
74LS32	30
74LS37	45
74LS38	45
74LS40	30
74LS42	1.10
74LS47	1.40
74LS48	1.50
74LS49	1 80
74LS51	45
74LS54	45
74LS55	45
74LS73	90
74LS74	50
74LS75	70
74LS76	95
74LS78	50
74LS83	1.50
74LS85	1.50
74LS86	50
74LS90	1.10
74LS92	1.20
74LS93	1.10
74LS95	1.50
74LS107	1.20
74LS109	50
74LS112	1.20
74LS113	55
74LS114	55
74LS122	2.00
74LS123	1.90
74LS125	1 90
74LS126	1.50
74LS132	1.60
74LS126	79
74LS138	1.20
74LS139	1 90
74LS151	1.20
74LS153	1.90
74LS154	1.60
74LS157	1.00
74LS158	1 90
73LS160	2.20
74LS161	2.20
74LS162	2.30
74LS163	1.20
74LS164	1.30
74LS168	3.30
74LS169	3 50
74LS170	3 50
74LS173	2 10
74LS174	1.00
74LS175	1.00
74LS190	2 80
74LS191	1.20
74LS192	1.20
74LS193	1.20
74LS194	1.20
74LS195	1.20
74LS196	1.20
74LS197	1.90
74LS221	1.90
74LS253	1.85
74LS279	65
74LS365	75
74LS366	90
74LS367	75
74LS368	75
74LS386	95

CMOS

4000	40
4001	25
4002	25
4006	1 40
4007	25
4008	1.25
4010	1 25
4011	25
4012	25
4013	55
4014	1.30
4015	1.20
4016	50
4017	1.30
4018	1 40
4019	75
4020	1.55
4021	1.35
4022	1 60
4023	25
4024	90
4025	40
4026	2 10
4027	80
4028	1.25
4029	1 85
4030	40
4040	1.30
4041	1 25
4042	1 25
4043	1 59
4044	1.50
4046	1.80
4049	60
4050	60
4051	1.20
4052	1 20
4053	1.20
4060	2 60
4066	1 00
4068	40
4069	35
4070	40
4071	40
4072	40
4073	40
4074	40
4076	1 85
4077	40
4078	40
4081	40
4082	40
4510	1 40
4511	1 40
4518	1 50
4519	95
4520	1 45
4528	1.20
14553	7.30
14584	1.25
74C00	40
74C02	40
74C04	40
74C08	40
74C10	40
74C14	1 75
74C48	2 40
74C73	1 20
74C75	1.20
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ROD IRVING ELECTRONICS

A training system from Signetics: Instructor 50

Described by Signetics as a "desktop computer", the Instructor 50 has been designed primarily as a training tool. It offers a number of features not found on small evaluation systems, and comes complete with both a comprehensive set of training manuals and a tape cassette loaded with eight demonstration programs.

by JAMIESON ROWE

Since 1976 when microprocessors really began to " take off", many small microcomputer systems using them have appeared on the market. Some of these have been intended for the hobbyist, while others have been "evaluation" kits or systems intended to help engineers become familiar with the particular microprocessor concerned.

But very few systems have been designed specifically for training and educational purposes. This is a pity, because the concepts involved in microcomputer operation are relatively unfamiliar to many of the people who are going to have to operate them, program them, design them into equipment or service equipment which will use them.

Until now, those wanting to become familiar with microcomputer concepts have generally had to get hold of a small hobby or evaluation system, and largely use it to teach themselves by experience. Most such systems have been rather poorly supported by user literature, particularly when it comes to the introduction to basic concepts.

The Signetics "Instructor 50" system is an attempt to fill this very gap. It is a small desktop unit designed specifically for training, and comes complete with a comprehensive set of training manuals. Also supplied as part of the training package is a cassette tape with eight demonstration programs, ready to feed into the system via a standard cassette recorder.

Superficially the hardware side of the Instructor 50 looks rather like many of the small evaluation systems, except that it comes as a small cabinet rather than a naked PC board. It has a hexadecimal data input keyboard and an eight digit 7-segment LED display, with a separate 12-key pad for feeding in commands to the monitor program.

Like some of the evaluation systems it has an inbuilt cassette tape interface, which will operate with any normal audio cassette recorder. However unlike the majority of evaluation systems it also has full buffering and decoding for system expansion using the S-100 bus convention — a feature which will no doubt make it of interest to hobbyists and small business users.

Neatly housed in a small desk-top case, the Instructor 50 system comes complete with three comprehensive training manuals.

As you might expect, the Instructor 50 is based on the Signetics 2650 microprocessor. Along with the 2650 it has 512 bytes of RAM for user programs and a 2656 SMI (system memory interface) device which contains a 2K byte monitor program in ROM, together with 128 bytes of RAM for the monitor scratchpad.

The monitor program built into the SMI is rather more powerful than is usually found in evaluation systems. Besides the usual facilities for entering program instructions and data, examining memory and processor registers, and running programs, it offers a number of features which make the Instructor 50 easier and more straightforward to use.

For example there is a "fast patch" data entry mode, which allows instruction and data bytes to be loaded into memory rather faster and more conveniently than the normal "display and alter" mode. There is also a single-step run mode, in which you can step through programs instruction by instruction, and a breakpoint facility which enables you to exit from a program at any desired point with the processor's status preserved so that you can analyse what had happened to that point.

The monitor commands concerned with the cassette interface are also more powerful than is usual. The "write cassette" command used to dump a program or data block to tape allows the block to be given a file identification number (from 00 to FF hex), while the "read cassette" command may be used to seek and load either a specified file, or the first file encountered. There is also an "adjust cassette" command, in which the Instructor 50 can be used to indicate the optimum playback level for the cassette tape machine.

In short, then, the Instructor 50 hardware seems to have been designed with particular emphasis on flexibility and convenience of use — making it

especially suitable for use as a training tool.

Of course what tends to make it of even more interest as a training system is the accompanying literature. This comprises three separate manuals, all about 215 x 275mm, and with a total of about 600 pages between them.

By far the thickest of the three manuals is the Users' Guide, which is a comprehensive guide to the system's hardware, software and operation. This manual gives an introduction to microcomputer basics, a description of system operation, an explanation of the control functions and monitor commands, full details of the 2650 instruction set, and a useful glossary of microcomputer terms. It also gives full circuit details, a full listing of the monitor program, and calling details for useful monitor sub-routines.

The second of the manuals is an introductory guide for those who need additional background in logic, binary numbers and basic computer operation. It goes into these subjects in considerable detail, yet in a straightforward and easily understood fashion.

The third book is a software applications manual. Along with a brief revision of Instructor 50 operation it gives eight demonstration programs designed to illustrate various aspects of microcomputer programming. Each program is described in depth, with an explanation of its operation and use together with a full listing.

The eight programs described in the applications manual are in fact those provided on the demonstration cassette which comes with the Instructor 50, so none of the programs has to be fed into the system by hand. The programs are titled "Electronic Billboard", "Desk Clock", "Stop Watch", "Crap Game", "Beat the Odds", "Slot Machine", "Train" and "Instructor 50 Music Theme".

After looking through the manuals and using the Instructor 50 for a while my impression is that both have been very carefully planned. They integrate together to form an attractive teaching package, which seems particularly well suited for providing people with a sound but easy to follow introduction to microcomputers.

At the quoted price of $390 plus 15% sales tax the Instructor 50 costs a little more than typical evaluation systems, but still seems quite good value for money considering its potential as a training tool. I imagine schools, colleges and industrial organisations will find it of considerable interest.

The Instructor 50 is available from Philips/Signetics stockists Cema Distributors, Soanar Electronics, Technico Electronics, Radio Parts, Fred Hoe & Sons (Brisbane), Applied Technology and Silicon Valley stores. It is also available from the Electronic Components and Materials division of Philips Industries, with offices in each state.

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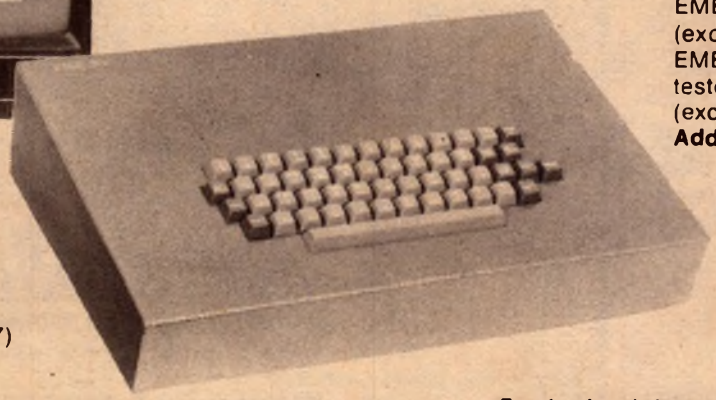

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Microcomputer News & Products

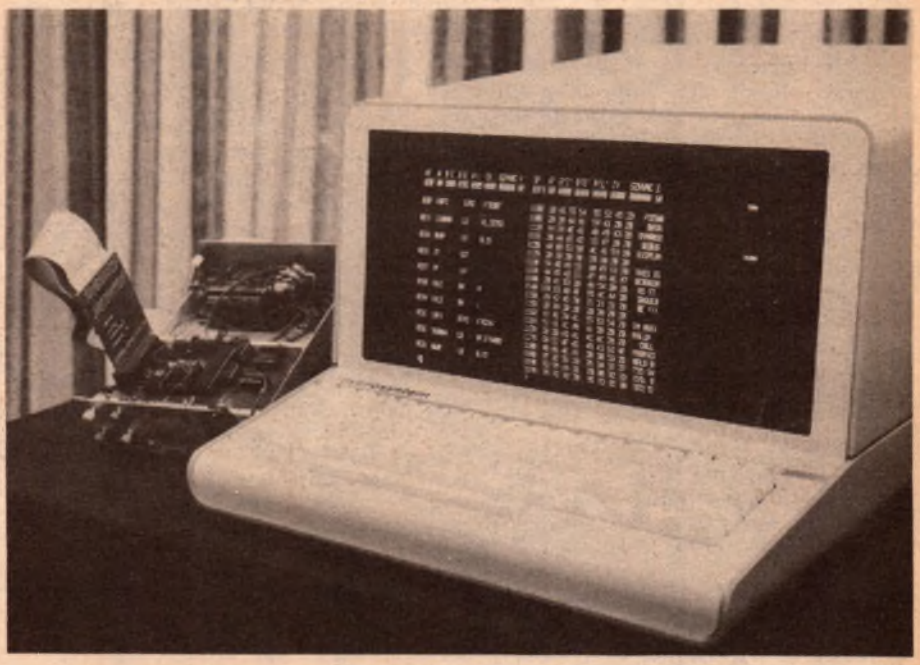
State-of-the-art development system

Probably the most powerful microprocessor development tool yet produced is now available — not from a semiconductor manufacturer or one of the big, established test equipment makers, but from a small and relatively new firm based in Los Angeles, California. The Futuredata AMDS-AFD provides virtually all of the hardware and software design and test facilities needed for development of products based on the 8080, 8085, 6800, 6802 or Z80 microprocessors.

Heart of the development system is a tabletop unit integrating a CPU and 48K bytes of RAM memory with a high-speed video display. A companion dual-floppy disc drive is used for loading software and applications programs, and saving test data.

The video display uses a DMA technique to provide the capacity to change up to 20,000 displayed characters per second. This together with powerful diagnostic software gives the AMDS-AFD the ability to perform interactive debugging and software development with a speed and efficiency not available on other types of development system currently available.

In debugging mode the display can simultaneously show ten lines of disassembled machine code, 160 bytes of independently defined memory space displayed in both hexadecimal and ASCII code, and a full display of the processor's internal registers. Any information on the display can be changed at will, using powerful editing facilities, and the results observed directly as programs are run. Single-step, breakpoint and trace facilities are all provided.



The Futuredata AMDS-AFD being used for in-circuit emulation (ICE).

The AMDS-AFD can be supplied with any of the above microprocessors in the CPU. In each case the system comes with a complete set of development software on diskette; as well as the debugging system there is a relocatable

Microcomputer News & Products

macro-assembler, object program linker, disc file manager, command file processor, and a variety of optional high-level language processors.

In addition to its software development features the system can also be used as a powerful logic analyser for hardware development and troubleshooting. In this mode it provides 48-channel triggering and analysis facilities, with a 256-state trace buffer, three hardware break registers, loop counters and delay counter. Sixteen selected signal lines may be displayed on the CRT screen simultaneously.

A further facility for both software and hardware development is a powerful in-circuit emulation (ICE) facility, whereby the AMDS-AFD can be effectively "plugged into" a system under development, in place of the microprocessor chip. It can then be used to "see inside" the system, and analyse operation.

EPROM programming facilities are provided also, with the ability to program 2704, 2708, 2758 and 2716 devices.

In short, the Futuredata AMDS-AFD development system seems to offer just about every facility one could want for fast and efficient development of both software and hardware.

Further information is available from the Australian representatives for Futuredata, Promicro Pty Ltd, cnr Croydon and Lincoln Roads, Croydon, Victoria 3136. Telephone (03) 725 5654.

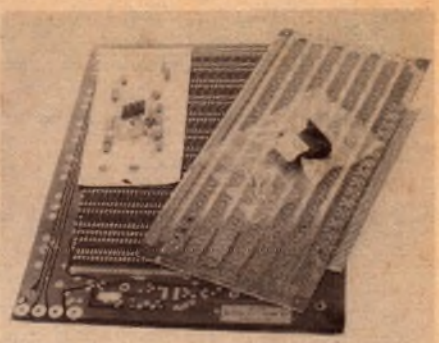
S-100 PC boards, wire wrap tool

Those building up microcomputer systems based on the S-100 interface bus should be interested to learn that a flexible range of prototyping and applications PC boards is available from Vector Electronic Co.

Of particular interest is the type 8803, an 11-slot motherboard which has provision for either passive or active busline terminations. It comes complete with mounting spacers and bypass capacitors, together with an instruction sheet giving details of termination circuits, etc. The 8803 motherboard costs $39.50, while matching 100-way edge connector sockets are available separately for $8.50 each.

