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AUGUST 1979

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ELECTRONICS Australia

Volume 41 No. 5 August, 1979

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Radio receiver

Getting started in electronics? You'll find this simple radio receiver easy to build and low in cost. We show you how to build it p66.

On the cover

Our cover this month shows the three men responsible for the design & construction of the magnificent new pipe organ at Sydney's Opera House. The men are shown at the console of the instrument and are (from left to right): Myk Fairhurst, Mark Fisher, & Ron Sharp (designer). We tell you all about the new organ in our feature article commencing on p10. (Photo by Opera House photographer Don McMurdo.)

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Editorial Viewpoint

A few words of appreciation

As some of you will be aware already, a randomly-selected sample of our June issues carried questionnaire forms designed to find out more about our readers and areas of mutual interest. The number of readers who responded has been particularly gratifying, and on behalf of all of us at EA I would like to express our warmest thanks to the very large number who were prepared to spend the time and effort involved.

You can rest assured that your responses are being very carefully studied, not just out of academic interest but more importantly with the idea of finding out how we can make the magazine of greater interest and value to the greatest number. Your efforts will have been well spent! Thank you again.

I have also received a number of letters from readers in response to my editorial in the same issue, discussing the consumer's right to expect basic servicing information with all electronic equipment purchased. Some of these letters have raised a separate but related matter: the refusal of some firms to make service information available at all. One such letter is reprinted in this month's "Letters to the Editor" columns, on page 62.

It would seem that this sort of situation applies in a number of product areas, including sound movie cameras and projectors, and video cassette recorders. At least some of the distributors of this equipment either refuse to supply, or profess themselves unable to supply any service information, either to the consumers or to independent service organisations. This means that they are able to enforce a de facto monopoly on servicing: if you want to get the equipment serviced, you are virtually forced to take it back to the distributor's own service department.

This seems to me to be a restrictive trade practice, and one which must inevitably make it harder and more expensive to obtain service on the equipment concerned. However it appears I must be naive, because when I raised the matter with the NSW Department of Consumer Affairs and the NSW office of the Trade Practices Commission, neither seemed to regard it very seriously. All I could get from a TPC spokesman was a rather circumspect and non-committal response, to the effect that they "might perhaps be able to pursue the matter, if consumers presented them with enough evidence."

I was left with the distinct impression that I would be very unwise to hold my breath.

What do you think? If you agree with me that refusal to supply service information is a restrictive trade practice and a denial of a basic consumer right, I'd urge you to write to the Minister for Business and Consumer Affairs and tell him so, providing any evidence you can. And if you send copies of your letters to us, we'll try to publish as many as we can.

Who knows, we just might be able to stir the authorities into a little action!

— Jamieson Rowe

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News Highlights

TI to launch talking home computer!

Texas Instruments, the $3 billion US electronics group, has announced plans to move into the market for home computers.

by Max Wilkinson
Financial Times

Texas Instruments has an impressive record in bringing down the price of new high technology products to a level attractive to consumers, and at the same time calculating how technology will become marketable. The recent history of the hand-held calculator and the digital watch are two examples.

The company is launching into the personal computer market with characteristic energy at a time when most analysts are predicting a surge of demand for the new microcomputer based machines. However, the consumer market is still largely untapped.

Most of the existing competitors in the personal computer market are serving the small businessman, hobbyists, professional engineers and educational establishments.

TI appears, however, to be aiming full tilt at the consumer. Its new machine will be priced at about £645 in the UK towards the end of the year, but it is likely to be selling for considerably less than that in the larger US market. The machine, designated the TI-99/4, will have programs for home budgeting, teaching programs, US football and even physical fitness.

But above all it will be able to talk! Presumably, it will employ the same speech synthesis technology as used in the recently released "Speak & Spell" spelling aid.

Plug-in program modules will cost between £15 and £45 in the UK.

Quite what people will do with a talking computer in their home remains to be seen.

The ability of a computer to talk obviously gives it greater flexibility for tasks in the home. As a teaching aid for children, for example, the addition of speech to colour graphics on the screen could make the machine a powerful tool.

Even for the more sophisticated user the use of the spoken work can make a small computer seem more friendly and easy to use.

It is a small step to program the home computer to respond to simple voice commands from the owner and to recognise a limited vocabulary including the numerals. Programs which will accomplish this have been demonstrated by International Telephone and Telegraph on the home computer which it produces in Europe under licence from Apple of the US.

A machine which can plug into a television set, respond to an operator which is talking to it and answer back, obviously has the ability to break down the nervousness with which most people regard computers.

TI has tried to make the operation of its computer as simple as possible with its plug-in program modules. The company announcement emphasises that its target is the unsophisticated person.

Mitsubishi develops fusion welding technology

Mitsubishi Heavy Industries, Ltd has announced development of a new diffusion welding technology at its Nagoya Aircraft Manufacturing Works. Welding systems employing the new technology will be marketed towards the end of the year.

The new technique welds base materials (metallic or non-metallic) by mutual diffusion of atoms. This is achieved by aligning the two welding faces in a vacuum, heating them to a temperature below their melting points, and applying relatively low welding force.

Mitsubishi says that its technique could bring about sweeping changes in product design, and theoretically makes possible the welding of non-metallic materials such as ceramics and graphite.

Portable colour TV set from Toshiba

RELEASED IN AUSTRALIA last June, the Toshiba Model C631 is said to be the smallest colour TV receiver on the Australian market. Screen size is just 12.7cm! Main features of the set include operation from battery or mains power, "instant-on" picture, and touch tuning. A comprehensive three year warranty covers all parts and labour. Enquiries to Toshiba Australia Pty Ltd, 16 Mars Rd, Lane Cove, NSW 2066.

TINY TV FILTER — RCA technician Kenneth Alderson prepares circuitry for installation of a high precision SAW (Surface Acoustic Wave) filter, used in the company's newest line of TV transmitters. The filter (shown in the foreground) replaces components weighing more than 220kg in older model transmitters!

20 second body scan!

An accurate picture of a complete anatomical cross-section of a patient's body can be made in just 20 seconds with the new EMI 7020 Scanner. One of a new generation of diagnostic systems known as the 7000 Series, it uses the principle of computer tomography or CT scanning — a combination of X-ray technology and computers — to examine areas of the body not normally picked up by conventional X-ray equipment.

For examination the patient relaxes on a comfortable couch as a gantry rotates an X-ray tube and highly-sensitive crystal detectors which take many thousands of readings of tissue density. These are transmitted to a computer which then reconstructs an accurate and highly detailed picture on a television screen for immediate examination by a doctor.

Nearly 1000 EMI scanners of different types are now used in 50 countries. Of the thirty 7000 Series already sold, perhaps the most significant orders are for 7020 and 7070 scanners placed by China.

One-board TV chassis fits four receivers

Thorn Consumer Electronics Ltd, UK, has come out with a single-board chassis that it is billing as the ultimate in colour TV standardisation.

Called the TX9, the new board carries all the set's electronics — just 410 components, versus 618 previously — and will drive thorn's new range of 33, 38, 43 and 48cm colour receivers without the need for any component or electrical change.

The TX9 is largely assembled by a new $20 million automated assembly line at Thorn's Gosport factory. Such is its output that Thorn has had to close one of its three UK plants, and lay off over 2000 workers!

OTC executive Intelsat chairman

For the first time in the 15 year history of the International Telecommunications Satellite Organisation, an Australian has been elected Chairman of the Board of Governors.

He is Mr Randolph Payne, Director (Marketing) of the Overseas Telecommunications Commission (Australia). His election is heralded as international recognition of Australia's continuing contributory role in international telecommunications through Intelsat.

Intelsat is the 102 member-country organisation that owns and operates the telecommunications satellites used by countries around the world for international communications and by a number of countries for domestic communications. Australia is a foundation member, and the eighth largest shareholder of Intelsat.

Colour TV output falls in Japan

Japan's output of colour TVs fell last year to 8,549,000 units, a drop of 1 million units from the 1977 total. It was the second year in a row that output had declined.

The domestic market staged a minor recovery, with a growth of between 4% and 5%, but exports fell to the US and other developed countries. In all, output declined nearly 20% from the record year of 1976 when production reached 10,530,000 units!

Courses in Cobol & microprocessor programming at University of NSW

A course entitled "Structured Programming in Cobol" will be conducted in mid-August over Radio University and Television University of the University of NSW. The course will consist of 10 radio lectures, 3 television lectures and 3 seminars, and students will have access to the University's Cyber computer to run assignment programs. The fee for the course is $29, and includes lecture notes.

A further course, entitled "Microprocessor Programming Pt 2", will be offered towards the end of August. This course is designed as a sequel to the successful "Microprocessor Programming" course offered earlier in the year. Once again, the course fee is $29.

Further information can be obtained by contacting the Division of Postgraduate Extension Studies, University of NSW. Telephone 662 2691.