Also of interest are a number of S-100 prototyping boards, which are designed to allow rapid assembly of applications cards. The cards have provision for onboard 3-terminal regulators, and come complete with regulator heatsink and mounting screws.

The 8800V board will hold up to fifty-two 14 or 16-pin DIL chips, or ten 40-pin devices, or a combination of each. The 8801 board is more general-purpose, and seems more suitable for discrete components. Both boards cost $29.50. There is also a type 8804 "any DIP" board, for $31.95, and an S-100 ex-



tender board (type 3690-12) which costs $32.50.

Also available from Vector is a new type of wire-wrapping tool, which uses a special wire coated with thin Tefzel insulation. The tool has an integral insulation slitter, which automatically makes a narrow slit in the insulation during the wrapping — obviating the need for pre-stripping. The type P184 Slit-N-Wrap tool sells for $34.50, complete with two 15m spools of Tefzel wire and full instructions.

Power operated Slit-N-Wrap tools are also available for production use.

Further information on Vector S-100 PC boards and Slit-N-Wrap tools is available from The Byte Shop, 17 Arawatta Street, Carnegie, Vic. 3163.

2650 enthusiasts

A group in Victoria is proposing to set up a 2650 Enthusiasts' Group to provide a two-way communications link between users throughout Australia. Main object of the group would be to exchange software and hardware designs on a non-commercial co-operative basis.

Those interested in the proposal are invited to contact the group by writing to Bruce Riley, 15 Salisbury Street, Wangaratta, Victoria 3677, enclosing a stamped self-addressed envelope for reply.

131,072-bit ROM!

In a few months' time, Signetics Corporation is apparently planning to release the largest N-channel MOSROM yet produced, with a capacity of 131,072 bits. Coming in a 28-pin package, the new device is organised as 16,384 bytes — making it particularly suitable for storage of microcomputer firmware. Access time for the initial devices will be 450ns.

Currently Signetics is recognised as the largest shipper of 64k ROM devices.

LEDs have memory

A new series of LED display modules from Litronix Inc provides full alphanumeric display plus latches, ASCII decoders and LED drivers in the one package. The DL1414 "intelligent" displays provide four characters of display, and may be mounted side by side for longer displays. A plastic immersion lens is part of the package, giving an apparent character height of 2.8mm (a similar device, the DL2416, has

AMPEX

Dave Marett and Ampex at EMI Studios, Sydney

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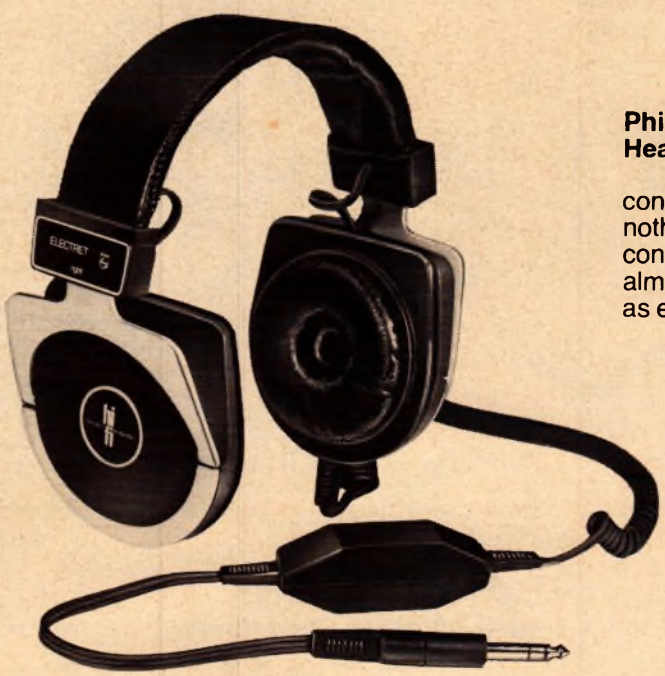

Philips N6325 Electret Headphone (Above)
The electret principle embodies all the advantages of electrostatic sound reproduction, yet manages this without cumbersome weight or expensive power supplies.
There is no reduction in performance, but there is a significant fall in cost.

Philips N6330 Electrodynamic Headphone (Below)

Although N6330 (Philips' range leader) is a conventional electrodynamic headphone, there is nothing conventional about the revolutionary design concepts that put these phones far in advance of almost any competitor in the world today. And **not** as expensive as you would expect.

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characters effectively 4mm high).

The devices are designed for connection to a microprocessor's address and data bus lines. They accept 7-bit ASCII codes directly, storing the characters in four randomly accessed internal registers. The characters stored are then decoded and displayed on the device's LED arrays.

The first of the displays off the production lines are going into the new Lexicon LK-3000 hand-held language translators (see our story in the News Highlights columns on page 7 of the March 1979 issue).

Price of the DL1416 displays in the USA for 1000-off quantities is around $13 each.

Club to hold film day

MICOM, the Microcomputer Club of Melbourne, is organising a film day on Saturday, July 21. Theme of the films to be shown will be computers; among those planned at present are "2001: A Space Odyssey", "The Forbin Project", "Demon Seed", "Logan's Run" and perhaps some documentary films like "Billion Dollar Bubble".

Enquiries to MICOM at PO Box 60, Canterbury, Victoria 3126 or to P. Fredin, 154 Kooyong Road, Caulfield 3161.

Sord president in Australia

Mr Takayoshi Shiina, president of Sord Computer Systems Inc of Japan, recently visited Australia for talks with local Sord representatives Mitsui & Co (Aust) Ltd. Mr Shiina also visited distribution firms Abacus Computer Store in Melbourne and The Small Business Computer Co in Sydney, to gain insight into local user requirements.

Only 10 years old, Sord Computer is rapidly becoming established as one of the fastest growing Japanese manufacturers of small business and home computers. Sales last year were $280,000, nearly twice that of the previous year, and projected sales for 1979 are approximately twice this figure again.

The latest addition to the Sord range is the model M203 Mk2, a desk top system which offeres Z80 CPU, 64K bytes of RAM, 8K byte user ROM, twin minifloppy disks, and a flickerless 30cm CRT display. A wide range of disk-based software is available, including extended BASIC, FORTRAN and COBOL.

Further information on Sord Systems is available from any of the above firms.

A-D converter chip

A new analog-to-digital converter chip from Intersil is specifically designed to interface to microprocessors. The ICL 7109 offers 12-bit resolution and high performance, at a price claimed to be half that of equivalent products.

Features of the ICL 7109 include dual-slope integration, true differential input, low noise, and byte-organised TTL compatible outputs. It also features an optional handshake mode for use with UART devices for remote data logging applications. The device uses low power CMOS, and has all inputs protected against static charge. It operates at up to 30 conversions per second, and has an on-chip oscillator which uses either an inexpensive 3.58MHz NTSC colour TV crystal or RC timing components.

Further information on the ICL 7109 is available from the sole representatives for Intersil in Australia, R & D Electronics Pty Ltd, 23 Burwood Road, Burwood, Victoria 3125.

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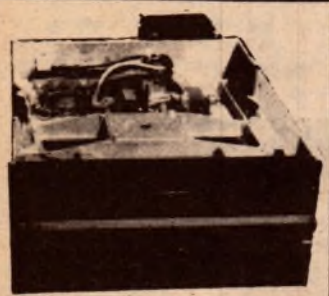

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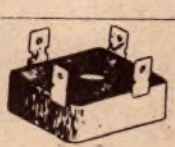

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KBPC 3502	35Amp	200V	$2.60
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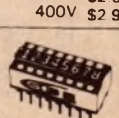

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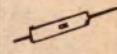

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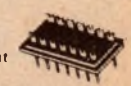

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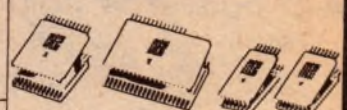

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Classical Recordings

Reviewed by Julian Russell

Beethoven: not likely to be forgotten

BEETHOVEN — Symphonies Nos. 1, 3, 4, 5 and 6. Coriolan and Egmont Overtures. Sydney Symphony Orchestra conducted by Willem van Otterloo. RCA Red Seal Stereo VRL4 0190. (Four boxed discs.)

All concerned with the production of this four disc set of five Beethoven Symphonies and some shorter works played by The Sydney Symphony Orchestra under their late, well-loved conductor, Willem van Otterloo, are worthy of great praise. The product is good enough for one to regret the more that the whole enterprise remained unfinished due to the untimely death of Otterloo as a passenger in a car accident in Melbourne, an event all the more bitterly ironic because Otterloo himself was a highly skilled and resourceful driver.

So let us regard this issue as a tribute to his work with the SSO. He found the orchestra restless after a fairly long period under the direction of the arrogant and, in my opinion, the vastly over-praised Dean Dixon. True Dixon was occasionally responsible for a fine performance but mostly I found him mediocre.

Otterloo lost no time in settling the orchestra down until they reached the high standard they had achieved at the time of his death. And in the process he endeared himself to them in a manner few conductors had done before him.

In the present production my first preferences are for his performances of the first and fifth Symphonies, perhaps not the finest extant but highly meritorious for all that. And while handing out praise the work of the producer, Eric Clapham, must not be overlooked. He has found just the right measure of the acoustics of the Sydney Opera House Concert Hall to produce sound of notable quality and a sense of balance that seldom fails him. I choose those two symphonies mentioned above, which were engineered by Rupert Mazlin, in slight preference to the 4th Symphony engineered by Paul McGrath, though McGrath is no slouch either and was also responsible for the find sound in the Overtures.

In a production of this magnitude it is not difficult for an ungenerous listener

to find an occasional blemish. But on the whole even the most churlish critics will, if they are fair, pay tribute to the success of the whole enterprise. And I take this opportunity to remind them that the going was not always easy for orchestra and conductor who, because of their busy schedules, had frequently to leave a work unfinished at one sitting and sometimes wait months, before resuming the recording.

Otterloo's work and that of his orchestra will be admired and enjoyed as long as this set is available, nor is it likely to be forgotten by discerning musicians long after it has inevitably been deleted from the catalog.

A further word of praise for RCA's enterprise in backing the whole venture. Under the well earned distinction of their label, there should be opportunities for world-wide distribution.

☆ ☆ ☆

HOROWITZ ENCORES — Piano recital of pieces by Liszt, Debussy, Scarlatti, Rachmaninoff, Moszkowski, Chopin, Scriabin, Schumann, and Horowitz. CBS Stereo Disc SBR 235959.

As a rule, I treat these confections — Sir Thomas Beecham used to call them "lollipops" — with seemly brevity. But such is the artistry that has gone into these short pieces that I felt induced to give them more space. Many of the items are well known — and loved — though others might be new even to regular concert-goers.

The sleeve contains no information as to when they were recorded. Some of them obviously date from a fair time back, though Horowitz' latest recording of a Rachmaninoff piano concerto shows no diminution of his septuagenerian powers.

He starts this recital with one of the lesser known Liszt Rhapsodies — the 19th. It was the last of this mercurial virtuoso series, which were usually based on Hungarian and Gypsy folk songs. Here, the slow opening is more thoughtful than in those of an earlier date. Then follows the fast dance movement played with breathtaking virtuosity, for which Horowitz makes no apologies. He takes the music at the very maximum velocity, introducing many subtle changes of sonorities as he goes, yet manages to rise above mere exhibitionism.

In the next, Debussy's Serenade for the Doll, he changes his touch effectively to give dream-like simplicity to this charming little piece. Domenico Scarlatti's Sonata in A rushes past at a pace that would have made the old master's hair rise under his wig. To me, this makes the piece, originally composed for harpsichord, sound rather too pianistic. The speed robs it of some of its character, for to reach such a pace on a harpsichord would be impossible.

The next item, Rachmaninoff's G Sharp Minor Prelude is refreshingly unhackneyed, unusual in form and content to those who expect to hear something like the vastly popular Prelude in C Sharp Minor. I found it interesting but never engrossing, though Horowitz' playing of it made it sound worthwhile. Moszkowski's Study in A Flat concludes the first side, another prestissimo example smudged a trifle here and there by the pedal.

On Side 2, I was ever so slightly disappointed with Chopin's A Flat Polonaise. I thought Horowitz' treatment a trifle too pretty and wholly self-indulgent. He also seems to have some difficulty in restraining his tendency to speed. To me his performance just lacks the proud patriotism usually associated with these Polonaises.

Scriabin's C Sharp Minor Study is not typical of this composer in his maturity. An early work, it might easily be mistaken for a Chopin piece. It is difficult to imagine Scriabin's later development while listening to this trifle.

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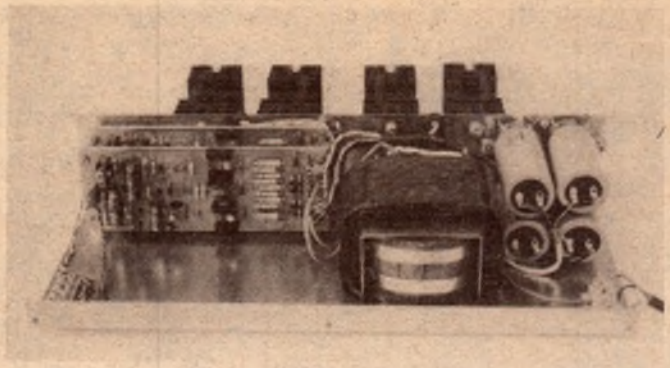

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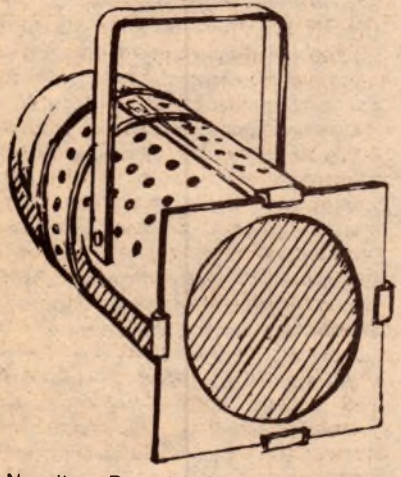

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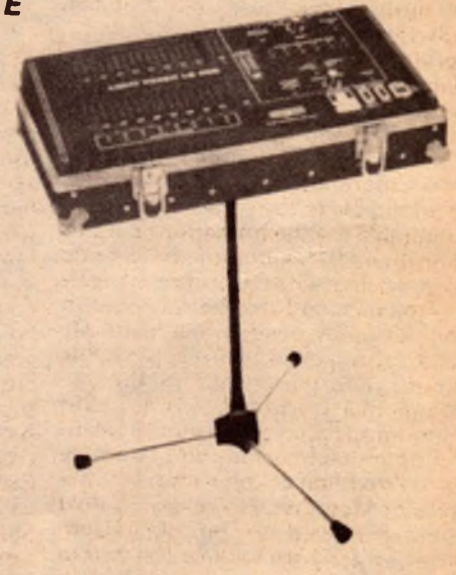

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But Horowitz, with supreme artistry, does not treat it as a Chopin work. This is made manifest in the Chopin C Sharp Minor Waltz which follows. There is a subtle difference in the treatment which is in true Chopin style. Schumann's Traumerei, as one would have expected from Horowitz, is made truly reflective with the style deliberately simplified to avoid sentimentality.

The recital ends with Horowitz' own Variations on a Theme from Bizet's Carmen. It starts with the Bohemian Dance which opens Act 2 of the opera. However, its harmonies are changed — always tastefully if surprisingly — and later this is combined polyphonically with another of the opera's themes, all brought off with terrific panache. Yet with all Horowitz' tamperings it still, in some curious way, preserves the spirit of the original.

I strongly recommend this disc to those looking for escapist fare, though I do wish that CBS had been strong-minded enough to cut out the football bellowing of the applauding crowd — it was obviously recorded live — at the end of both sides. These outbursts, however, are mercifully brief.

☆ ☆ ☆

MOZART — Piano Sonatas in F Major (K.280), B Flat Major (K281), D Major (K.311) and C Major (K.330). Krystian Zimmerman (piano). DGG Stereo 2531 052.

After the wizardry of a man in his 70s, it comes as a shock to hear four early Mozart Piano Sonatas played by the very young Krystian Zimmerman, the youngest (17) ever to win the Chopin Prize in Warsaw (in 1975). The shock comes about not only because of the spare purity of the music following the exhuberance of much of Horowitz' program, but also because of the oddness of Zimmerman's choice of these works. One might well have expected his first recorded recital to contain some Chopin, and not a composer so very different as Mozart. He suits his style admirably to the earlier composer, so admirably that he perhaps wanted to demonstrate his skill with the rococo school, having earned his laurels with the romantic. And this he succeeds in doing elegantly, everything carefully spaced, and paced, and importantly without use of the pedal.

Zimmerman is said to be interested in modern music also, and it would be interesting to hear him in the percussive style of Prokofieff or the hammered examples of Messaien. However, his next recording is said to be of Chopin Waltzes, which I am looking forward to with interest.

In the meantime this Mozart disc is not to be ignored, for despite its comparative fresh innocence it also reveals talents that should take him far. The engineering is superb.

Strauss — "my favourite reading"

STRAUSS (RICHARD) — Ein Heldenleben. Tone Poem played by the Cleveland Orchestra conducted by Lorin Maazel. CBS Stereo Disc SBR 235955.

Ein Heldenleben means "A Hero's Life" and the fact that the hero is Strauss himself should surprise no one who has learned anything about his character, at once innocent and complex, refined and vulgar, often elegant in his work and borish in company. As an example of the extent of his vanity, Peter Eliot Stone, in his excellent sleeve notes, quotes him as writing: "Beethoven's 'Eroica' is so little liked by our conductors and for that reason rarely performed . . . that to fulfill a pressing need I am engaged in writing a rather large tone poem entitled 'Heldenleben', admittedly without a funeral march, but still in E Flat with lots of horns which are always a yardstick of heroism."

Despite his undoubted genius, Strauss was no hero. He was a typical bourgeois, comfortably married early in life to the daughter of a rich brewer. He was, as Mr Stone points out, no Siegfried. And few would accept his own valuation of his Heldenleben against Beethoven's Eroica. Yet it is rich in ideas, often noisy and inflated, but just as often exquisitely melodious, especially in the love music.

Strauss provided no written program to describe the various incidents in his work but spoke about them often enough to his friends to make identification easy. They are The Hero, The Hero's Adversaries (the critics), The Hero's Helpmate, The Hero's Battlefield, The Hero's Works of Peace — in which he quotes passages from some of his earlier works — The Hero's Escape from the World, and Fulfillment.

The work is beautifully played by the Cleveland under Maazel. The most heavily scored passages emerge with splendid clarity, the important — and enormously difficult — solo violin part superbly played by Daniel Majeske. Even the most boisterous sequences in the climaxes are controlled with the utmost discretion by Maazel. By taking the love music a little slower than usual, he conveys very subtly the love of a married couple, rather than the ecstacies of a younger union. His is my favourite reading, and there are many notable competitors. The sound is absolutely first class.

SCHUMANN — Symphonies No. 1 in B flat (Spring) and No. 4 in D Minor. Chicago Symphony Orchestra conducted by Daniel Barenboim. DGG Stereo Cassette 3300660.

Symphony No. 3 in E flat (Rhenish). Manfred Overture. Chicago Symphony Orchestra conducted by Barenboim. DGG Stereo Cassette 330 940.

Schumann has long been notorious — perhaps too severe a condemnation — for the poor qualityof his scoring for orchestra. He presents special problems for solution by his performers. The trick for bringing off a satisfactory performance is to alter the balance of the orchestra from that which Schumann must obviously have intended to be heard.

As you probably know, an orchestral composer should be able to hear in his "mind's ear" just what the music he is writing will sound like. I deliberately chose the word "should" because even the greatest of the writers for orchestra have been known to make alterations during rehearsal and on one occasion Richard Strauss at the first performance of his opera, The Woman Without a Shadow, continued to conduct with one hand and make a small alteration to the socring with the other. And I am sure that many avant garde composers — and their conductors — are not sure what everything is going to sound like until they hear it played.

To make Schumann's scoring sound "better", a sensitive conductor will change the balance of the instruments by leaning more heavily on some passages and lightening the pressure on others. The timbre of musical instruments changes according to what register is being used, a point Schumann often failed to appreciate.

It has always puzzled me that a composer who wrote such superb songs and piano music as Schumann, and who was diligent enough to deform his hands in trying, by mechanical means, to increase his "stretch", should fail to appreciate this important point. Another puzzle: his orchestral works were not written early in his career, but later when he had achieved maturity.

That Barenboim's recordings of these symphonies are so good must be due to a keeness of ear that informs him when to increase the dynamics here and there and decrease them elsewhere. In this way, he intensifies the warmth and vitality of the sound so consistently that I consider this set unique.

But the technical feat is not Barenboim's only outstanding merit in this set; there is also his deep perception of the emotional differences between not only the symphonies as a whole but also individual movements — and all this without any unwanted exaggerations. And as if all these virtues were not enough DGG have provided him with splendid engineering.

Altogether this is a set I can recommend with the greatest enthusiasm.

Lighter Side

Reviews of other recordings

LIMITED EDITIONS:

Binaural, experimental

WOOFERS, TWEETERS AND ALL THAT JAZZ. Direct cut binaural, Sonic Arts Laboratory Series No. 7. (From P.C. Stereo PO Box 272, Mt Gravatt, Qld 4122.)

The natural assumption from the title of this album is that it will provide lots of exercise for your prized loudspeaker systems. Then one discovers that the album is branded "binaural", having been made with twin miniature microphones worn on the head of an observer at the performance. That same observer mentions listening again to the album on phones, but that is the only such mention.

I listened to it on phones too, but while the sound was crystal clear, as would be expected, it suffered the normal limitation of having no intrinsic front/back definition. This, despite the reference on the jacket to "sensuous expansive circular sensations". On loudspeakers, it is much more successful, with the group performing out front, where one expects them to be.

The players involved are all jazz musicians, completely at home when improvising. Their approach to this album was to select two titles for each side, work from very sparse charts and bridge from one to the other without pause. The result is a record of pleasant freewheeling jazz featuring "One Way To Brazil", "Keith's Blues", "Sometimes Plums, Sometimes, Turnips" and then "Spend It First".

The recording is very clean, with good dynamic range and only a suggestion of surface prickle here and there in the quiet passages. The transients are hard and precise but don't expect a presentation especially contrived to give a workout for your woofers and tweeters. It's freewheeling jazz; nothing more, nothing less. (W.N.W.)

FOOTNOTE: The above remark about binaural listening is not directed solely to this album. We sense the source of a sound from its amplitude and time relationships at our respective ears, reinforced by visual clues, phase effects of the head and pinna and involuntary head movements. With headphone listening, these reinforcing sensations are missing and the amplitude/time relationships on their own become subjectively ambiguous. A given sound may originate anywhere on a locus extending from in front to above and behind the listener.

KOTEKAN PERCUSSION AND ... Stereo, Reference Recordings Limited Edition, Classic Series RR3. (From M.R. Acoustics, PO Box 165, Annerley Qld 4103)

To fill you in first on the title, Kotekan is the name of an American ensemble formed in 1975, which aims to develop and present musical programs of an experimental, yet entertaining, character. The members of the ensemble, as introduced in the jacket notes are — or have been — members of traditional orchestras. They have developed their skills, however, into jazz, avante-guarde, balinese gamelin and improvisatory music.

The program here is as varied as their approach to it: The Perilous Night, 6th Movement (Cage) — La Flute Enchantee (Ravel) — Dreaming of Another (Kvistad) — Rainbow Ripples (Green) — Lift-Off (Peck) — Lo Hear The Gentle Lark (Bishop).

The recording itself is off a tape master on to vinyl at half-speed, with deliberately limited use of both tape and "mother". It is very clean, with wide dynamic range, but you will notice some pre-and post-echo where loud passages occurr adjacent to near-silence.

It is certainly the kind of disc that you use to show off your hifi system to an audience, provided their tastes are sufficiently catholic to respond to the unusual: a mix of avant garde, vocal and almost conventional, through to a drum performance that sounds remarakbly like a journey in a fast-moving, old-fashioned steam train. The San Francisco Chronicle described the album as "heady, explosive, weird, bizarre and brilliant"; I'll go along with that. (W.N.W.)

New Devotional Records

JESUS IS MY MUSIC. 16 Singing Men, directed by Dick Bolks. Stereo, New Dawn ZLP-3054S. (From S. John Bacon Pty Ltd, 13 Windsor Ave, Mt Waverley Vic 3149. $7.95)

A recent recording from the Singspiration organisation, this can only be described as an extremely pleasant album. With instrumental backing, the (presumably) 16-man chorus provides the basic sound but with occasional featured solo segments.

The compositions are mostly recent, with an up-tempo sound, but they are highly melodic and with the potential to please old and young alike: The Lord Makes Me Happy — His Name Is Love — He's The One — Bless That Wonderful Name — I Found It! — My Master's House — Water From The Rock — The Lord's My Shepherd — Turn Your Life Over To Jesus — Jesus Is My Music.

The balance and quality of the sound is first-rate and if you're looking for an album which can be variously featured or played as a gentle background, this is it. In case you're interested, a note on the jacket indicates that it is available as a cassette, cassette instrumental track only and as a record/book combination. Recommended. (W.N.W.)

Reviews in this section are by Neville Williams (W.N.W.), Jamieson Rowe (J.R.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), David Edwards(D.W.E.), Greg Swain (G.S.), and Danny Hooper (D.H.).

Instrumental, Vocal and Humour

FIDDLER ON THE ROOF. Featuring Robert Merrill, Molly Picon, with Stanley Black conducting the London Festival Orchestra and Chorus. Stereo, World Record Club WRC — S/5201.

"Fiddler On The Roof" is a musical, popular with most people and a favourite of many, more or less guaranteeing a ready audience for this W.R.C. release. Robert Merrill makes an excellent Tevye, ably supported by Molly Picon as his wife Golde. And the orchestra and chorus under Stanley Black provide a first rate backing.

Inevitably, the performance will be compared with the original Broadway cast recording featuring Zero Mostel, or the local production featuring Hayes Gordon. It may be argued that, in this W.R.C. release, traces of American accent occasionally break the Jewish spell, invoking touches of, say, "Carousel" but it's still good and all your favourites are there:

Tradition — If I Were A Rich Man — Sabbath Prayer — Matchmaker, Matchmaker — To Life — Tevye's Monologue — Miracle Of Miracle — Tevye's Dream — Sunrise, Sunset — Far From The Home I Love — Do You Love Me — Chava Sequence — Anatevka.

From the Decca Phase-Four catalog, the sound quality on this release is excellent, which must be a further plus. (W.N.W.)

For information on World Record Club albums, contact the club at 605 Camberwell Road, Hartwell, Victoria, 3124. Tel. 29 3636.

MADRIGALS ARE FUN. The Scholars. World Record Club stereo WRC R 04208.

While listening to this album, I could not help but think that it is aptly named. My wife has been a member of a small choral group so most of the songs are familiar to us. The Scholars are a very polished troupe and really do revel in their performance. It might even be argued that they had more fun than their prospective listeners. Recording quality is first class.

Nineteen songs are featured in all, some listed as follows: Now is the month of Maying — Those dainty daffadillies — Fine knacks for ladies — Cease sorrows now — Were I a king — Adieu sweet Amarillis. (L.D.S.)