OTC launches international data transmission service

OTC has launched a new international data transmission service called MIDAS (Multimode International Data Acquisition Service) which will provide Australian subscribers with access to databases and computer installations initially in the USA, and subsequently in other countries.

MIDAS will have particular application to industrial, educational, research and library organisations and it will be extended to meet the needs of corporations utilising their own internationally distributed database and computer processing facilities.

The MIDAS switch will be located in OTC's International Gateway Centre in Sydney, and will be connected by satellite and submarine cable circuits through OTC's correspondents in the USA to the Tymnet network, which in turn provides access to the many database and computing services spread throughout the USA.

Other countries are providing similar packet switching interconnections to the USA, and extension of the MIDAS service to these countries (eg, UK, Europe, Japan, Canada, and Hong Kong) is foreseen, at a later date as the service develops.

The US databases which will be available include System Development Corporation's "ORBIT" service, the Lockheed Corporation's "DIALOG" service, the New York Times' "INFOBANK", the Ohio College Library Centre and many others.

Apart from the "public" databases that will be available, many international corporations will be able to use MIDAS for their own corporate database access, and access to the many timeshare computer bureau services with their wide range of applications software will be available to the researcher, corporate planner and the community in general.

Metric conversion calculator

Toshiba has just announced the Model LC-838 metric conversion calculator as the latest addition to its range of calculators.

The LC-838 is pocket sized and is protected by Toshiba's popular "Compu-Wallet" holder. It provides 28 metric conversions (14 reversible) including inches, feet, miles, ounces, pounds, gallons and degrees fahrenheit. Square and cubic inches and feet can also be converted to metric equivalents, and vice versa.

This new Toshiba calculator also provides the usual basic mathematical functions and features a 4-key independent memory, full-floating decimal and square root key.

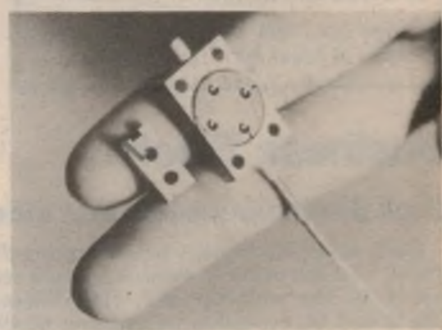
Further information from Toshiba (Aust.) Pty Ltd, 16 Mars Rd, Lane Cove, NSW 2066.

New quarterly publication from Philips

Philips has announced the introduction of a new quarterly publication entitled "Electronic Components & Applications". The new publication is effectively a combination of two previously separate publications — "Mullard Technical Communications" (England) and "Electronic Application Bulletin" (Netherlands). These two publications have now been discontinued.

"Electronic Components & Applications" is intended for equipment designers, laboratories, research organisations, educational establishments, consultants and libraries, and is jointly published by the Elcoma Components and Materials Division of N.V. Philips Gloeilampenfabrieken, Eindhoven, the Netherlands, and Mullard Ltd, London, United Kingdom. The subscription rate per volume (four issues) is $8.00. Write to Philips Electronic Components & Materials, Technical Publications Department, PO Box 50, Lane Cove, 2066.

Semiconductor laser



Hitachi, Ltd has developed a high performance InGaAsP laser diode for use in optical fibre data transmission systems. The device, designated the HLP 5000 series, is said to feature low current operation, a power output of 5mW, fast response time, and an operational wavelength of 1.3um.

According to Hitachi, the new laser makes possible data transmission over optical fibres at rates of 1 gigabit/second. The data can be transmitted up to 50km without a repeater.

Video specialist opens in Melbourne

Recently opened in Melbourne is a new specialist video shop, manned primarily by people who are technically qualified to give guidance in the choice and use of equipment. Under the name "Looky Video", the company says that they deal in just about everything that has a screen: semi-professional and domestic video recorders, mono and colour TV cameras, TV monitors, VDUs, computers and software, TV games, calculators, etc. They cater also for amateurs interested in amateur band television.

Founder of "Looky Video" is Bruce Fisher VK3YRF, a physics, science and maths teacher, who has built up several years of experience with video aids in teaching situations. His staff are mainly ex-students, whom he trained in video work and who have since qualified at a tertiary level.

Looky Video is at 418 Bridge Rd, Richmond, 3121 (next door to Tandy and with parking at rear). Phone is (03) 429 5674.

Australian designed analog computer

A new analog computer, designed and manufactured in Australia, has achieved impressive overseas sales since its introduction in 1978. So far, 79 units have been sold overseas, a figure representing 80% of the total production.

Called the EAI-1000, the new computer has many applications in the fields of education, research and science. Typical applications demonstrated at its official lauunch, held quite recently, were an environmental study of fish populations, and an installation showing the use of analog computers as an aid to medical therapy as used at the Spastic Centre of NSW.

In particular, the EAI-1000 is useful for simulation studies in the fields of electrical engineering, chemical engineering, physics, medicine, and electronics.

Enquiries on the EAI-1000 should be directed to EAI-Electronic Associates Pty Ltd, 48 Atchison St, St Leonards 2065.

RIGHT: Senator J.J. Webster, Minister for Science & the Environment, and Otis C. Wright, Jr. Managing Director of EAI, at the launch of the EAI-1000.

Fred Bail — obituary

It is with sadness that we report the death of Fred Bail, one of the principals of Bail Electronic Services, on Friday, May 25.

Fred operated Bail Electronic Services in partnership with his brother Jim, and was the first to import the Japanese-made Yaesu Musen amateur radio equipment into Australia in the early 1960s. He was a well known amateur radio operator, and during the war served as a Warrant Officer in the RAAF.

Jim Bail will keep the business going, at least for the time being.

Solar heating for Forbes Abattoir

A large-scale solar energy installation is to be built at the Forbes Abattoir in the Lachlan Valley Region of NSW. It will be the first large-scale industrial installation of integrated solar collectors in Australia. The collectors will be incorporated into the roof of a new building while it is being built, and will be covered by acrylic roofing sheets.

It is proposed that the solar collectors, which will cover an area of approximately 700 square metres, will pre-heat 120,000 litres of cold water by up to 20°C each day, thereby conserving furnace oil.

Analog display for electronic clocks

Digital electronic clocks and watches have become popular in recent years, but many people still prefer the more familiar analog display found on mechanical timepieces. Certainly, the analog display has more immediate impact on the casual observer.

Recently, Hosiden Electronics and Nippon Electric Company (NEC), Japan, announced joint development of a 60-pole analog fluorescent display tube for use in clocks, and the electronic drive circuitry to go with it. The new inventions now make it possible to combine the accuracy of a digital electronic clock with the advantages of an analog display.

The new display features some 60 electrodes, each equivalent to the length of the long hand, positioned around the display at 6-degree intervals. These form the minute markers. A further 12 electrodes are positioned at 30-degree intervals around the main electrodes, to form the hour markers, and are permanently lit.

Two oval-shaped grids positioned behind the 60-electrode array allow selection of the long and short hands of the clock. When combined with its drive circuitry, the new tube displays hours, minutes and seconds just like an ordinary analog clock.

What's more, it's possible to build the display in a range of colours from blue to yellow, by using filters. Alternatively, a multi-colour array can be constructed by changing the phosphor material coating the display anodes.

Business Briefs:

Dick Smith opens two new stores

Dick Smith Electronics has announced the opening of two new stores — one in Perth, and the other in Canberra. Both stores will carry the full range of Dick Smith products. The addresses are: 414 William St, Perth (telephone 328 6944); and 96-98 Gladstone St, Fyshwick (telephone 80 4944).

Smith Industries chairman to visit Australia

Mr E. R. Sisson, Chairman of Smiths Industries Ltd, will be visiting Australia from October 15-18, 1979. During his visit, Mr Sisson will visit the company's various centres throughout Australia. Smiths Industries is involved in automotive equipment, money handling systems, and security equipment.

Rank Xerox opens new factory

Rank Xerox (Australia) Pty Ltd has opened a new warehousing and workshop complex in the industrial suburb of Mascot, some 6½km south of Sydney. The new complex cost Rank around $5 million, employs 110 people, and has a computerised stock control system. The address is 546 Gardeners Rd, Mascot, NSW 2020.

How electronics has helped to create

Sydney's outstanding new pipe organ

In the publicity surrounding the inauguration of the new pipe organ in the Sydney Opera House, much was made of the fact that it has 10,000 pipes and is the largest mechanical-action pipe organ in the world. What didn't emerge is that builder Ron Sharp has used the latest electronic technology to provide the organist with facilities far beyond those on any existing instrument.

by JAMIESON ROWE

Surprisingly, in view of the way Australians tend to lack confidence in their fellow countrymen, the contract to build the Grand Organ for Sydney's Opera House went to an Australian. Not only that, but the man who got the job had no formal qualifications. He had learnt solely from experience — a little disturbing in an era when formal qualifications are almost worshipped, but after all no different from the famous builders of the past.

Still, it wasn't as if Ron Sharp was unknown. He had built 15 organs before being awarded the Opera House contract, and many of those organs had become widely acclaimed. There was the Chancel organ in St Mary's Cathedral and the organ in the chapel of Knox Grammar School, both in Sydney; the instrument in Wollongong Town Hall; that in Ormond College chapel, in Melbourne; and the organ in Perth's Concert Hall.

What these instruments demonstrated was Ron Sharp's belief that the organ should be a musical instrument, rather than an ego-enhancing machine or a sheer generator of loud noises. They also demonstrated his ability to translate that belief into practice. It was obvious that if given the job of building the Opera House organ, he would strive to achieve the same goal.

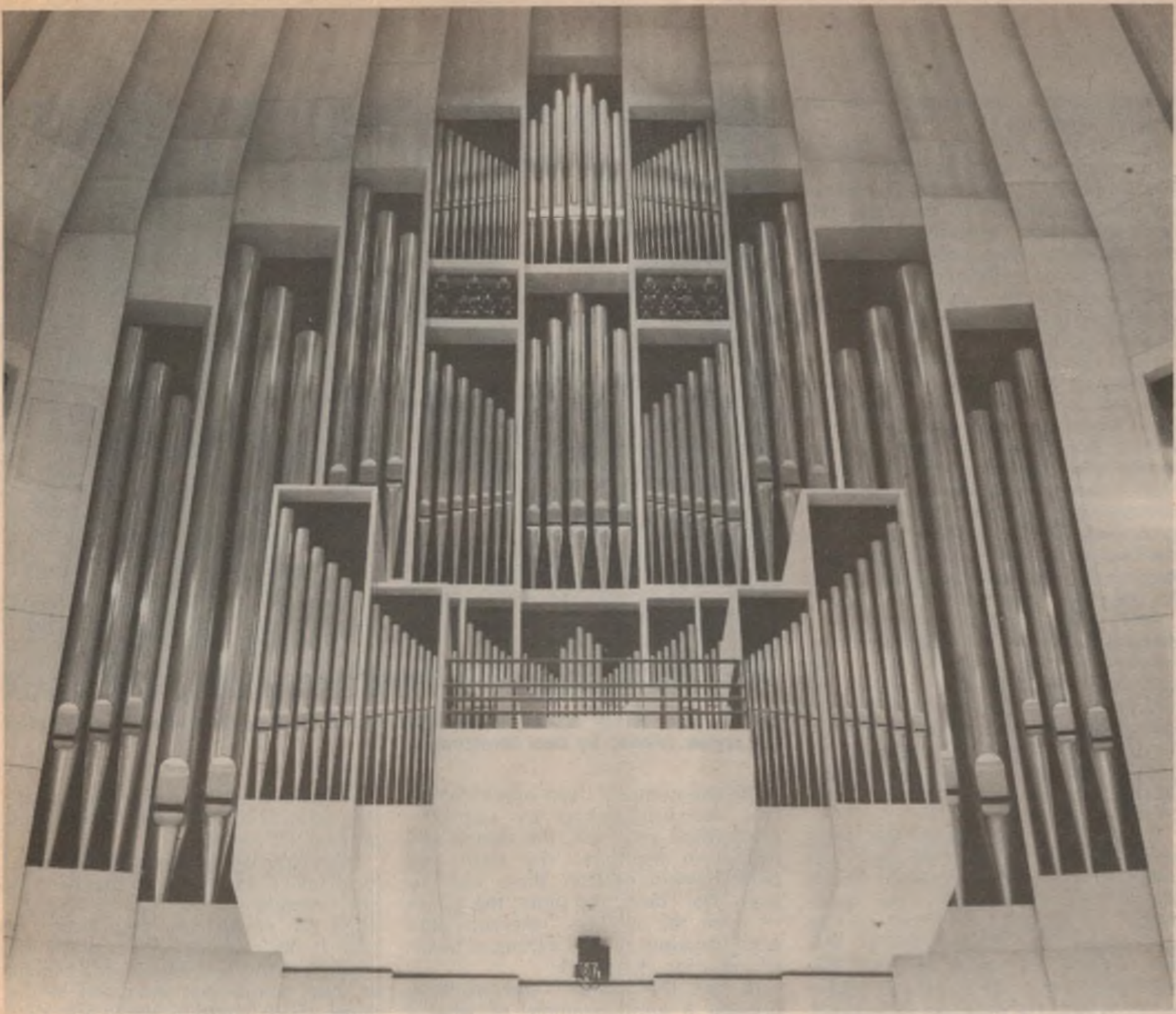
Ron Sharp, designer and builder of the Opera House organ, shown here at the console. Its facilities are far beyond those of any other instrument. (Photo by Don McMurdo.)

It has taken more than 10 years. Like painting the ceiling of the Sistine Chapel, building a fine pipe organ can't be rushed if the result is to be worthwhile. A large organ is equivalent to a whole orchestra of instruments, each of which must be able to play harmoniously with the rest. Every pipe and every part of the mechanism must be made and adjusted with meticulous care, if the overall instrument is to be musically satisfying. There can be no short cuts.

But if there were any initial misgivings about giving the contract to Ron Sharp, they should now be well and truly laid to rest. Although it is still not fully completed, and won't be for quite a few months, there is no doubt that the new Opera House organ is destined to be one of the finest instruments in the world.

Of course, the most obvious characteristic of the organ is its size. It contains approximately 10,000 pipes, grouped into 200 ranks and made available to the organist as 127 speaking stops. The stops are grouped into six divisions, each of which is associated with one of the console keyboards. There are five manual keyboards of 61 keys, and a pedalboard of 32 keys.

In the best classical tradition, the organ is mounted high up on the front wall of the Opera House main concert hall — an ideal position acoustically, and visually very impressive. The console is 10 metres above the floor of the hall, projecting 2m from the wall with the cases of the Ruckpositiv division of the organ on either side. Behind the console and rising a further 15m to the ceiling is a facade of 109 glittering show



pipes, made from almost pure tin and burnished to a mirror finish.

Mounted high up on the front of the concert hall, the organ is in an ideal position. It contains more than 10,000 pipes, in 200 ranks. (Photo courtesy Sydney Opera House Trust.)

Needless to say, the bulk of the organ is behind the facade, housed in a concrete chamber 15m high by 13m wide by 6m deep which overhangs audience seating at the rear of the stage. Although the show pipe facade is suspended from the roof of the hall, the rest of the organ together with the console is supported within the chamber by a cantilevered steel platform.

Inside the chamber, the organ proper is supported by a 14 metre high framework, made from special steel section welded together on site. The frame is divided into four levels, with a stairway, a spiral staircase and a ladder providing access to the various levels. Distributed over the framework are something like 25 soundboards or "chests" to support and control the pipes, together with air reservoirs, trunking and mechanism.

From the musical point of view, a feature of particular interest is that the organ uses direct mechanical linkage or "tracker action" to interconnect between the console keys and the pallet valves in the chests which admit wind to the pipes. This is the type of key mechanism used by the classical organ builders, before pneumatic and electric techniques were developed.

Why go back to tracker action? For one very good reason: it is the only technique which gives the player continuous "analog" control over pipe speech. Pneumatic and electric actions provide only on-off or "digital" control which is incapable of conveying the full subtlety of musical expression possible with tracker action.

The only real criticism of tracker action organs in the past has been their heaviness of touch. With a system of levers and long "tracker" rods attached to each key, the keys on some old tracker instruments have required a lot of playing force. The player had to develop strong finger muscles, and the sheer effort required tended to make it difficult to take full advantage of the potential for expression.

Ron Sharp and his craftsmen have spent a lot of effort to get around this problem. Partly by taking advantage of modern materials, but mainly by careful design and precision workmanship, they have kept the playing force down to a level virtually indistinguishable from that of instruments using pneumatic or electric action. A remarkable achievement when you consider that the trackers attached to the uppermost manual are just on nine metres long!

I can vouch personally for the lightness of touch, because I had the opportunity to try it for myself while looking over the organ a few weeks ago at the invitation of Ron Sharp and his colleagues. The visit was the happy result of a call made to them after I had heard Mr Sharp in a radio interview,

Sydney's outstanding new pipe organ . . .

talking about the organ's use of modern electronics.

As one who has been interested in pipe organs for many years, I found the visit particularly rewarding. It was not just the opportunity to look over this remarkable new instrument, but also the chance to meet and talk with the people who have designed and built it. And of course the organ does make very interesting use of electronics, as I'll explain shortly.

I just couldn't have been more fortunate, as it turned out. By sheer good luck, all four members of the team were working on the organ the day I visited. Ron Sharp was there himself, tuning and regulating with colleague Mark Fisher who has shared a lot of the construction work and is also the chief demonstrator. And working quietly at the back were Myk Fairhurst and Hans Rasmussen, who have been responsible for the electronics side of the organ.

Mark Fisher very kindly gave me a demonstration of the stops and stop families in the organ, which was fascinating. Even though some of the ranks are still not fully tuned, it was obvious that every stop is being adjusted for optimum clarity and tonal beauty — not just for solo use, but (more importantly) for harmony in every conceivable combination.