☆ ☆ ☆

ITALIA MIA Mantovani And His Orchestra World Record Club WRC S/5709

This easy to listen to collection of Italian favourites was originally released by Decca. There are eleven tracks in all, in the usual Mantovani style with plenty of strings: Catari, Catari — Theme from Capriccio Italien — Italia Mia-Vissi D'Arte — Mattinata — Variations on Carnival of Venice — Bersaglieri March — Come Back To Sorrento — Return To Me — Nessun Dorma — Italian Fantasia Medley; Tarantalla, O Sole Mio — A Frangesa — Santa Lucia — Maria Mari — Funiculi, Funicula.

As you can see there is a mixture of of excerpts from the classics and opera as well as the more 'Pop' field. The quality is excellent throughout, making an ideal background for relaxing. (NJM)

☆ ☆ ☆

LOVE OR SOMETHING LIKE IT. Kenny Rogers. United Artists stereo L 36669.

Kenny Rogers can probably be categorised as a country and western singer, although like many singers in this idiom, the songs he sings have only a tenuous relation to country life as it might once have been lived. Kenny has a light but husky voice with an easy delivery. He is backed with an "up tempo" instrumental group all adds up to an easy-to-listen-to formula. Recording quality is about average.

The list of song titles is as follows: Love Or Something Like It — There's A Lot Of That Going Around — Buried Treasures — Something About Your Song — Momma's Waiting — We could Have Been The Closest Of Friends — I Could Be So Good For You — Sail Away — Even A Fool Would Let Go — Highway Flyer — Starting Again. (L.D.S.)

☆ ☆ ☆

SWEET DYNAMITE. Claudja Barry. Lollipop Records. RCA release VPL1 4098.

"Sweet Dynamite" is probably an appropriate name for this album. Claudja Barry, whose photo appears on the jacket, is black and beautiful!

Nine songs are included on this album in all, ranging in style from disco to "semi-soul" music. I can't say I was terribly enthusiastic, although I suspect my reaction would be quite different at a live performance! The best advice I can give is to listen first to see if the style appeals.

In order, the track titles are: Sweet Dynamite — Why Must A Girl Like Me — Dance, Dance, Dance — Live A Little

TRUMPET AND ORCHESTRA Volume 3. Maurice Andre, trumpet, with Marie-Claire Alain at the Detlef-Kleuger organ of the German Evangelical Church, Parish. Stereo, World Record Club, WRC R. 02970.

This is the third recording in the series featuring trumpet and organ music, made by Maurice Andre and Marie-Claire Alain originally for Erato, and now being re-released by World Record Club. And it continues the formula which has proved so successful, at least in the main.

The pieces played here include two very interesting little sonatas by the 17th-century Italian composer Viviani, two quite beautiful sonatas by Albinoni, and some 16th-century dances by Gervaise and an anonymous composer. These all sound delightful when arranged to exploit the tonal and expressive differences between organ and trumpet.

Less successful, to my mind, is a transcription of Bach's well-known Jesu, Joy of Man's Desiring. Here the trumpet does not quite seem to fit into the choral part easily, and the balance of the harmony seems disturbed. it was with some relief that I found the trumpet has been omitted from the other Bach piece on the disc: "War nur den lieben gott lasst walten" (BWV 647).

Still, even if you find yourself sharing my reservations about Jesu,Joy of Man's Desiring, I think that on the whole you'll find this disc most enjoyable if you're a baroque music enthusiast or organ lover. (J.R.)

. . . a most enjoyable disc

LIGHTER SIDE — Cont.

Bit — This Taste Of Love — Love For The Sake Of Love — Ride On My Fire — Do It again — Nobody Loves Me Like You Do.

The overall technical quality is good, with negligible surface noise. (G.S.)

☆ ☆ ☆

THE WORLD'S MOST BEAUTIFUL MUSIC. John Purcell & The Cathedral Strings. World Record Club. WRC R 03298.

To call a collection of pieces of music "The Most Beautiful Music In The World" may sound somewhat pretentious but, to anyone with even a slight liking for classical music, this record will at least be very enjoyable.

Recorded in St Augustine's Church, in Maida Vale, there are twelve tracks, one "Ave Maria" being given in two arrangements. The others are: Agnus Dei — Air On The G String — Silent Night — Sheep May Safely Graze — Panis Angelicus — Solemn Melody — Pastoral Symphony From "Messiah" — Abide With Me — Jesu Joy Of Man's Desiring — The Lost Chord.

The record is fairly subdued in its performance, making it an ideal background for a moment or two of revery, if you're lucky enough to find the time. (N.J.M.)

☆ ☆ ☆

HEARTBREAKER. Dolly Parton. RCA Victor. APL 12797.

Dolly Parton should be known to many listeners by reason of the exposure she has had lately. On this album her sweet voice wends its way through ten ballads, with a professionalism and a style that we have come to expect. This with the able help of Michael Omartian, Jim Gilstrap, Jeff Baxter, Jim Keltner and Larry Williams.

All of the tracks are of a very high standard: I Really Got The Feeling —

We're sorry but . . .

THE PIRATES OF PENZANCE. The D'oyly Carte Opera Company. World Record Club stereo WRC S/5464. Two-record set.

This is a really first-class performance by the D'oyly Carte Opera Company but it is unfortunately marred at times by bad recording quality. The symptoms are akin to severe cartridge mistracking. In fact, I tried several known cartridges just to be sure that the fault did not lie there. Whether or not the fault is in the master or the pressing I am not really sure. My sample discs were not above reproach as far as surface defects were concerned.

So unless you are tolerant (very) of recording defects I am afraid I cannot recommend this album. (L.D.S.)

It's Too Late To Love Me Now — We're Through Forever ('til Tomorrow) — Sure Thing — With You Gone — Baby I'm Burnin' — Nickels And Dimes — The Man — Heartbreaker — I Wanna Fall In Love.

Technically, the recording is very good, with clean highs and very little surface noise. (D.W.E.).

☆ ☆ ☆

STEP ON IT. The New Marketts. 7 Records MLF 224.

The New Marketts recorded this album in Hollywood, California. Eight tracks are instrumental and two tracks contain lyrics. The New Marketts are a quartet with a sound like a big band concentrating on disco but appealing to across-the-board easy music listeners who like to dance.

The ten tracks on this album are: Soul Coaxing — Song from M*A*S*H* (single release) — Smile Happy — African Lightning — Out of Limits — City Nights — No Matter What Shape — Pinada — Tears Behind The Mask — Balboa Blue. (D.H.)

SUNDOWN. Lonnie Donegan. Chrysalis Records Ltd. Festival Release L36783.

Are you from the south? . . . the south of the USA that is. I think you'd need to be to become enthusiastic about this latest release from Lonnie Donegan. With backing from such instruments as fiddle, accordian, mandolin and banjo, some of the songs have a "hillbilly" sound that many will find irritating.

The greatest disappointment is his treatment of one of my favourite songs: "The Battle of New Orleans".

The other track titles are: All Out & Down — Home — Streamline Train — Sundown — Mama's Got The Know How — Morning Light — Louisiana Sun — Cajun Stripper — Dreaming My Dreams.

The sound quality is generally quite okay, although winding back the treble a little does help! (G.S.)

☆ ☆ ☆

MIDNIGHT PROWL. Angelo. Fantasy Records. L 36635. Festival release.

Angelo is a 29-year-old singer/songwriter and accomplished keyboard player from Los Angeles, U.S.A.

"Midnight Prowl" is Angelo's second album release, comprising eight tracks: Midnight Prowl — I've Loved These Days — Changing Man — The Desert —

Have You Ever Seen The Rain —We're Over — As I See You Now — Miami 2017.

Three of the album's eight selections were composed by Angelo and his lyricist collaborator Anne Newton. "I've Loved These Days" and "Miami 2017" are by Billy Joel; the title track "Midnight Prowl" is by J. D. Souther; "We're Over" by Weil-Mann; and "Have You Ever Seen The Rain" by John Fogerty.

Musically, this album is predominately ballad-type with rock overtones. Angelo is very refreshing and definitely a performer to look out for in the future. (D.H.).

☆ ☆ ☆

NEW BEGINNINGS. Cockrell & Santos. A&M Records L 36673. Festival release.

Bud Cockrell recently split from Pable Cruise and is now re-united with Pattie Santos and his band. Bud Cockrell and Pattie Santos are married and perform professionally with their band: Angelo Rossi, Michael Shetton and Jim Anderson.

The album contains strong originals from Bud and Pattie plus great duets like "I Wanna Stay With You" written by Gallagher and Lyle.

The 10 tracks on the album are: I Wanna Stay With You — I Got Love — All You Can Do With Love — New Beginnings — I Tried It All — I'm In Love With You, Baby — Move On Up — Need A Little Help — Out In The Starlight — Run Coyote Run. (D.H.).

☆ ☆ ☆

BOOGIE DOWN MESS AROUND. Blackwell. Penny Farthing Records MLF 193. M7 Records release.

This album was originally released in 1976 by Penny Farthing Records Ltd. but has been re-introduced into Australia by M7 Records, in response to the disco craze.

The album is mostly disco and boogie with a touch of reggae. The 9 tracks on the album are: Boogie Down and Mess Around — Put The Funk Back — That's What It's All About — Move Your Ass Gringo — I Love To See Ya Dancin' — Sneeky — Give It All Ya Got — Let's Boogie — Belly Button.

The song titles and the album title give the impression of a good disco album but frankly, I found it disappointing. (D.H.)

AMATEUR RADIO

by Pierce Healy, VK2APQ

Maitland RTTY repeater offers many facilities

The previously separate spheres of amateur communications and amateur computers are now tending to merge, providing new avenues for experiment in both subjects. One example is the new RTTY repeater at Maitland, in NSW, and another is the new Canadian "Digital" licence.

The introduction of UHF and VHF repeaters, and their development into highly reliable devices, using complex solid state control and identification facilities, has been a very active phase of amateur work in recent years. Such VHF repeaters are now commonplace as voice communication aids between base and mobile stations.

Not so common are amateur television (ATV) and radio teletype (RTTY) repeaters. However, of the latter type, the Maitland Postel Institute Radio Club repeater has some interesting ancillary features.

This repeater is in the Hunter River district just west of Newcastle, NSW, and operates under the call sign VK2RPI. The frequencies are 146.025MHz in and 146.625MHz out. The transmitter power is 10 watts and the antenna is a groundplane at 60 metres. There are the normal control functions, time out, carrier tail, etc. The identification call sign is transmitted in MCW at five minute intervals at approximately 800Hz, so that it does not interfere with the RTTY tones.

The repeater can only be activated by an RTTY signal and is regenerative, ie, it does not retransmit the received signal but generates it own tones. Thus, even if a noisy signal is received, a noise free signal is transmitted.

The repeater is connected to a microprocessor to extend its capabilities. To operate the microprocessor all that is required is to transmit a coded teletype signal consisting of JJJ followed by another letter to indicate the function required. After a 10 second delay the repeater will transmit the function selected. For example —

JJJR — will give three lines of RYs followed by the repeater call sign.

JJJA — will give the "quick brown fox" message and some details of the repeater.

JJJT — accepts a message into the microprocessor and, on completion, will re-transmit the message as it was received. This is useful for testing the transmitter and the path between it and the repeater. The input message must end with the blank key and is limited to three lines.

JJJB — Repeats the last message put in with the JJJT instruction, as often as it is required. This is a useful function for repeating an often used phrase or message, or leaving a message for collection some time later.

JJJC — Will send back all the above details to explain the functions to the new user of the repeater.

Functions being installed include the ability for a message to be addressed to a particular call sign, and the message being transmitted only on request from that call sign.

Also the microprocessor is loaded with Tiny BASIC and the users of the repeater can run their own BASIC programs from their normal RTTY terminal, thus saving them the expense of visual display unit, ASCII keyboard and microprocessor of their own.

The microprocessor facilities and functions are being provided and programmed by Ian Fyfe, VK2ZIF. The coordinator of the repeater operations is Reg Wood, VK2RW, 17 Kennedy Street, Rutherford, NSW 2320, telephone (049) 33 5088, to whom all reports and enquiries should be directed.

NEW CLASS OF CANADIAN LICENCE

On September 15, 1978 the Canadian Department of Communications issued details of a new experimental class licence called the Amateur Digital Radio Operator's Certificate. The licence allows digital and pulse techniques on specified VHF and UHF amateur bands.

The licence allows Canadian amateurs to take up the challenge offered by these new techniques and become proficient in the organisation of radio and computing equipment for resource sharing in man-to-machine and machine-to-machine networks.

Such licences are permitted to operate only above 144MHz. Existing holders of the Canadian Amateur Radio Operators Certificate and the Advanced AROC are allowed the new licence privileges with the exception of pulse emissions. However, holders of the Advanced certificate will be authorised to use pulse emissions upon successful completion of pertinent sections of the new class licence. Holders of the new class licence will be issued with an advanced class certificate upon completion of the Morse code test at 15wpm.

WORLD TELECOMMUNICATION DAY

"Telecommunications for all" is the theme proposed for the 11th World Telecommunications Day which 154 member countries of the International Telecommunication Union, the United Nations and the Specialised Agencies, a large number of non-government organisations, and the news media are preparing to celebrate on May 17, 1979. This event marks the founding of the ITU in Paris on May 17, 1865 — 114 years ago — which makes it the oldest intergovernmental organisation of the United Nations system.

World Communications Day for 1979 is of particular importance. September of this year will see the opening of the World Administrative Radio Conference, WARC-79, the 3rd World Telecommunication exhibition TELCOM-79, and the 3rd World Telecommunication Forum. All will have some effect on the future of amateur radio for at least the remainder of this century.

Although no details have yet been received, it is anticipated that, following the pattern of previous years, a world wide amateur radio contest will take place to commemorate the day.

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 RADIO

IARU NEWS

The VI general conference, IARU Region II, was held in Panama early in September, 1978. A total of 26 countries were represented by delegates of national amateur radio societies. Region II includes North and South America Greenland, Central America and the West Indies.

Mr M. Mili, secretary general of the ITU, addressed the delegates, congratulating the IARU and offering sincere wishes for its prosperous future. The IARU was celebrating its 53rd anniversary.

On that theme Mr Mili continued — "You can now look back on more than 50 years of intense activity which, through disinterested research and sound scientific studies embracing the entire radio frequency spectrum, has made an appreciable contribution to the progress of radio communication.

"This half-century of international cooperation has forged a chain of human brotherhood between all those who, by inclination or through dedication, have devoted or are devoting the greater part of their leisure time to seeking human contact over the continents and seas, and beyond differences of language, nationality, religion and political systems.

"The millions of chance contacts which have occurred during this period have been instrumental in saving many lives, thus making the International Amateur Radio Union one of the most dynamic organisations when it comes to helping to save individual lives or lives of many in natural disasters and catastrophies."

The address also recalled that, in 1925, amateur radio was organised as a service in connection with the first regular sound program broadcasts. Also the role of amateurs in technical training and the vast program of the ITU technical aid to developing countries. "...there is no doubt that the development of amateur radio networks in the countries concerned makes a substantial contribution to the execution of this immense task and a contribution, moreover, that costs governments so little."

Referring to WARC 79, Mr Mili said: "You will readily understand that it is impossible for me to make the slightest forecast as to the way this conference will go. One thing is pretty sure, however, namely, that the problems it has to face will be highly complex. It would therefore not be amiss for me to emphasize the care you should take to present to your national administrations any wishes or requirements you have, in the most convincing manner possible.

"Nobody can tell what will come of it; ...but I am convinced that the half-century that has gone by has amply demonstrated the importance of the part played by radio amateurs and that once again you will have the sympathy of the conference on your side."

The Wagga Amateur Radio Club's 10m and 15m tent on Mt Granite for the John Moyle Memorial National Field Day. The aerial on top of the mast is a 10m quad. (See story, page 110.)

(Acknowledgement to Region II News No. 10.)

A booklet was received from the Secretary, Region III Association, David Rankin, 9V1RH/VK3QV covering a novel Electronic and Amateur Radio Training Course. This was provided by a training group from the Deutscher Amateur Radio Club in conjunction with the Radio Society of Sri Lanka at the Sri Lanka Foundation Institute, Columbo, during October 1978.

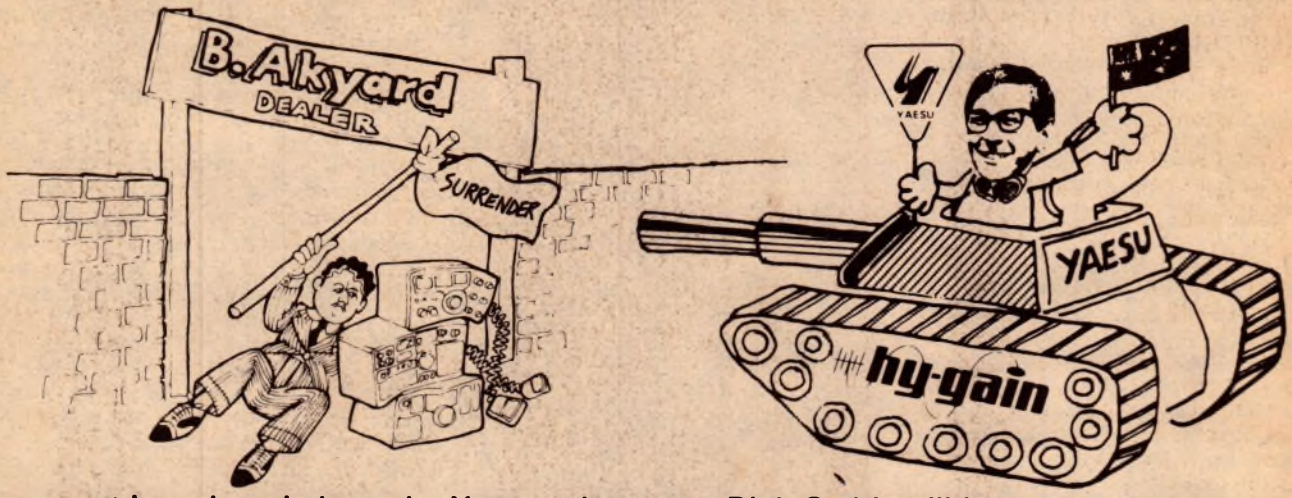
Preparations for the three weeks course in electronics and amateur radio extended over a period of two years, being the first of its kind undertaken by national amateur radio societies. The project received government assistance from the Federal Republic of Germany and the Republic of Sri Lanka, in addition to that given by amateur radio societies which included the DARC; RSSL; IARUK; RSGB; ARRL; JARL; WIA and the Sri Lanka Foundation Institute.

The inaugural meeting of the Sri Lanka Foundation Institute was addressed by the Hon. Anandatissa de Alwis, MP, Minister for State, Broadcasting, and Tourism, and Mr A. R. M. Jayawardene, Postmaster General and Director of Telecommunication. They emphasised that they would fully support the interests of amateur radio during the forthcoming WARC 79.

The training course was divided into three groups; specialists, advanced and beginners. There were 30 participants whose ages ranged between 17 and 65

THE WAR CONTINUES

THE BATTLE STILL RAGES WITH YAESU — NOW HY-GAIN ANTENNAS HAVE FALLEN TOO!



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FT-7 Mobile HF transceiver	Cat D-2866	**$375.00**	FT-227RA 2m FM scanning transc.	Cat D-2891	**$379.00**
FT-227 2m FM transc with memor	Cat D-2890	**$379.00**	CPU-2500 computerised 2m transc.	Cat D-2889	**$549.00**
FC-301 Antenna tuning unit	Cat D-2896	**$219.00**	FC-901 antenna tuning unit	Cat. D-2855	**$249.00**
FL-2100B 1.2kW linear amplifier	Cat D-2546	**$529.00**	FL-110 200W linear amplifier	Cat D-2884	**$189.00**
FRG-7 Solid State HF Rcvr	Cat D-2850	**$319.00**	FRG-7000 Digital HF rcvr	Cat D-2848	**$599.00**
FP-301 13.8V/20A supply	Cat D-2872	**$169.00**	YC-500S 500MHz Freq. Counter	Cat D-2892	**$475.00**

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For us to better any price, simply show as the advertisement from any Australian company. After checking that they have stocks available at that price we will sell for a lower price. Offer remains open while present stocks last (approx. $250,000 worth).

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18AVT VERTICAL
SAVE $14.50
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HY-GAIN VHF ANTENNAS ALSO IN STOCK. ASK OUR PRICE!

AMATEUR RADIO

years. At the conclusion of the course, certificates were presented by the Minister of Post and Telecommunication.

Call signs of the seven members of the DARC who conducted the training project were:— DL2WI; DJ3JW; DJ0VZ; DH8KL; DJ3WV; DJ7QC and DJ7GS. They were all given a 4S7 prefix (with their home stations suffix) during their stay in Sri Lanka.

52MHz DX

What has been described by six metre operators as a spectacular opening occurred during the second and third week in March, 1979. It was thought that it may have been due to the combination of Sun spot activity and the equinox.

During that period trans-Pacific contacts between eastern Australia and American west coast became almost a regular event. The US has now been worked from VK2, VK3 and VK4 call areas on six metres.

Contacts were also made on six metres from Sydney to Guam, Japan and the Aleutian Islands. The KL7 contacts were made on March 13 and lasted several hours. The most frequently worked station was W6XJ operating from Mt Palomar, California, on 52.02MHz. The openings appeared between 2200GMT and 2400GMT.

Among the Sydney stations making the contacts were VK2BA, VK2AIP and VK2ZRH.

AMATEUR LICENCES

Figures released by the P&T Department for the quarter ending December 31, 1978, showed an increase of 705 amateur licences issued in Australia, taking the total for all grades to 10,768. This was made up of 5611 full, 2833 limited, and 2224 novice.

In NSW the increases were 89 full, 73 limited and 29 novice, taking the overall total of VK2 call signs to 3633.

FIJIAN NEWS

It was announced in mid March 1979 that the Fiji Association of Radio Amateurs, FARA has been restarted with the following office bearers:—

President — R. L. Northcott, 3D2CM; joint secretaries — Upali Ranasinghe, 3D2UP, Bernard Malandain, 3D2BM; treasurer and QSL manager — Raj Singh, 3D2ER; committee members — George Williams, Bod Hodkinson, 3D2BH.

The address for the society and the QSL bureau is: FARA, PO Box 184, Suva, Fiji.

It is anticipated that the reactivation of FARA will see an increase in activity from the 3D2 call area and be a point of contact for amateurs on tours in the Fijian Islands.

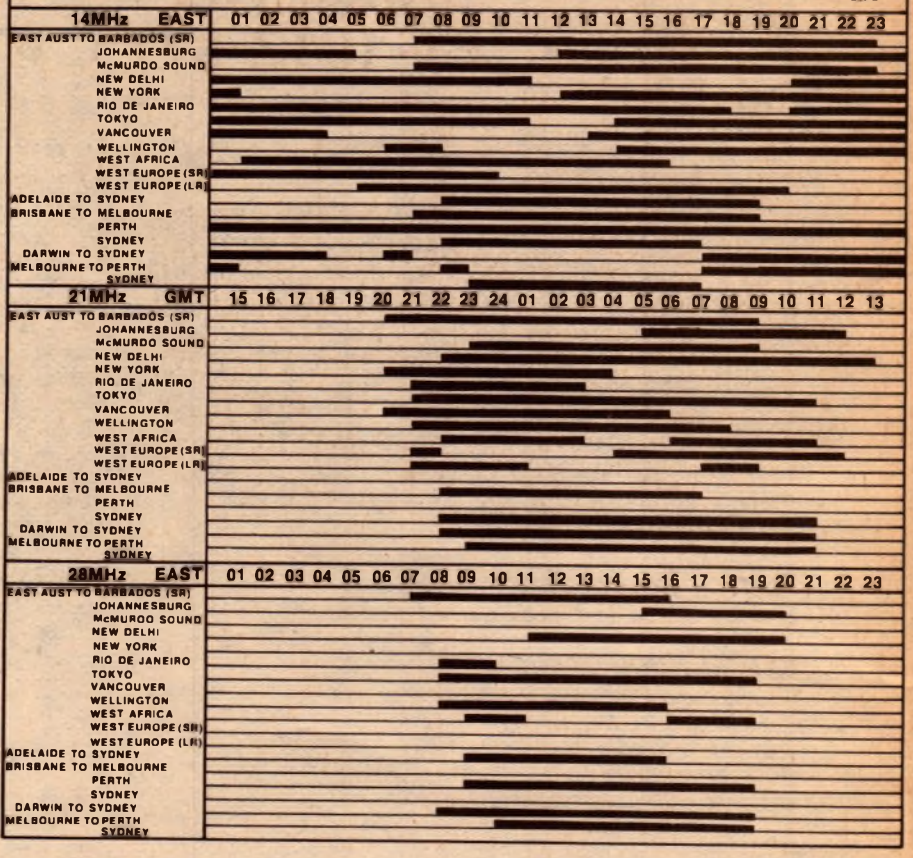
On Friday March 23, 1979, the amateur radio station at Sydney's Museum of Applied Arts and Sciences was officially opened by the Hon A. Staley, MP, Minister for Posts and Telecommunications. The station was donated to the Museum by Dick Smith Electronics and includes both HF and VHF equipment. The photo shows the Minister (left), Dick Smith, and Pierce Healy (back to camera) examining part of the installation after the ceremony. (We were not in on the joke!)

AMATEUR RADIO

IONOSPHERIC PREDICTIONS FOR MAY

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.

5.79



RADIO CLUB NEWS

RADIO AMATEURS OLD TIMERS' CLUB: The RAOTC was started in Melbourne about five years ago by Bob Cunningham, VK3ML the object being to maintain interests and good fellowship among the older members in the common cause. Membership has now grown to over 250 throughout Australia.

To be eligible for membership it is necessary to have been qualified to hold an amateur licence for at least 25 years.

There is no membership subscription. However, $2 should be forwarded with application to cover the membership certificate.

An annual dinner is held in Melbourne at which an appropriate address is given by a guest speaker.

For full details and application form write to: Harry Cliff, VK3HC, PO Box 50, Point Lonsdale, Victoria 3225.

COFFS HARBOUR & DISTRICT AMATEUR RADIO CLUB: A novice licence instruction course sponsored by the club is held every Wednesday evening at 7.00pm in the Coffs Harbour Technical College. For full details contact Norm Cameron, VK2ZNQ, 77 Manning Avenue, Coffs Harbour, NSW 2450. The district net is held on 3610kHz on Monday evenings at 8.00pm.

WAGGA AMATEUR RADIO CLUB: The most popular annual contest enjoyed by WARC members is the John Moyle Memorial National Field Day. Each year a large multi-operator station is set up on some remote hill top. The 1979 location was Mount Granite about 30km east of Tumbarumba, on the edge of the Snowy Mountains

Preparations were under way months prior to the contest date in February and, on the Friday afternoon prior to the contest, 15 members assembled with a generous stack of provisions and a wide range of HF and VHF equipment, aerials, generating sets, and tents.

A social evening under canvas was a prelude to setting up antennas and equipment on Saturday morning prior to the commencement of the contest at 3.00pm.

Radio conditions were generally good over the weekend and all bands from 1.8MHz to 144MHz were used. However, participation by a larger number of multi-operator stations would have added more zest to that section of the contest.

Details of WARC activities, including amateur licence classes, may be obtained from the Secretary, c/- PO Box 71 Kooringal, Wagga, NSW 2650.

TAREE RADIO CLUB: The meeting place is now Chatham High School, Davis Street, Taree, on Wednesday evenings at 6.30pm. Club net frequency is 28.550MHz with a WIA news broadcast on 28.470MHz at 7.30pm each Monday night.

For information on club activities contact — Secretary, Margaret Gerity, VK2NYG, 34 Wootton Crescent, Taree, NSW 2430. Telephone (065) 52 4069.