What struck me about the stops which are finished was their clean and unforced sound. They could be added to each other without any of the "muddying" so apparent on many existing instruments. Ron Sharp explains that this is partly the result of using low wind pressures — he is using pressures as low as 50mm of water on some stops. However I imagine that the real secret is meticulous voicing of each and every pipe.

Almost as fascinating as the demonstration was looking over the instrument itself. I could rave on at great length here, and probably bore you with a lot of detail. I won't, but I feel I must make two brief comments.

The first comment is that after even a short look at the interior of the organ, you can't fail to be impressed by the sheer amount of work it represents. There is just so much involved in an organ of this size, and virtually everything must be handmade. No wonder it has taken more than 10 years to build.

My second comment is really a corollary to the first. What struck me even more than the scale of the work — and in fact more so because of that scale — was the standard of workmanship evident. As anyone familiar with pipe organ construction will tell you, it's not unusual in large organs to find evidence of glossed-over details and "ad hockery". But nowhere could I find these faults in the Opera House organ.

Builder Ron Sharp shown tuning pipes in the main or "Hauptwerk" division of the organ. (Photo by Don McMurdo.)

On the contrary I can only describe the workmanship as superb. Everywhere you look, the design and execution testify to the skills and perfectionism of Ron Sharp and his team. The chests, the pipes, the action — even the blowers, reservoirs and wind trunking: they're a thing of beauty and a joy to behold.

In fact the blowers and trunking provide a good example of what I mean. Stand inside the organ when it is going, but with no music being played, and it's so quiet you can't believe it is on. There is no hiss of air escaping from the trunking, no muffled roar from distant blowers; nothing.

The incredible thing is that the nine blowers which provide the wind are all inside the main organ chamber, along with the organ! They are housed in special silencing boxes, each of which is provided with temperature sensing alarms and automatic BCF gas fire extinguishers. A remarkable achievement.

By now, you might well be wondering just how electronics fits into all this. In fact, it plays a very important role in the organ. By taking advantage of modern digital electronics and microprocessor technology, Ron Sharp and Myk Fairhurst have been able to give the instrument operating facilities far beyond those of any existing instrument. These achievements alone are enough to make the organ a milestone in organ building, quite apart from its size and musicality.

Perhaps the major role played by the electronics is in the combination piston capture action. What are combination pistons? I'll explain.

With large organs having many stops, it can take quite a while to change from one combination of stops to another, using the normal drawstop knobs or tabs. If the organist had to make the changes in this way whenever a change of tone colour was indicated in the music, there would be intolerable gaps in the music. To obviate this problem large organs are provided with "combination pistons": a series of buttons, usually between the various keyboards, which allow rapid selection of different stop combinations.

You've probably noticed how the drawstop knobs seem to pop in and out by themselves at certain times, while an organist is playing. That's the combination pistons in action.

On the first organs to be provided with combination pistons, the combination of stops provided by each piston button was either fixed by the organ builder, or had to be set up somewhere inside the organ by some sort of mechanical or pneumatic programming system. Needless to say both approaches are rather inflexible.

To remedy this, organ builders developed what is called "capture action". Here the combination of stops called by any piston may be changed at will by the organist, easily and while seated at the console. To "program" a piston, the appropriate drawstops are pulled out and others pushed in to set up the desired combination. Then a "setter" button is pressed, and while it is held down the piston button is also pressed and released.

The programmed combination will then be set up again by the organ's capture action every time that piston button is pressed, unless it is reprogrammed.

Except for very old instruments, most large pipe organs throughout the world are fitted with this type of combination piston capture action. With it, an organist can set up any desired combinations of stops, and change quickly from one combination to another while playing.

The only problem is that it can take quite a while to program all of one's combinations into the pistons, before you start. With a large instrument like the Opera House organ, which has some 69 pistons, setting up the combinations can take more than an hour. And because such an instrument tends to be in frequent use by many different people for both rehearsals and performances, each player must reset their own combinations every time they get access to the instrument.

There's no easy way of avoiding the need to set up one's combinations in the first place. But by using modern electronics, Ron Sharp and Myk Fairhurst have found a way around the need to repeat this tedious procedure every subsequent time.

The piston capture action is implemented in electronics, with a semiconductor memory used to store the combinations data. A microprocessor is also connected to the memory, along with a cassette recorder. At the touch of a button, all of the data describing current combinations may be "dumped" onto a tape cassette, which the player can slip into a bag or pocket.

Next time the player gets access to the organ, the cassette is simply slipped back into the recorder. Pressing another button then causes the complete set of saved combinations to be fed back into the capture action — in a mere 12 seconds!

This is a tremendous advance over the time and tedium involved with existing organs, as you can imagine. It means that each organist can have a cassette to "save" their combinations, and can resume playing with those combinations fully set up again less than a minute after sitting back at the console. The new Opera House organ is the first instrument in the world to offer this facility, and it represents a significant breakthrough.

But that's not all. The other main facility which Ron Sharp and Myk Fairhurst have been able to provide the organ using electronics is in some ways even more impressive.

Although the main key action is mechanical, using trackers, the organ is also provided with a complete "parallel" electric action. This was provided initially to implement the intra- and inter-manual couplers.

What are couplers? Well, they are facilities provided on organs to give increased dynamic and expressive range. Basically, they make it possible to couple up additional pipes to each key, over and above the pipes which are normally available to it.

Intra-manual couplers are those which allow the addition of pipes from the same keyboard and, in fact, from the stops already in use. The two most common intra-manual couplers are "octave" and "suboctave" couplers, which respectively add in the pipes playing an octave above or an octave below the pipes which would normally sound when a key is pressed.

In contrast, inter-manual couplers allow the coupling in of pipes from other keyboards. These too may be either coupled in unison pitch, or at octave or suboctave pitches.

Like most large organs, the Opera House organ has quite a few couplers of both kinds. There are eight intra-manual couplers, and 20 inter-manual couplers — six of which make pipes from the manuals available to the pedal keyboard.

Some of the couplers, including those linking the manuals up to the pedal keyboard, are implemented mechanically. However the intra-manual couplers and most of the inter-manual couplers could not be implemented in this way, because the key touch would have become excessive. Hence the provision of parallel electric action.

But having provided the parallel electric action in order to implement the couplers, Ron Sharp realised that it might allow them to do more than this. It might be possible to provide a facility which no other existing concert pipe organ provides: the means of letting the organist hear what his or her playing really sounds like, down in the audience, and to adjust the stop registration for the most satisfying effect.

The problem with most large organs, particularly those with tracker action, is that the console is attached to the front of the instrument and generally well below the level of most of the pipes. Most of the sound passes over the

Electronics engineer Myk Fairhurst showing the author some of the pipes in the Hauptwerk division. This division alone has more pipes than most medium-sized organs. Behind us are reed pipes; in front flue pipes. (Photo by Warren Webb.)

organist's head, and it is very difficult to judge the true tonal balance and contrast as heard by the audience.

It occurred to Ron Sharp that it might be possible to use the parallel electric action to overcome this problem. Wouldn't it be possible, he asked Myk Fairhurst, to arrange for the player's keying and stop information to be recorded on another cassette, which could then be played back to have the organ play the piece of music again? That way, organists could hear the piece as they themselves had played it, from the body of the hall — even use a remote control unit to adjust and optimise the stop registration!

It was not only possible, replied Myk, but relatively easy to implement. They already had a microprocessor in the electronics, which was also involved in scanning the keyboards for the coupler action. It would be relatively straightforward to arrange for the microprocessor to record keying and stop data on a second cassette, and then be able to "play" the organ from the cassette via the electric action.

And so the "player" facility became part of the Opera House organ design. It isn't fully completed as yet, but when it is the instrument will be the only one in the world to offer the organist this remarkable facility.

When the player section is fully operation, there will be a suitcase-style remote control unit which will plug into an outlet at the rear of the Concert Hall. From the control unit, an organist will be able to have the organ replay a piece he or she has recorded, and have full real-time control of all stops and couplers to adjust registration.

In fact the control unit will also have a single keyboard, which may be connected to any of the organ's six divisions. This will allow the organist to experiment with different phrasing, etc., while playing any desired manual from the back of the hall. How's that?

Needless to say, it would also be relatively easy to provide the organ with a second full-scale console, which could be made available on the stage floor or anywhere else inside the hall. However the Opera House authorities apparently have no plans at present to implement this.

A further possiblity created by the organ's player facility is that organists will be able to play duets with themselves, by recording one part on cassette and then playing the second part when the cassette is played back. This is possible because the tracker and electric actions are completely "parallel" — either can operate every key pallet. This opens up all sorts of possibilities for experimental music.

In addition to the combination piston capture action and the player facility, Ron Sharp and Myk Fairhurst have also been able to use electronics to provide the organ with an improved crescendo pedal facility.

Most large organs are provided with a crescendo pedal which, as the name suggests, is designed to allow the organist to increase the volume of the organ for a musical crescendo and, conversely, to decrease the volume for a musical diminuendo. Generally such a pedal works by gradually bringing more and more stops into operation in a controlled fashion, until the "full organ" sound is being produced.

The mechanism used to perform this addition and subtraction of stops in existing organs is generally quite clumsy and unreliable. In addition the changes in volume are often uneven and coarse, rather than smooth and subtle.

With all of the stops in the Opera House organ already under the control of the electronics, it was logical to implement the crescendo pedal function electronically. In fact, it is looked after by the microprocessor, under the control of a stored program.

Myk Fairhurst at the electronics cabinet, which contains close to 8000 ICs on 100 PC boards. (Photo by Warren Webb.)

Apart from giving a vast improvement in reliability, this has allowed Ron and Myk to provide a much smoother and more carefully controlled crescendo action. There are no less than 171 "levels" in the crescendo pedal range, and the fact that the stops added or subtracted at each level are under the control of a stored program has allowed the levels to be very carefully graduated.

There are a number of other benefits as well. It has been possible to make the crescendo pedal action independant from the drawstop and piston capture action, so that the stops it adds in are additional to those already in use. When the pedal is disabled, the organ returns to the original stops.

Three sets of thumbswitches allow the starting level, upper limit and lower limit of the crescendo range to be preset, giving the organist full control over the pedal dynamics. And if that were not enough, there are two different rates available for both crescendo and diminuendo — controlled simply by the pressure applied to the pedal itself.

All of the electronics to provide these facilities is housed in a single 283mm wide instrument rack, near the rear of the organ. The logic devices are all CMOS, operating from 8V DC rails derived from the 17V/400 amp power supply system of the electric action. Opto-couplers and Darlington power transistors are used to interface between the CMOS logic and the pallet and stop action magnets.

Myk Fairhurst tells me that there are close to one hundred plug-in boards in the electronics, each of which is wire-wrapped because of the large number of interconnections between the ICs. Many of the boards have close to 100 ICs — so that the total IC count for the lot would be close to 8000.

In other words, although the organ is nominally a mechanical action pipe organ, it has far more electronics than the vast majority of electronic organs!

But of course that's not the point. The electronics is basically there to provide the organist with the facilities to get the most from the pipes themselves. And there's no doubt that it does this to a degree never before achieved in any pipe organ, let alone one of this scale.

All in all, it seems to me that the new Opera House organ is an outstanding instrument, destined to become one of the most highly regarded organs in the world. Ron Sharp, Myk Fairhurst and Mark Fisher have every reason to be proud: they have created a milestone in musical history.

Of course Ron Sharp, the perfectionist, still isn't really happy. He finds it frustrating to have to design and build organs in halls and buildings that other people have designed. What he'd really like is the chance to design and build an organ and a hall together, so they really suit and complement each other. All he needs is a rich benefactor with a desire to sponsor such a unique public monument.

I for one hope he finds them.

Finally, some words of thanks. To Ava Hubble, the public relations officer at the Sydney Opera House, for her gracious help in organising things to make this story possible; to Opera House photographer Don McMurdo, for his patient cooperation and help in taking some of the pictures; to our own Sungravure staff photographer Warren Webb, for his help also; and finally, but most of all to Ron Sharp and his team for their generous and willing donation of time and inconvenience.

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MHD power: making better use of coal

Magnetohydrodynamic (MHD) power generation holds great promise for increasing the efficiency of coal burning power stations, thereby reducing fossil fuel consumption and lowering thermal and atmospheric pollution levels. An experimental MHD system has recently been installed at a Sydney power station.

Many alternative generating processes for bulk power generation have been investigated in the last decade and MHD is one of few approaches left promising a more effective use of fuel when compared with conventional plant.

Station efficiencies of over 50 per cent and a generating cost of 20 per cent below that of conventional steam plants should make magnetohydrodynamic or MHD systems feasible in the 1990s. An increase from the present overall power plant efficiency of 33% to 50% would reduce fuel requirements by one third and thermal pollution by one half. Similarly, atmospheric pollution must drop quantitatively since overall fuel consumption drops.

The magnetohydrodynamic (MHD) process involves an interaction between a conducting fluid and a magnetic field. The basic ideas are simple and date back to last century when the first patents were taken out. However, only in the last 15 years have technical solutions emerged which may allow man to realise the potential offered by MHD.

MHD has been proved technically feasible and the main question is its economics. For example, the USA is planning to have an operational pilot plant of 250MW thermal rating by 1985 and a base-load commercial demonstration plant before 1995. In Russia a 350MW thermal facility has been operational for some years generating up to 20MW electrical on a continuous basis. A 500MW electrical output MHD power plant is being developed for operation by the mid '80s.

MHD generators convert directly the thermal energy in a fluid into electricity and the MHD channel acts both as generator and prime mover. The whole structure is stationary as shown in Fig. 1 and many complex mechanical problems in conventional rotating plant are avoided. In addition, the generator can operate at elevated temperatures of 3000 to 3300°K which are very much higher than the temperature in conventional plants, and thus allow for a much higher thermal cycle efficiency.

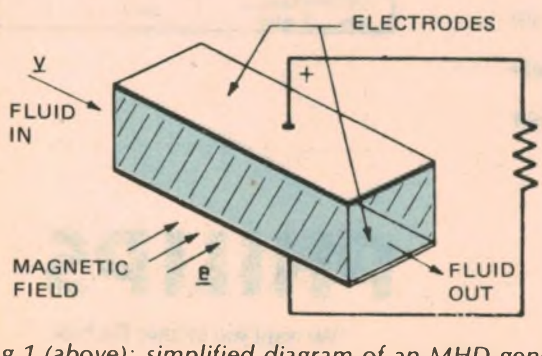
Major MHD facilities exist in Russia, USA, Japan and Poland. Several others are under development in India, Rumania and Australia.

At the School of Electrical Engineering, University of Sydney, work in electrical power and energy conversion has been pursued for a long time. Interest in the alternative generation area started to concentrate on MHD in the early '60s since it appeared to be the only alternative approach for bulk power generation to become serious in our life time.

Early MHD experiments in the School used shock tubes as transient plasma sources and later an electric arc jet for steady state experiments. The arc jet is still used for electrode studies and produces noble gas plasmas mixed or seeded with alkali salts. Since 1976 experimental emphasis has moved to a 2MW combustion plasma experiment.

A 2MW (thermal) facility has been developed and installed at the White Bay Power Station, Sydney, of the Electricity Commission of NSW. The major aim is to study the use and suitability of Australian coal for MHD power generation.

The MHD project is one of a number of programs carried out at the School of Electrical Engineering concerned with energy. The other programs involve a Model Power Transmission System, a High Power Testing Laboratory and an Energy Utilization Laboratory.



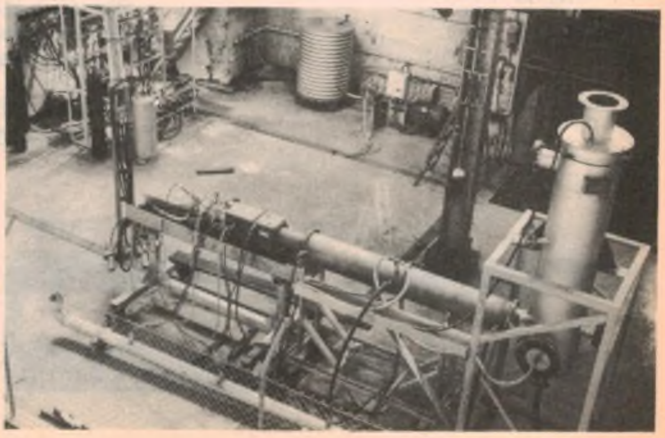


Fig 1 (above): simplified diagram of an MHD generator. A highly ionised fluid (plasma) is passed through a magnetic field and the electricity generated tapped off by electrodes. At right is a view of the experimental area at White Bay.

The lady with the (arc) lamp

It's extremely rare to find a woman electrical engineer, even in these so-called enlightened times. Yet the first woman member of the Institution of Electrical Engineers in London was elected some 80 years ago. The lady was Hertha Ayrton, whose work on the arc lamp had established her as one of the foremost electrical engineers of her time.

by TERENCE McLAUGHLIN

The myth that half the human race consists of so-called "helpless little women", with no grasp of mechanical matters, seems to be so firmly entrenched that it survives in the face of every move towards equality of the sexes. Nowhere is this more true than in the engineering profession. In spite of all the official efforts to encourage women to enter engineering and technology, only five per cent of the girls in British universities take such courses and the woman engineer tends to be regarded by most of her male colleagues as a strange and probably dangerous interloper.

If this is the way things are now, it was a hundred times worse a century ago. Technology was exclusively a man's world; even to be admitted to the fringes of the profession, a woman had to be superlatively brilliant, strong-willed and preferably rich. In spite of all these difficulties, one remarkable woman with no family tradition of engineering or science and with very little money managed not only to get into the electrical engineering profession but to rise to the top of it.