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Rcvr includes variable IF bandwidth with two 8-pole crystal filters and a highly effective all-new NB circuit with front panel blanking level control. Also included are 10 and 20 dB attenuators, and offset tuning for transmit and receive.
Trans. section uses two 6146 final tubes with RF neg. feedback. An RF speech processor is built in. Available options include DC-DC converter, cooling fan, dig. display/counter unit (for FT 101Z), hand or desk mic, and CW filter. CW filter may be used in addition to SSB filter in CW mode. Write for our full colour brochure today.

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Options, YC-7B ext. dig R.O. can be mounted on dash or steering column for convenient and safe viewing, includes adjustable sunshade, **$125.** Extra 10M range crystals **$12** each.

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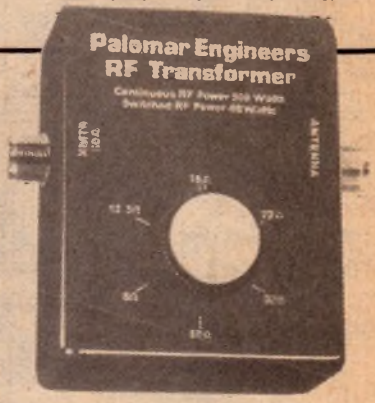

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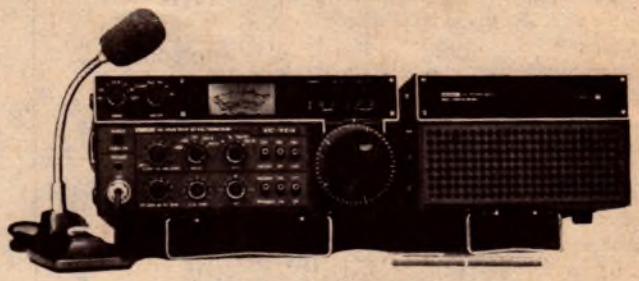

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AT320	Alt Round AC/DC Regulator	54.00
HF305	Converter 175-105 MHz to 105 MHz	28.00

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SHORTWAVE SCENE

by Arthur Cushen, MBE

BBC — most popular short-wave service

Medium-wave stations in Australia and New Zealand conduct regular surveys to determine their popularity, but international broadcasters, with a world-wide audience, find an extensive survey impossible. A recent gallup poll held in the United States gives some interesting figures though.

In the United States, with 142 million listeners and viewers and with a huge number of radio and television stations, it would be understandable if the short-wave audience was relatively small. However, the gallup poll showed a sizeable audience interested in short-wave programs.

The survey found that the BBC was the most popular short-wave service with 4.5 million, followed by Radio Canada with 4.4 million, then Radio Moscow with 2.8 million, Radio Havana Cuba 2.7 million, Deutsche Welle (The Voice of Germany) 2.4 million, and Radio Nederland 1.9 million.

The BBC, in its surveys, indicates that it has 70 million listeners world-wide every day. In many countries where local broadcasting is not very reliable or has poor coverage, short-wave stations have a very high audience rating. The United States would possibly have the lowest percentage short-wave of any country, because of the tremendous coverage by other electronic media.

LP ON SHORT-WAVE HOBBY

Over the years there have been several recordings and tapes made of station identification signals. One of the earliest was produced by the late O. Lund Johansen, the founder of the World Radio and Television Handbook.

In more recent times excellent recordings of station announcements have been produced in Denmark and North America. We recently received a copy of a new LP called "Long Live Shortwave", produced by Mitch Murray of the Isle of Man. On one side of the recording there is an introduction to many aspects of short-wave listening, including some comments from Henry Hatch of the BBC World Radio Club. On the reverse side there are interval signals and announcements from the best known 30 international broadcasters.

Geoffrey Haggett, Overseas Program Manager of Radio New Zealand, who is in charge of shortwave operations.

The recording is of excellent quality and is available on disc or cassette. Further information about "Long Live Shortwave" can be obtained by writing to Mitch Murray, Trans-Island Productions Limited, PO Box 24, Douglas, Isle of Man, British Isles.

VOA EXTENDS SERVICE

The Voice of America has extended its use of the 11-metre band, and is now operating on five frequencies. One new frequency recently introduced is 25620kHz from Dixon, and is used by the American Armed Forces Radio and Television Service from 2100-0500 GMT. The other new frequency is 25880kHz at Bethany, which carries the Voice of America program 1600-1830 GMT.

The other three frequencies have been in use for some months. They are: 25990 Delano operating 2200-0330; 26060 Greenville operating 1600-2300; and 26095kHz Dixon operating 2200-2400 GMT.

This high frequency band is also being used by several other countries. The Voice of America signals, two of which are beamed to listeners in Australia, are providing excellent reception for those readers who have short-wave receivers covering this band.

OSLO CHANGES

Radio Norway has two transmissions which give suitable listening times in Australia. These are at 0700-0830 and 1100-1230 GMT, with the last 30 minutes in English for the Sunday transmission.

The increasing use of the higher frequencies has resulted in some changes, and Oslo has reflected this in its latest schedule. The broadcast at 0700 GMT to Australia is on 9590kHz, to the Pacific on 15135, and to the Far East on 17825kHz. Broadcasts at 1100 GMT are on 17755, beamed to Indonesia, and on 21730kHz to Australia.

Radio Norway has also announced that it plans to construct the largest broadcasting station in Northern Europe. It will be built on the island group between Haugesund and Stavanger and will consist of two 600kW medium-wave transmitters and two 500kW short-wave transmitters. A further transmitting site at Sveio is to be built at the beginning of the 1980s.

KOREA ON 6240kHz

The Korean Broadcasting System has been heard testing on 6240kHz up to sign-off at 1930 GMT. The program consists of popular Korean music with announcements by a lady speaker every ten minutes. The broadcast originates from Seoul and is heard 1600-1930 GMT.

According to the BBC Monitoring Service, this is a test transmission for reception by Korean nationals in the Middle East.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill, NZ. All times are GMT. Add 8 hours for WAST, 10 hours for EAST and 12 hours for NZT.

SHORTWAVE SCENE

SPAIN ALTERS SERVICE

The Spanish Foreign Radio at Madrid has recently re-timed some of its services. Broadcasts in English to North America are at 0005 and 0105 GMT to the east coast and at 0515 GMT to the west coast, with all three transmissions being on 9630 and 11880kHz.

The transmissions for morning reception in this area at 2010 and 2110-2200 GMT are received on 9505 and 11840kHz, while 2110-2200 GMT is also carried on 7275kHz.

The English transmission on Mondays includes a DX Program for the last five minutes of the broadcast, and this has been well received at 0610 GMT on 9630kHz. The daily broadcast in Spanish from Madrid for listeners in Australia and the Philippines is carried 0730-1000 GMT on 9520 and 11730kHz.

ENGLISH FROM LISBON

Details of English transmissions from Radio Portugal, Lisbon were recently published in the "New Zealand DX Times" from information supplied by Stuart Forsyth.

Broadcasts to North America are at 0300 and 0500 GMT on 6025 and 11935kHz; India and Middle East 1400 and 1600 on 17895; Africa 1800 on 15340 and 17880; and Europe 2030 on 6025 and 9740. On Sundays there are no broadcasts to India or the Middle East, while the service to Africa is re-timed from 1800 to 1700 GMT.

THE WORLD OF RADIO

A new feature, called the "World of Radio", is to be broadcast in Sunday Best by Finnish International Radio. The new feature will take a look at various aspects of the hobby of short-wave listening. The timetable of subjects to be covered is as follows: May 6, amateurs and CB; May 20, utilities; June 3, VHF reception; June 17, UHF and satellite transmissions. Finland is at present using 21495kHz for the Sunday Best program each Sunday 0800-0930 GMT.

The new Finnish International Radio is asking listeners for their comments on the length of the daily English broadcasts. The English transmission to Australia is at present broadcast 0930-1000 GMT. Comments should be sent to Finnish Radio International, PO Box 95, 00251, Helsinki 25, Finland.

KABUL AGAIN MOVES

Radio Afghanistan has made three frequency moves in recent weeks in order to find a better channel for its service to Europe. English is broadcast 1900-1930 GMT and at present is carried on 11890 and 15140kHz. These two frequencies have both been received at fair strength, though jamming caused some trouble on 11890kHz.

The frequencies of 11985 and 11980kHz were tested before the use of 11890kHz was considered; likewise 15295 was used before 15140kHz was put into permanent service. In all, the transmissions of Afghanistan are broadcast 1730-1930 GMT. Pushtu and Dari are carried to 1830; then follows a broadcast in German to 1900 GMT, followed by English for the last 30 minutes.

ANTIGUA SERVICE EXTENDED

The BBC has extended the use of its relay base on Antigua and now includes some transmissions for reception in Australia. The frequency of 9510kHz has been operating 0600-0915 GMT to this area after tests were carried out using a new aerial system beamed to the South Pacific. The frequency of 6195kHz is in use at 0900 GMT, while a further broadcast of the World Service is observed on 11775kHz at 1100 GMT.

The relay base on Antigua is a joint venture between the BBC and Deutsche Welle, with four transmitters of 250kW being available together with 18 aerial systems. The new base is providing excellent reception in North and South America. Its extension to cover the South Pacific was made to replace the Masara relay base in the Persian Gulf, which did not provide satisfactory coverage of Australia.

AUSTRIAN NEW CHANNELS

The Austrian Radio at Vienna, in common with many other broadcasters, is moving into the 13-metre band and can be heard on four frequencies during evening listening in Australia. The frequency of 21475kHz is in use 0600-0700 GMT; 21555 0600-0900; 21590 0700-0900; and 21715 0900-1300.

The English broadcast report from Austria can be heard at 0830 GMT. The power of the transmitters is 100kW and they provide very good reception when compared to stations operating in the same band with much higher power.

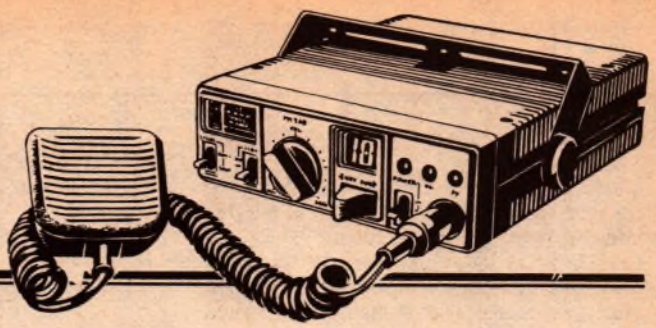
NEW SINGAPORE BASE

The BBC has completed the transfer of its base at Tebrau in Malaysia to a new site at Singapore and this is now the point from which the BBC Far Eastern Relay station operates. The new site has resulted in improved reception of the relays of the World Service, while some new frequencies have been introduced.

The Singapore transmitter is using a frequency of 11955kHz at 2200 GMT for a relay of the World Service, but suffers interference from the Voice of Turkey broadcasting in English on the same frequency. The frequency of 17880kHz carries the World Service up to 0945 GMT when it is then used for Asian language broadcasts. The frequency of 17715 replaces 17880 for the World Service for 0000-0030GMT.

Another new channel is 15270kHz, which opens at 2200 in Japanese and has been heard closing at 0330 GMT.

The Australian CB SCENE



NEW REGULATIONS ARE NOW IN FORCE

After months of delay, new regulations governing CB radio in Australia have finally been gazetted. While copies of document RB14 (January 1979) can be obtained from the Postal and Telecommunications Department, outstanding differences from the original regulations are summarised below.

In actual fact, two new documents are available. The first is the formal RB14, up-dated to January 1979: "Conditions Governing The Licensing And Operation Of The Citizens Band Radio Service". The second document is RB14A (January 1979), being guidelines set out in a less formal way.

We have gone one stop further and, by comparitive reading, extracted the most obvious differences between present-day thinking and the original licensing conditions. We would stress that our remarks are intended as a guide only. It is for the P&T Department to set, interpret and administer the regulations in detail.

THE SERVICE: Originally and officially the Department would not recognise the term "CB" and, in the original RB14, it was referred to as the Citizens Radio Service (CRS). It is now known officially as the Citizens Band Radio Service (CBRS).

27MHz CUT-OFF: Original and firmly stated policy was that CB style transmissions on the 27MHz band "must cease" on June 30, 1982. The new RB14 appears to take a softer line: "Current policy anticipates that . . ." RB14A says "on present indications . . . etc.

SSB ONLY: Serious consideration was being given earlier to restricting new licences and new equipment for the 27MHz band to SSB only, after July 1, 1979. This clause has been dropped.

NUMBER OF TRANSCEIVERS: Originally , it was necessary to have a separate licence for each CB transceiver. Now, up to 5 transceivers can be covered by the one licence. They can be installed in the one place, or distributed over a number of locations or conveyances. An applicant for a licence must state details of the equipment, where normally sited and, in the case of a boat, the address of the person directly responsible for the boat on its mooring.

STATION TYPES: The CRS was envisaged as primarily a mobile service, with base stations seen as a concession, and subject to special restrictions. In the new RB14, fixed, base, mobile or portable installations are accepted as normal. The 32km limit, which previously applied to base stations, has been deleted.

ANTENNAS: These must normally be of the vertical omni-directional type, not exceeding ⅝ wavelength in the case of 27MHz. For UHF, the gain relative to an isotropic radiator must not exceed 6.2dB. In isolated rural areas, the Department will consider applications for beam antennas not exceeding 3 elements for HF and 5 elements for UHF. Departmental limits on antenna height have been removed but installations must still conform to local government, aviation or other such requirements.

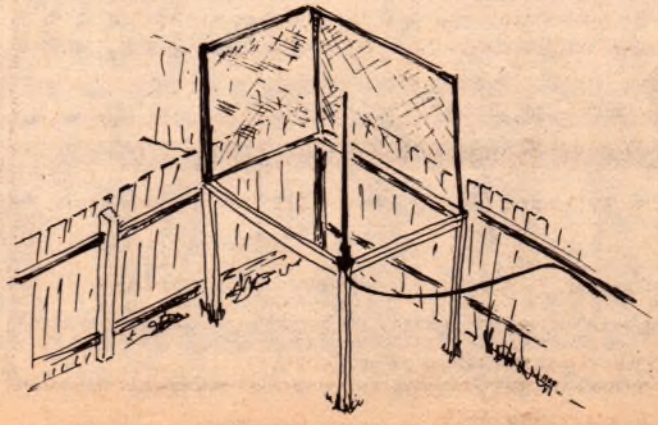
LICENCE NAME: The new CBRS licence will supersede the Mobile Station (Class C) licences currently in force. An application form RB13A will accompany renewal notices, with the intention that it should be filled out and returned to the P&T Dept, along with the appropriate remittance and the licence (or licences) which it will supersede. The new CBRS licence will carry an expiry date based on the last expiry date of the lapsing licences. This policy will continue until all existing Mobile Station (Class C) licences have been phased out.

MINORS: Their right to operate a CBRS station is retained, subject to responsibility for their actions being assumed by a parent or guardian. However, their existing licence will be renewed and replaced by a CBRS licence only if the parent or guardian requests that this should be done.

OTHER OPERATORS: CBRS equipment covered by a current licence may be operated by a person other than the licensee, provided the licensee accepts responsibity for the way in which the particular piece of equipment is used.

ADDITIONAL EQUIPMENT: The holder of a CBRS licence must advise the Department within two weeks of acquiring additional transmitting equipment. The Department may arrange a routine check of station equipment preparatory to licence renewal.

US STANDARD TRANSCEIVERS: A licence may be renewed for equipment not complying to Australian standards, provided the applicant can offer proof that the equipment had been licenced prior to February 1, 1978. The



D.S.E. CONTEST CARTOON

Corner reflector? Oh, no inspector . . . My son's building an aviary, so I stuck the antenna on one corner! (From R.D. Bray, 12 Ferguson Pl. Flynn, ACT 2615).

The Australian CB SCENE

Department may require to inspect the transceiver in question as part of the licence renewal procedure.

CALLSIGNS: The official callsign must be announced by each station during each series of transmissions and no less frequently than once every five minutes. A club or other identification may be used but in addition to — not instead of — the official station callsign.

INTERFERENCE: Between them, the two documents RB14 and RB14A manage to perpetuate a confusion on procedure that we have complained about on previous occasions. RB14 stresses that CBRS licences are issued on a non-interference basis and implies that a CBRS operator shall cease transmission immediately on becoming aware that his/her signals are causing interference with reception of sound or vision broadcasting; in short, at the behest of any neighbour alleging interference. However, RB14A calls for bilateral cooperation between the parties in attempting to solve the problem; failing a solution, a complaint would be lodged to the P&T Department, which would carry out an inspection and issue the appropriate direction. We believe that this is the way it should work and would work, but the documents aren't all that much help in resolving the matter!

CHANNEL USEAGE: Channel 5 in the HF and UHF bands is reserved specifically and only for emergencey traffic. No other channel can legally be claimed by any other operator group or for any other category of operator. All operators have equal right of access to channels other than 5.

ADD-ON UNITS: The regulations prohibit the use of "linears" to boost the output of a CBRS transceiver. So-called "power" microphones are also specifically banned as a substitute microphone for transceivers intended to operate with a normal (non-power) microphone.

TECHNICAL GLOSSARY — continued

CO-CHANNEL INTERFERENCE: The term used when reception of a wanted signal suffers interference from one or more transmissions on the same channel. It is likely to occur if an operator begins to transmit without first checking to see whether the channel is already in use. Under skip conditions, it can happen accidentally if a signal from perhaps hundreds of miles away interferes with local conversations. Apart from trying upper or lower sideband reception, there is little one can do about co-channel interference, because the wanted and unwanted signals are coming in on the same frequency.

COLLECTOR: One of the three electrodes of zones in an ordinary bipolar transistor; the other two are "base" and "emitter". They correspond respectively, in a general way, with the plate, grid and cathode of a triode valve.

CONTINUITY: An old but established term relating to the presence (or otherwise) of a continuous DC path through wiring or through a component which is supposed to provide a DC path. Continuity is most commonly checked with the aid of a multimeter set to one or other of the ohms ranges. If the resistance through a circuit or device is near zero, or no greater than anticipated, the circuit would be considered "continuous" (continuity okay).

CONVERTER: a term which can have a host of different meanings, according to the context. When discussing transmitters of receivers, the word occurs most frequently in the context of a "frequency converter". This describes a stage or circuitry which changes a frequency up or down to a new figure, which can be handled more conveniently. For example, in a normal superheterodyne receiver, the incoming signal passes through a frequency converter stage which changes it to a selected lower frequency — the so-called "intermediate" frequency.

CPS or cps: a common abbreviation for "cycles per second" — the number of complete cycles in a recurrent alternating wave which occur within one second. While "cps" will be found frequently in older literature, it has now been replaced by the term "Hertz", abbreviated to "Hz". Therefore 1000cps, equivalent to 1000 cycles per second, is expressed nowadays as 1000Hz.

CROSS MODULATION: An effect commonly encountered when a receiver is being operated in the presence of a very strong signal other than the one to which it is desired to listen. The strong signal may come from a modest transmitter close by, or from the very powerful transmitter (e.g. TV, FM, broadcast, etc) within a mile or so. Even though the powerful transmission may not be within the tuning range of the receiver, and not be audible on its own, it may ride through as a background whenever one is tuned to a normal but weaker, wanted signal. Virtually, the unwanted modulation comes through on the wanted carrier — hence the term. If a receiver is more than usually prone to cross modulation, the design may be suspect.

Electronic Components and Materials

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New Products

Atari's CX2600 video computer game system

The new Atari CX2600 "video computer system" shows just how far video games have developed from the first simple products to hit the market. By means of plug-in cartridges and interchangeable hand controllers it offers a bewildering range of challenging full-colour games — and the promise of even more to come.

To emphasise the vast difference between the CX2600 and earlier generations of video games, Atari calls it a "video computer system". And it doesn't take you long to see why. Even when you unpack it from its box you realise that it's more than "just another video game" when you find two different sets of hand controllers and a sample plug-in games cartridge.

When you connect it to a colour TV set and fire the two up, the difference becomes even more apparent. The "Combat" games cartridge supplied with the system provides no less than 27 different games, all in brilliant colour and with sound effects. There are five tank battle games, four "tank-Pong" games with "billiard" or ricochet hit, two "invisible tank" games, three invisible tank-Pong games, six "biplane" combat games, and seven "jet fighter" games!

The games aren't just minor variations on the same theme, either. The tank games give a choice of an open field, a simple maze or a complex maze, and either simple or guided missiles. Similarly the biplane and jet fighter games offer a choice of open skies or clouds, simple or guided missiles, a single plane or a group in "formation", and also a "machine gun" option in the case of the biplane games. And of course all games have on-screen scoring.

The same sort of complexity is also evident with the other game cartridges. Take for example the "Outlaw" cartridge, which provides a total of 16 games all with a "Western shoot-out" theme. Twelve of the games are for two players, and the other four for a single player. In the two-player games you can have either a cactus, a stagecoach, a series of moving stage-coaches or a brick wall between the two gunmen, and in each case you have a choice of "Blowaway" (the ability to shoot away the obstacle), "Getaway" (the ability to move the gunman immediately after firing his gun), and either single-shot or "six shooters". All games involve two-axis movement of the gunmen, control over shooting angle, changing graphics as the gunmen shoot or are hit, sound effects and on-screen scoring.

It's much the same with the "Air-Sea Battle" cartridge, which offers a further

27 "target shooting" type games. Here there are six anti-aircraft games, six torpedo ("sink the ships") games, three "shooting gallery" games, three "ship to air missile" games, three "bomb the ship" games, and six "ship-with-missile vs bomber" games. These games have graded field colouring, a wide variety of target shapes, random target movement, simple or guided missiles and moving mines or "barrage balloon" obstacles. All again feature sound effects and on-screen scoring. One of the things which we particularly noticed about the "shooting gallery" games is the way the graphics for the moving targets change in shape as they reverse direction, all independently!

What about all of the "traditional" video ball games? Well, Atari cover virtually all of these with a single cartridge, the "Video Olympics" cartridge. This has no less than 50 different games, for 1, 2 and 4 players. There are eight versions of Pong, four of Super Pong, six of Soccer, four of FoozPong, two of QuadraPong, four of Handball, four of Volleyball and eight of Basketball. The variations cover number of players, ball speed-up, hit angle control, the ability to capture a ball, and the ability to "spike" or jump up and hit the ball suddenly. There is also the option of reducing the paddle size to one-half, for greater difficulty. These games use the "paddle" type hand controllers, and again feature sound effects and on-screen scoring.

There are a total of 20 different games cartridges available at the time of writing, with a further 10 likely to be available by the time you read this. Some of the new cartridges have names like "Bowling", "Slot Machine", "Sky Diver", "Human Cannonball", "Video Chess" and "Video Backgammon", indicating the degree of sophistication available already. There is also a rumour that Atari will soon be coming

Ultra-flexible wire has 511 strands!

There are many applications in both electronics and electrical engineering whiich involve subjecting insulated conductors to continual mechanical flexing. Typical examples are electronic test leads, cables on medical electronics equipment, connections to moving parts of machinery, etc. Generally most normal insulated wires and cables have a very limited life in such applications, as the stresses involved cause accelerated metal fatigue.

Happily it is now possible to obtain high-flexibility wire especially intended for this type of application. "Datwyler" hi-flex wire is Swiss made, and comes in a variety of sizes. Basically it consists of a relatively large number of fine wire strands, each strand of very pure annealed copper. A sheath of high flexibility PVC provides insulation and protection.

In Australia four main sizes of Datwyler hi-flex wire are available, each in a variety of insulation colours. The smallest type has a nominal conductor area of .06 sq mm, made up from 30 strands of .05mm wire. Overall diameter of this wire including insulation is 0.8mm. Needless to say, this size is very suitable for microprobe test leads and similar applications.

The next size has a nominal conductor area of 0.5 sq mm, made up from 259 strands of .05mm wire. Overall outside diameter is 1.8mm in this case. This size and the smaller wire are both designated type 1607-H, and are rated for 300V use (2000V test).

The two larger wire sizes are suitable for general test leads, connections to moving parts in machinery and so on. These wires are designated type 1737-H. The smaller size has a nominal conductor area of 1 sq mm, and consists of no less than 511 strands of .05mm wire. Overall outside diameter is 2.6mm, and the insulation is rated for 300/500V operation (2000V test).

The larger size has a nominal conductor area of 1.5 sq mm, and consists of 392 strands of .07mm wire. It has an overall outside diameter of 3.3mm, and the insulation is rated for 600/1000V operation (3500V test).

Temperature range for both the type 1607-H and type 1737-H wires is from -20 to +70C.

Datwyler hi-flex wires are available in 100-metre spools from the importer and distributor, Assembled Products Pty Ltd of P.O. Box 85, Liverpool NSW 2170. Short lengths are available for hobby and similar users from Radio Despatch Service, 869 George Street, Sydney NSW 2000. Cost of the 1 sq mm 511/.05 wire in small lengths is 55 cents per metre.

Pocket-sized viewer for PCB holes

The Model ZPR Hole Inspector is a valuable quality control tool where checks on precision drilling and plating inside holes of printed circuit boards is required.

This unique pocket-size magnifier shows, in 9 images, a full 360 degree view of the inside of holes, and provides approximately x5 magnification. It automatically focusses on contact with the surface of the board and has three legs, rather that a rim base, so that it can straddle wires and solder on the board.

Vital parameters such as plating voids, smoothness and solder flow can be easily checked with the new tool, as can drilling inperfections.

Further information from C & K Electronics (Aust.) Pty Ltd, Office 2, 6 McFarlane St, Merrylands, NSW 2160.

'Wersi' organ kits

Wersi electronic organ kits have become very popular in Europe and are now available in Australia. Made in Germany, the kits are designed for easy assembly even by those with no previous experience.

A range of models is offered, some with two four-octave manuals and twelve pedals, some with two five-octave manuals and thirty pedals, and the "flagship" which has three five-octave manuals and a thirty note pedalboard. Most models are designed for a broad range of music, but one model is specifically designed for classical and liturgical music.

A full series of kits to make up any specific model usually consists of thirteen packs, which may be purchased as required or all together. It is not necessary to include all packs, providing options whereby the builder may "customise" an instrument to his own wishes and requirements.

Each model when made up with all options is a very comprehensive instrument. Electronically and mechanically, the designs are thorough and state-of-the-art. Fixed stops and drawbars are provided on alll models, together with an electronic rotating speaker system, automatic rhythm (except on the classical model) a programmable memory system for registrations, and much more.

A full colour catalog giving full details of alll models may be obtained for $2.00 from Defi Agency, 9 Florence Street, Burwood, Victoria 3125.

Atari CX2600 video computer . . .

up with a full alphanumeric keyboard option, together with cartridges which convert the CX2600 into a full-scale home computer (it is of course based on a microprocessor).

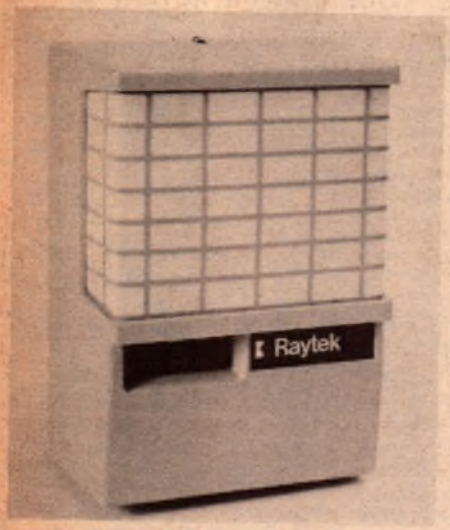
Apart from this tremendous flexibility, the CX2600 also offers the advantage of Atari's long experience in the video games field. For example unlike earlier games, it involves minimal risk to the TV set's picture-tube screen phosphors: if you don't use the controls for about 15 seconds, it automatically begins to cycle the field colours so that no one phosphor gets the game pattern "burnt in."