Hertha Ayrton was born in 1854, the daughter of Levi Marks, who had a small business making and repairing clocks in Portsea, part of the large seaport town of Portsmouth. She is reputed to have taken a watch to pieces when she was six, not a remarkable thing for a child to do, but she is said then to have put it together again, a rare feat at that age. She progressed so brilliantly at school that while still in her teens she was able to contribute some earnings to the small family budget by teaching other children.

University education for girls was almost unknown at the time, but fortunately for young Hertha the movement towards it had started. The great educationist Barbara Bodichon succeeded in the late 1860s in getting grudging support for setting up the first women's college, Girton, at Cambridge University, and the bright young teacher from Portsea was an obvious candidate for the new institution. Some of the money for her support probably came from Mary Anne Evans (alias George Eliot, the famous novelist) who also was an enthusiastic campaigner for women's rights and particularly their right to have equal educational opportunities. Even so, there was not much money to spare, but Hertha showed her practical ability by inventing pieces of equipment for engineering drawing and mathematical demonstrations. Her first patent, taken out in 1883, was for a drawing instrument to be used in making scale diagrams.

Having graduated, she moved to London to teach mathematics and science. She was soon fascinated by the new world of engineering that was being opened up by electricity. Most of the important theoretical work had been done earlier in the century, but the spread of power transmission by cable meant that, for the first time, electricity was moving beyond the laboratory. Electric tramways and railways, cranes, lifts, lighting and telegraphy all became practical realities in the 1880s. It was inevitable that Hertha should be drawn into the company of the foremost English electrical engineer, William Edward Ayrton; he was a good-looking and persuasive young widower with a daughter to care for, so it was perhaps equally inevitable that he and Hertha married in 1885.

In spite of her responsibilities of home and family (she had a daughter of her own before very long, christened Barbara Bodichon after her benefactress), Hertha became an active assistant to her husband in his laboratory, learning the new science of electrical engineering almost as it developed. When William took on a long assignment in the USA, she had the opportunity she had been waiting for — to prove that she could carry out some research on her own. She elected to tackle that dragon of the 19th-century electrical engineer, the arc lamp.

The enormous potential of the arc lamp had, in almost equal proportions, fascinated and exasperated Victorian engineers ever since its discovery by Sir Humphrey Davy. When it worked well, it gave a clear, white light far surpassing the smoky flames of oil or gaslight, and much brighter even than the new carbon-filament electrical lamps invented by Swan and Edison.

On the other hand, if it decided not to work properly, the arc could be more recalcitrant than an army mule. It would hiss or hum for no apparent reason, usually a sign that the arc would extinguish itself soon and refuse to light again. Sometimes bits of white-hot carbon rods would fall off, or even explode. Electrical measurements revealed the absurd situation that the arc lamps defied Ohm's law, for the current across the arc increased as the voltage dropped. Electricians of the time, presumably in desperation, took to talking about negative resistance as one of the arc's characteristics.

Young Mrs Ayrton accepted all these problems as her starting point, and in a few weeks work which remains a classic example of logical and scientific thinking, swept away the folklore and provided a clear explanation for nearly all the oddities. She showed that the so-called negative resistance was merely caused by current carried by vaporized carbon: the more carbon vapour, the lower the resistance of the gap between the carbon rods. More impor-

Hertha Ayrton at a suffragette rally in 1913.

tant, she was able to explain some of the practical deficiencies, and suggest ways of eliminating them, so that the arc lamp became a reliable and useful source of illumination.

Her many scientific papers on arc lamps and electric furnaces, and her book *The Electric Arc*, established her as one of the foremost electrical engineers of her time, and in 1899, after much heartsearching, the 3300 men in the British Institution of Electrical Engineers finally elected their first woman member. She subsequently received the Gold Medal of the Institution for her research; one of her fellow recipients was a certain Mr G. Marconi.

Around that time, her attention was attracted to wave theory (apparently while looking at the pattern of ripples left in the sand by the tide, when she was on holiday). By 1904 she had solved the formidable mathematical and practical problems of her theory (at one time, with true economy of means, she studied the motion of particles of black pepper in a tank of water), and wrote a paper which was read at the Royal Society, the first scientific paper by a woman to intrude into that august body. One interesting feature of the paper, which did not assume importance until later, was her suggestion that high-speed motions in water could cause cavitation, a matter which Sir Charles Parsons found significant when he came to study high-speed propellers.

There was a strong recommendation by many of the members that she should actually be elected to the Royal Society, but the entrenched male diehards produced a legal judgement that "the Society under its constitution has no power to elect a woman." She might have pressed her case with more spirit had it not been for the death of William Ayrton in 1904: although she continued her work, she retired somewhat from public life for a time.

The outbreak of war in 1914 found her the leading authority on arc-lighting, and the need for powerful searchlights, especially during bombing raids by Zeppelins, kept her busy. She also found time to use her knowledge of fluid flow when poison-gas attacks

(Continued on p129)

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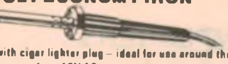

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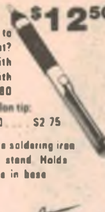

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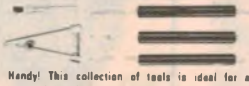

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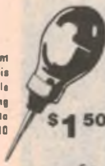

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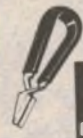

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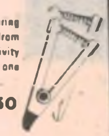

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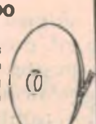

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How many times have you been short of a power point or extension cord in the workshop? Dick can come to the rescue with these great ideas from Kambrook.

EXTENSION CORD REELER

10 metres of extension cord in a handy reeler. Don't be caught short: unwind as much cord as you need. Ideal for caravans, too! Cat P-5600
$12.00

4-WAY POWER BOARD

What a great idea! Double adaptors can be dangerous: use one of these 4 way safety shutter outlets on a 2 metre cord for top safety.

$16.50
Cat P-5610

INCREDIBLE!

Save a massive $9.00 on the ARRL 'Radio Amateurs Handbook' (1978 edition)
NOW ONLY
$4.95

This was our 'book of the month' last month: an incredible super bulk purchase of last year's ARRL Handbook – the amateur's 'Bible' – we are able to reduce the price to less than 35%! It is very similar to the current (1979) edition containing valuable reference data. NOTE: The 1978 edition is the last to contain valve data.
● Ideal for novices who want to study for their full AOCP license! Cat B-2218

WATCH THIS SPACE

AND FIND OUT WHAT YOU MISSED

Each month all of our stores feature an outstanding special which is actually BELOW COST! N.B. Specials are strictly while store stocks last.
Don't miss out!

LAST MONTH:
CHARGETTE
BATTERY CHARGER
Was $15.00 — now $9.80
SAVING
$5.20

NEW GAMES CARTRIDGE FOR FAIRCHILD CHANNEL F: BOWLING!

Yes, now there is another games cartridge to go with your channel F video computer system. All the fun of the real game with strikes, spares, and gutter balls. There are 18 game variations, with on-screen scoring and full colour playing alley (on a colour TV!) Try it: you'll have just as much fun with this game as all of the others in the incredible Fairchild Channel F system.

NOW THERE ARE 19 GAME CARTRIDGES TO CHOOSE FROM GIVING THOUSANDS OF GAME VARIATIONS: Blackjack, Desert Fox, Maze Baseball, Spitfire, Space War, Math quiz (addition & subtraction), Math quiz (Multiplication and division), Magic Numbers, Torpedo Alley, Drag Racing, Backgammon, Sonar Search, Memory Match, Dodge it, Pinball, Hangman and Bowling. And there are more to come!

ALL CARTRIDGES
$24.50
Cat Nos X-1201 - X-1221

HAVEN'T GOT YOUR CHANNEL F YET?

Then you are missing out on one of the greatest breakthroughs in home entertainment you'll ever find. The Fairchild channel F is not just another TV game: it is based on the powerful F8 microprocessor IC giving it features never dreamed possible a few years ago!
The Channel F plugs into any TV (colour pictures on colour set) and will not harm your TV. Call into any of our stores for a no obligation demonstration. It's INCREDIBLE

$259.00
Cat X-1200

BUILD A DISCO!

HIGH POWER STROBE

Make your parties come alive with this incredible device. Intense flashes of blue white light stops motion, giving everything a jerky, hypnotic effect.

You can build one of these from Dick Smith's High Power Strobe Kit. Everything you need, down to the last nut and bolt, plus full instructions including construction techniques. Cat K-3150

$29.50

$65.00 Cat K-3140

COLOUR ORGAN

You've seen them in the discos, now you can build your own. Takes the audio output from any amplifier and uses it to control three channels of coloured lights in time.

Dick's Musicolour kit is easy to build and comes complete with full instructions. You can check it out under our 7 day satisfaction guarantee.

Now: 150W coloured globes to suit Musicolor. . .