Of course all of these wonders don't come cheaply. The basic CX2600 system will cost you $339.00, including two "joystick" controllers, two "paddle" controllers, a mains power supply and sample "Combat" games cartridge. Additional keyboard or "car driving" controllers cost $26 a pair, while the various games cartridges cost $33.95 each. But then you're getting a lot of entertainment value for the money.

The Atari CX2600 video computer system is available from Futuretronics Australia Pty Ltd, 79-81 Levanswell Road, Moorabbin, Victoria 3189. Telephone (03) 95-5536. (J.R.)

New Products

Infra-red detector



The Raytek BiSpy series 8500 infra-red intrusion detector operates by sensing the heat energy emitted by an intruder. It is a passive device in that no radiation is emitted from the device itself. Two independent detector channels are used, with a summing circuit to protect the device from false triggering. The device is also compensated for normal room temperature variations. "Dead zones" in the sensitivity pattern allow the sensor head to be orientated so that its operation is not affected by hot air vents or other heat emitting objects. The sensing head itself is hidden behind an attractive, tamperproof cover which conceals the direction of maximum sensitivity.

The Raytek 8500 is available from Currency Handling Systems, 28-30 Langley St., Darlinghurst NSW 2010, who also have available a wide range of smoke detectors and other security equipment.

Trade shows

Elmeasco Instruments will be releasing a new range of Fluke counters and demonstrating other new instruments — including the Biomation K-100D digital logic analyser — at exhibitions to be held at the US Trade Center, Sydney, on May 21-22 and the Commodore Matthew Flinders Motel, Melbourne on May 24-25. The exhibitions will also give visitors the opportunity to check the calibration of their multimeters or other meters using a Fluke 5100 series secondary standard.

Further details from Elmeasco at 13-15 McDonald St, Mortlake NSW, phone (02) 736-2888, 21-23 Anthony Drive, Mt. Waverley Victoria, phone (03) 233-4044, or offices in other states.

LED display panels

A new dot-matrix alphanumeric display module from Hewlett-Packard features an inbuilt microprocessor controller combined with a LED display of from 16 to 40 characters. Designated the HDSP-24XX series, the modules operate from a single 5V supply and offer four separate display formatting modes. Inputs are LS-TTL, allowing easy interfacing to customer systems.

Optional upper and lower case character founts are available, also user-programmed custom character sets. Display lengths available are 16, 24, 32 or 40 characters.

Further information from Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St, Blackburn, Victoria 3130.

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Electronics Self-Taught
Ashe — 285 pages.
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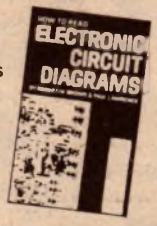

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Books & Literature

Active filters

THE DESIGN OF ACTIVE FILTERS, WITH EXPERIMENTS, by Howard M. Berlin. Published by E&L Instruments, Inc Derby, Connecticut, 1977. Soft covers, about 300pp, 150 x 230mm, many illustrations.

Another of the E&L "Bugbooks", and the second written by Howard Berlin, this book is a down-to-earth textbook/-workbook on the design of the various types of active filters. (In other words, filters based upon operational amplifiers.) It includes a considerable amount of practically orientated design data, such as graphs and tables, as well as working out illustrative examples.

For the technician or experimenter who wants to use the book for self-study there is a series of experiments with suitable questions and answers. This would also make the book suitable for class use in colleges and schools.

In short, a well written and very useful reference on active filters and their design.

The review copy came from Stewart Electronics, 33 Sunhill Road, Mt Waverley, Victoria 3149. (J.R.)

TV interference

TELEVISION INTERFERENCE MANUAL: Edited by B. Priestly. Published by the Radio Society of Great Britain. Second edition, 1979. Soft covers, 150mm x 210mm, 78 pages; illustrated with numerous circuits and drawings. Price in UK £1.35.

As might be assumed from its origin, this book is devoted entirely to the problem of radio and TV interference caused by amateur radio transmissions. It is directed to the radio amateur, although it deals both with faults in amateur equipment and those in that of the listener or viewer.

The book consists of eight chapters, and their headings give some idea of the total contents. Chapter 1 — The general approach; 2 — TV channels, systems, and TVI; 3 — Spurious radiation TVI; 4 — Strong signal TVI; 5 — Transmitter design; 6 — Other problems and solutions; 7 — Audio breakthrough; 8 — Data and reference section. There are also 12 brief appendices and an index.

The first chapter deals with what might be termed the diplomacy of TVI; how to deal with complaints without creating further ill-will and, hopefully, reduce some of the tension already created. What to say and what not to say, particularly where it becomes apparent that the fault is in the viewer's receiver.

The remaining chapters are technical, and are quite accurately described by their headings. A lot of the material has appeared elsewhere, such as in other RSGB publications, but is made more valuable by being presented in one book.

Inevitably the usefulness of the book is limited a little in Australia, particularly where problems involve specific TV channels which have no equivalents in this country.

I must also draw attention to a missing diagram belonging to the text (p44) explaining pi-tank design formulae.

But these are relatively minor criticisms. Overall the book must be regarded as a very useful one, containing much information and reference data applicable to TVI problems. The mere fact that all these data are in one volume is most valuable, since we never seem to be able to find the relevant magazine article when we want it.

For any amateur with TVI problems, or who is likely to encounter them in the future — and that means most of us — this book should be regarded as an essential addition to one's library. And, at the modest price implied by the UK figure, it is very good value for money. (PGW)

Cassette decks

CASSETTE DECKS AND TAPES. Hi-Fi Choice No. 11. By Angus McKenzie. Stiff paper covers, 192 pages, 200mm x 147mm, illustrated by photographs and curves. Published 1978 by Sportscene Publishers Ltd, London. Price in Australia $4.50.

Having been involved at various levels in reviewing equipment for this magazine, I could only take off my proverbial hat to Angus McKenzie for the effort behind this modestly presented book. Imagine checking through 50 cassette decks and from them selecting 36 for detailed testing and evaluation! Add 14 reviews as previously published and you have the equipment complement covered here.

Then, for good measure, add review

Books & Literature

and opinion on the best part of 50 varieties as currently on the British market. As a significant comment on that market, most of the names and brands are familiar here, having come from the same Japanese suppliers.

In addition to the actual reviews, there is considerable comment on technology and testing procedures, which many would find helpful.

It should also be said that Angus McKenzie is quite frank in his opinions and not slow to criticise big name products which fail to please for one reason or another.

Having in mind the modest price of this book, it appeals as an excellent buy for anyone interested in cassette decks, and especially to anyone contemplating purchase in the near future.

Our copy came from Thomas C. Lothian Pty Ltd, 4-12 Tattersall's Lane, Melbourne, Vic 3000. (W.N.W.)

555 applications

THE 555 TIMER APPLICATIONS SOURCEBOOK, WITH EXPERIMENTS, by Howard M. Berlin. Published by E&L Instruments, Inc, Dergy, Connecticut. Fourth printing, May 1978. Soft covers, 150 x 230mm, about 200pp, many circuits and diagrams.

This book is one of the "Bugbook" series published by E&L, under the joint editorship of David Larsen, Peter Rony, Jonathan Titus and Christopher Titus. And as you would expect from this, it is rather more than just another collection of handy circuits using the ubiquitous 555 timer IC. In fact it is a very thorough reference book on the device, its operation and applications, written for the person who wants to really understand what they're doing.

After an introductory chapter there are sections on monostable and astable operation, followed by chapters discussing power supply circuits, measurement and control circuits, electronic games, automotive and home equipment, telephone interfacing and hobby uses. A final chapter gives some 17 laboratory experiments with the 555, suitable for school or college classes. The book ends with a list of useful references and an index.

All in all, a most useful reference book for anyone working with the 555 or seeking to become more familiar with it.

The review copy came from Stewart Electronics, of 33 Sunhill Road, Mt Waverley, Victoria 3149. (J.R.)

INFORMATION CENTRE

TELESCOPE DRIVE: I recently purchased an astronomical telescope with a built in tracking motor for equatorial guiding. However, my first attempts at celestial photography suggest that using the mains frequency as reference just is not good enough. Your recent articles on a clock driver for the Yaesu Musen electric clock and the 12-230V Inverter suggest that a variable drive along these lines would not be too difficult. Could you, or have you ever described such a project that would supply the clock motors in a telescope drive, with 240V frequency from the 240V mains and a 12V car battery. (J.C., Macquarie, ACT.)

● We agree that the mains frequency, with its slight variations on either side of 50Hz would not be satisfactory for celestial photography. We have not described a unit specifically for this purpose but if you require a precise 50Hz supply, then the 12-230V Inverter as described in February, 1979 should be satisfactory. On the other hand, if you need sidereal time, then the 1MHz crystal would have to be changed to one on 1.00273MHz, as we calculate it.

ELECTRONICS CLUBS: As a beginner in the vast and wonderful field of electronics I would like to contact others in my peer group or in my local area who share my interest. I have heard of electronics clubs, but I cannot seem to find out where they are hiding in my area — or if they are a thing of the past. Can you help? Also how can you use an LM380 device in an 8-pin package in a PC board designed for the 14-pin device? Finally, are loudspeakers polarised? Some books say yes, while others say no. (P. Lee, 35 Jersey Road, Wentworthville, NSW 2145)

● We don't know of any specific electronics clubs in your area, but as you can see we have published your full name and address so that clubs or other hobbyists in the area can contact you directly. You might also check the list of amateur radio clubs given in the December 1978 issue (starting on page 115), as there are a number of these clubs based not far from you.

There is no easyway of using the 8-pin version of the LM380 in a PCB designed for the 14-pin version, unfortunately. This is because the 14-pin device has the active pins grouped at each end, separated by pins used for heatsinking. In any case, if the PCB is designed to use the 14-pin device it may well be taking advantage of that version's higher power dissipation capability, so that the 8-pin version may not be capable of dissipating the power involved (it has a lower rating).

Finally, it is true that loudspeakers are polarised in that the voice coil and cone will move in a specific direction when current flows in the voice coil in a particular direction. Change the direction of current flow, and the coil and cone will move in the opposite direction. This means that if multiple speakers are used they should be connected generally with the same polarity, to assist one another — unless phase shifts in crossover networks complicate the situation and require one or more voice coils to be reversed. The voice coil polarity is usually marked by a "+" or red dot near one terminal.

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PROJECT QUERIES: Members of our technical staff are NOT available to discuss individual projects, either in person at our office or by telephone.

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ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

Notes & Errata

2650 SOFTWARE RECORD (April 1978): Reader Mr. R. Rickaby has found what appears to be a bug in the Block Move routine. His suggested remedy is to change the instruction at location 1164 from a BSNR instruction (78) into a BSTR, UN instruction (3B).

2650 EXPANSION BOARD (November 1978, File No. 2/CC/32): It should perhaps be emphasised that to prevent malfunction when executing I/O instructions, either the G2 or G3 inputs (pins 4 or 5) of the 74LS138 address decoder on the CPU board should be disconnected from earth and connected instead to the "PAGE 0" output (pin 11) of the 74LS138 decoder on the expansion board.

300VA INVERTER (February 1979, File No. 3/IT/10): We have been advised that 300VA transformers designed especially for this project will shortly be available from Vesco Electronic Supplies, of 318 Huntingdale Road, Huntingdale Victoria 3166. The cost is around $45 plus tax.

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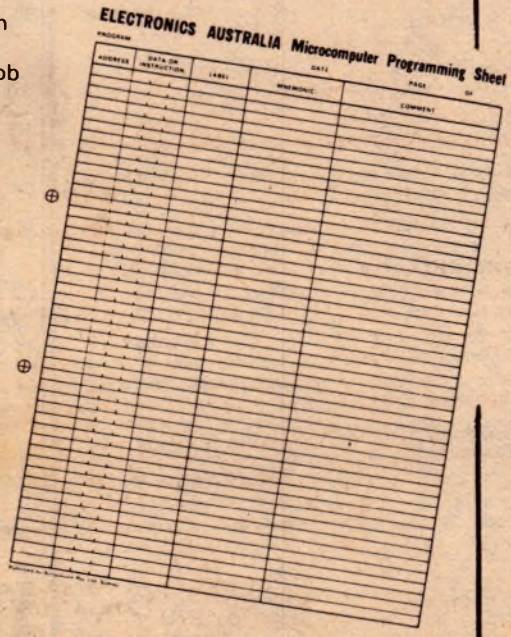

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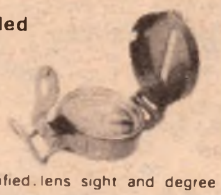

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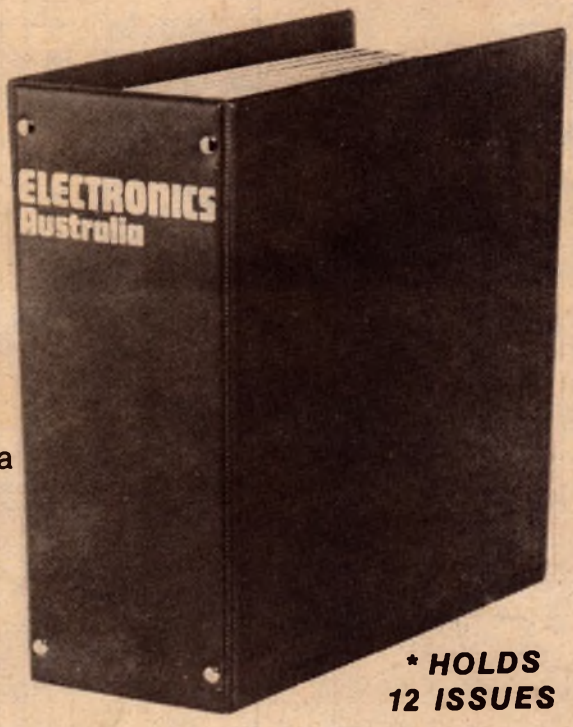

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WT93/78

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