Available in PAR 38 long-life pressed glass with integral reflector. Now in 4 colours: red, blue, yellow and new green (Cat nos S-3852, 3854, 3850, 3856 respect.)

ALL LAMPS **$7.95 ea.**

BASES TO SUIT: Swivel E.S. bases to take above lamps. Can be wall, ceiling or batten mounted to put light where you want it. Cat P-5620 . . . . **$3.50 ea.**

SMOKE DETECTOR

DON'T PAY $49 OR MORE FOR OTHERS

Yes! Now available – our dual chamber ionisation-type smoke detector has been fully licensed by the Health Commission. This type of detector is far superior to a heat detector: remember a fire can smoulder for hours before reaching flashpoint. Any smoke (even a cigarette at very close quarters!) will cause an ear shattering 85dBA alarm giving you precious minutes extra warning.
Easy installation, battery supplied. Cat L-5258

ONLY $35.00

SPECIAL OF THE MONTH FOR TV VIEWERS . . .

Here's good news for anyone who watches TV – and isn't that just about everyone? Improve your picture quality with a Dick Smith Masthead Amplifier kit. Easy to build (uses a single hybrid integrated circuit) and simple to install, the masthead amplifier can turn an unwatchable mess into a brilliant picture. (Yes, we've actually seen it demonstrated!)

WHY PUT UP WITH POOR RECEPTION ANY LONGER: THE DIFFERENCE IS INCREDIBLE!

The masthead amplifier kit is complete (power supply included) and comes ready to assemble with full instructions. And now is the time to build it: **You save nearly 10% for this month only!** Hurry while stocks last.

$32
NOW ONLY **$29.50**
Cat K-3230

UNIVERSAL CAR PROTECTION

Fully integrated auto alarm system uses current sensing system to detect entry.
Operates on any 12 volt negative earth vehicle, with very simple installation (full instructions provided). In-built exit and entry delays for legitimate users, plus re-set delay so the alarm doesn't flatten the battery (and also to comply with noise pollution requirements!)
You can also protect your CB/Stereo/Car radio/etc with this unit. Cat L-5090

$49.50

SPACE PROBLEMS?

Not enough room for you hi fi speakers? And you don't want those tiny ones because they're all junk? NOT ANY MORE!

These new mini hi-fi speakers from Dick Smith have to be heard to be believed! Although they measure only a tiny 120 x 120 x 190mm, their performance is right up there with the big guns. And they compare favourably with speakers costing twice and three times as much! So if you are a little pressed for space, have a look and a listen to these. Consider the possibilities:

- Cars
- Caravans
- Boats
- Home Units & Flats
- Demonstrations
- Etc. etc etc

$99.50 PAIR
Cat M-9530

CUSTOMERS PLEASE NOTE

Quite often, products advertised may be completely sold out within a few days. Or problems may hold up delivery of products so that they are not in the stores when the advert appears. Please don't blame the store manager or staff: they are powerless to do anything about it! What we are trying to say is that, if you are about to drive across town to pick up an advertised line, give the store a ring first – just in case.
Dick Smith and staff

DON'T FORGET OUR TWO NEW STORES:

Yes! Dick has opened two new stores recently for the benefit of our interstate customers:

CANBERRA: 96 Gladstone St Fyshwick
Phone 80 4944

PERTH: 414 William Street, City.
Phone 328 6944

SOON OPEN IN WOLLONGONG

Norman Gunston, eat your heart out!
The Electronic Dick is coming to Wollongong
The old town will never be the same again after Dick arrives — watch for the new store located at

263 KEIRA ST WOLLONGONG

WATCH YOUR LOCAL PAPER FOR THE GRAND OPENING: IT WON'T BE LONG!

FORUM

Conducted by Neville Williams

WIND POWER ISN'T AS EASY AS ALL THAT!

Where we are to get our power from in the next couple of decades is the subject of never-ending debate. Unfortunately, much of the debate is pointless and socially disruptive, because it rests on emotive assertions and slogans rather than a dispassionate appraisal of all the available evidence.

As a further factor in the debate, I doubt whether all the participants realise the scale of the problem we face. Over the past 50 odd years, western society has been progressively and completely "spoiled" by the abundance, convenience and relative cheapness of energy derived from fossil fuels and, in particular, from oil. All the energy we have needed has been to hand as gas, liquid or electric power — in exchange for a few pounds or a few dollars. We just don't realise how much of it we use.

It was not always thus. I have vivid memories, as a boy, of dragging countless loads of firewood out of the bush in a billycart, to keep the stove going. And of mile-long treks to the store for lighting kerosene. In those circumstances, one tended not to use any more fuel than was strictly necessary!

We certainly did not go in for all-night heating or mood lighting!

OUR WAY OF LIFE

Nowadays, the average suburban dweller (me included) rarely shivers or perspires, rarely works in dim light, and rarely does something the hard way if a power tool is available. We grumble about the quarterly bills but seldom make more than a token gesture towards reducing them!

I am not suggesting that we should forego the comforts of modern living but what we do need to appreciate is the enormous amount of energy we consume while enjoying those comforts. Walk into the average modern home on any winter's evening and you'll find the stove going full bore, along with lights, heaters, clothes dryer, hot shower, and so on. In the box outside, the power meter will be spinning like a top!

Typically, that may mean a load of 15 to 20 amps, or from 4000 to 5000 watts. Multiply that by the number of homes connected to the grid across the nation, and you get some idea of the total potential demand. And that's just the domestic load, with no allowance for street lighting, commercial, industrial, transport and so on.

But, recently, most developed nations have been faced with the problem of finding sufficient fuel to support this kind of demand plus, of course, other activities which require energy in other forms. There are seemingly no easy answers to the mounting dilemma — hence all the arguments.

- Oil is a dwindling resource, becoming progressively less accessable and more expensive.
- Coal is likewise expendable in the longer term and offers only a partial answer to our total energy needs.
- Uranium is allegedly fraught with hazards, such that it faces one of the strongest-ever "anti" lobbies.
- Nuclear fusion is somewhere out there in tomorrowland.

Which brings us to the "natural" energy sources: solar power, wind power, water power, thermal power.

They are acceptable and desirable in the current view of conservationists but of questionable adequacy in the view of those who would actually have to put them to work. For sure, it is possible to generate a certain amount of power by these "natural" means but, without a spectacular breakthrough, there is only a remote hope of meeting more than a small percentage of our total energy needs.

Even during the two or three weeks that this article has been in preparation, there has been a firming conviction among energy-deprived nations that they will not be able to wait for any much-hoped-for technological breakthrough.

What triggered these remarks was a letter to hand from a reader in Skipton, Victoria, who wrote as follows:

Dear Sirs,

As a keen reader of your magazine, I am surprised that, to date, there has been no write-up on wind-powered generation of electricity for household use.

I may, of course, have missed something but am wondering if it is possible to use a wind-driven 12V generator and inverter to supply 240V AC for the average household.

I understand that the original 12V generator would need an output of approximately 20A so that, after conversion to AC, one would have an output of 240V at about the same 20A current.

If not available from your magazine, could you advise me of any organisation which would be in a position to provide the necessary write-up and circuit diagrams?

C.K. (Skipton, Vic).

Two points arise from this letter:

The first is an error into which people frequently fall when pursuing such a concept.

The second follows in that, while straightening out the error, one discovers the real magnitude of the problem.

First off, let's assume that it was practical to instal a windcharger system and storage battery capable of coping with a load of 12 volts at 20 amps. This would represent 240 watts of power, and compares with the kind of backyard — sized windcharger which was, in fact, described in our July 1978 issue.

To convert this to 240V AC, one would neet to put together an inverter along the lines of the unit described in our February 1979 issue. Rated at 300VA, it would be of about the right size and, significantly, has a conversion efficiency of 85%.

If it was 100% efficient, such an inverter would deliver as much output power as it received input power: 240W (or volt/amps) in, and 240W (or V/A) out. In fact, the inverter was quoted as being 85% efficient, which means 240W in and 204W out.

But we have assumed an output voltage of 240AC so that, for an output power of 204W, the maximum output current can only be 0.85A — not 20A as C.K. has assumed. Far from being enough to meet typical household requirements, it would cope only with a couple of lights or maybe a TV set. And then only when the wind was blowing energetically!

More than that, would be out of the question, as would any of the high demand devices like heaters, stoves, etc.

As we said in the heading: "Wind power isn't as easy as all that!"

Let's say we attacked it the other way and assumed a system that would indeed cope with the demands of the average household — a demand that may peak, as we said, in the region of 4000 to 5000 watts. Applying a conversion efficiency of 85, these figures would rise to between 4700 and 5880 watts at the input. In turn, this would represent a current drain at 12V of between 390 and 490 amps!

Fairly obviously, this would force a move to higher voltage and lower current but the amount of power represented by volt/amps or watts would remain the same.

But, supply voltage notwithstanding, the mind boggles at the idea of an inverter rated to deliver 5kW. The modest 0.3kW inverter in our February issue was big enough; multiply that by a factor of 17!

Then there is the question of what happens when the wind isn't blowing — which is most of the time in a city like Sydney. If you had to wait for wind before cooking a meal, you'd either have to starve or learn the Asian art of eating your food raw!

So a storage system would be essential. But have you ever seen a battery bank large enough to sustain up to a 5000V/A load for long periods between charges?

Or a windcharger large enough to top it up?

And here I can clarify my earlier references to "emotive assertions".

Recently, a member of our technical staff was present at a symposium concerned with alternative energy sources. He raised this very question of energy storage, necessary to supply the demand during periods when there was no input from the source generator: no wind, no sun, no waves, etc.

A participant in the symposium had a ready answer: "batteries, of course!"

Our staff member pointed out that practical batteries in any existing or developmental form fell far short of the kind of requirement being talked about.

Unabashed, the aforesaid participant claimed that new batteries were being developed all the time. Then, with a grand gesture, he pointed to his wristwatch:

"Inside that watch is a tiny battery which will run the watch for a whole year!"

UHF TRANSLATORS — *The facts:*

We don't blame anyone for being confused by media reports covering new television outlets for Sydney. Here are the facts as we understand them:

- Four translators are being planned for North Head and four for Kings Cross, to provide UHF relays of existing stations for shadowed areas in Sydney's eastern and coastal suburbs.
- The proposed transmissions will not in any way modify or interfere with existing VHF coverage. Talk of extra ghosting on VHF has no foundation in fact.
- To receive the translators tobest advantage, a new (and much smaller) antenna system will be necessary, along with a receiver capable of receiving UHF transmissions. Many existing colour sets already have this provision.
- To allow for future committments, the present plan is to allocate a pair of adjacent channels to each of the stations for use at the respective sites. The transmitting antennas would be directional, with vertical polarisation at North Head and horizontal at Kings Cross. There is some apprehension that, in overlap areas, receivers may not be able to separate the two signals. The talk about interference flows from this problem, which is currently underdiscussion.
- The translators will involve a shared antenna atop a slender tubular steel mast, at most 15m high, and not unlike a modern lighting standard. The installations will not be a significant addition to the skyline in either situation, so a reported challenge by ecologists is hard to justify.
- The areas to be served by the new translators are not the only ones shadowed from the existing VHF transmitters. It is envisaged that translators will be installed to serve other areas as circumstances permit.

FORUM: Wind power isn't as easy as that!

In vain our staff member tried to make the point that the year-long life was a tribute, not to the battery, but to the ability of a modern integrated circuit to operate on a miniscule amount of current.

He may well have saved his breath. The listeners awarded the debating point to the man with the watch, not realising that the ploy was at the expense of their own technical comprehension.

To my mind, the situation is much too serious for mere slogans, mere posturing, mere point scoring.

ENERGY STORAGE

The fact is that an enormous amount of time and money has been expended around to world on research into batteries, much of it aimed at storing more energy in a smaller space for application in electric cars. There has been some progress, but nothing that resembles a major breakthrough in terms of size, cost and capacity. By and large, makers of electric vehicles are still having to fall back on the time-honoured lead-acid cell.

If windpower is to play any significant part in meeting tomorrow's energy demands, it will probably be in huge centralised installations of the kind featured in our June 1978 issue. Even then, it would be only in a supplementary role, picking up some of the load at times when wind is available to make it possible.

The figures quoted for the abovementioned unit suggested a prop. with 18-metre blades, mounted on a 30-metre tower, delivering a peak output of 200kW, or 15% of the power requirements for a small town in New Mexico, USA.

But, in saying this, I wonder how such ungainly installations will square with the environmentalists of tomorrow. Having in mind the fuss that was made about a relatively simple communications tower on the mountain overlooking Canberra, what reaction might there be to a line of huge windmill structures dominating the outlook or the skyline?

Nor is this a fanciful picture. We will have to come to terms with the fact that, if we need lots of power, we're going to need very large installations to produce it whether they be windmills, hydroelectric schemes, solar devices, or just plain coal mines and power stations.

And, almost inevitably, large installations are going to tangle somehow with the ecology, as witness coal handling in NSW or the Lake Pedder scheme in Tasmania!

All told, power from the Sun looks the most promising of the natural sources right now and it is certainly the area on which most attention is being focussed. But, here again, there is still a vast gap between the amount of energy we actually need and what we can manage to capture by any of the available systems. And it is likely to remain that way unless somebody, somewhere, can come up with a real technological revolution.

Inevitably, some who read this will interpret it as an attack on environmentalists, an attack on solar or other natural power sources and veiled support for the nuclear lobby — all hung on one man's enthusiasm for a home-style windcharger.

(At this point, our correspondent C.K. may well feel like somebody who, quite innocently, started a pub brawl!)

In fact, I am as aware as anybody of the potential hazards of the nuclear approach and would likewise hail any breakthrough that would render us less dependant on mineral sources of any kind. My own gut feeling is that even coal is too precious a commodity to simply burn.

No, my prime intention is to point up the enormous technological gaps that need to be bridged before we can stop consuming what we should be conserving. C.K. just happened to provide the catalyst.

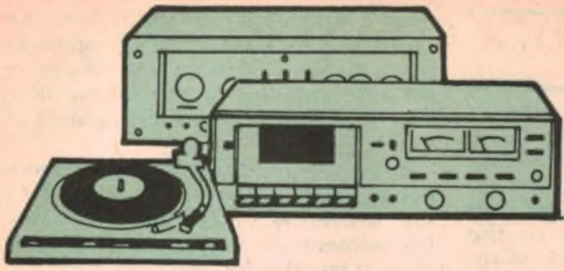
If I'm attacking anybody, it would be those whose only contribution to the problem is to shout emotive slogans, or to daub them on walls and fences — without stopping to think how little they really know about the subject of their crusade.

Perhaps I could round it out by mentioning a recent joint report released by the University of California and the Department of Energy of the same state. It says that by using sun, wind and water power, geothermal wells and biomass conversion, the state of California might achieve self-sufficiecy in power without petroleum or nuclear energy — this by the year 2025.

However, the forecast, professedly rests on certain assumptions which, if not valid, would negate its conclusions: that energy costs by the year 2010 will be from 2 to 4 times present levels; that adequate investment in research should begin very soon; and that people will not stall progress by protesting about wind generators, dams, etc, marring the landscape or interfering with the ecology!

Since that report was released, President Carter, a strong advocate of "natural" energy sources has nominated a target for the whole nation: 20% of total energy needs from renewable sources by the year 2000 — an increase of 14% on the present 6% level.

But even the target underlines the basic problem: where do they (or we) obtain the other 94% up till year 2000, or the other 80% beyond that?



Hi Fi Topics

WHAT'S RIGHT AND WRONG WITH TAPE HEADS?

Most hifi enthusiasts can only nod sagely when faced with the terms by which various manufacturers describe their respective tape heads. Rather more than the usual amount of light is shed on the subject by an engineering paper to hand from Akai Electric Co Ltd. It tells their story, of course, but it is interesting nevertheless.

by NEVILLE WILLIAMS

In the early days of tape recorders, there wasn't too much mystery about the heads; we even told readers how to make their own, using coils won from an old earphone and a lamination or two from a discarded transformer. The more suitable the coil and the lamination, the better would be the results — provided the gap was neither too wide nor too effectively "shorted"!

Even the commercial heads of the day, contrived on factory benches rather than kitchen tables, yielded to inspection under a magnifying glass, with coils, laminations, head finish and the head gap all plainly visible.

But that was in the days of full-track or at least half-track configuration and a tape speed of 7½ips. Oh yes . . . and a rule of thumb which suggested that you were doing famously if you could recapture a top frequency response in kilohertz equivalent to the tape speed in inches!

With the reduction in tape speed to 9.5cm/sec and then 4.8cm/sec (as for cassettes) and with the emergence of quarter-track and stereo recording, head construction become a precision task. It passed beyond the ambit of factories, and became one for skilled›cal factories, and became one for skiller operators using jigs and binocular microscopes.

Then, as the competition increased to win each extra kilohertz of treble response, particularly from cassette decks, the exotic descriptions started to appear: Permalloy, High Hardness Permalloy, Aluperm, Sendust, Sintered, Ferrite, Glass-Ferrite, etc. Most terms carried a hint of what they meant, most were the subject of claim and counterclaim, but their actual relative merits have not been so easy to discover.

The Akai paper, referred to earlier, seeks to answer some of these questions and, while one must expect it to be partial to the Akai philosophy and product, it could hardly afford to be blatantly inaccurate in this modern "trade practice" era.

Much larger than life . . . fortunately!

Akai quote the basic requirements for heads in a hifi tape recorder as:

HIGH PERMEABILITY: easy passage of magnetic flux with minimal loss.

MINIMAL CORE LOSS: large natural resistance. (Akai are presumably referring to so-called eddy current loss.)

LARGE MAGNETIC FLUX DENSITY: minimal distortion, by reason of wide linearity of generated magnetic field.

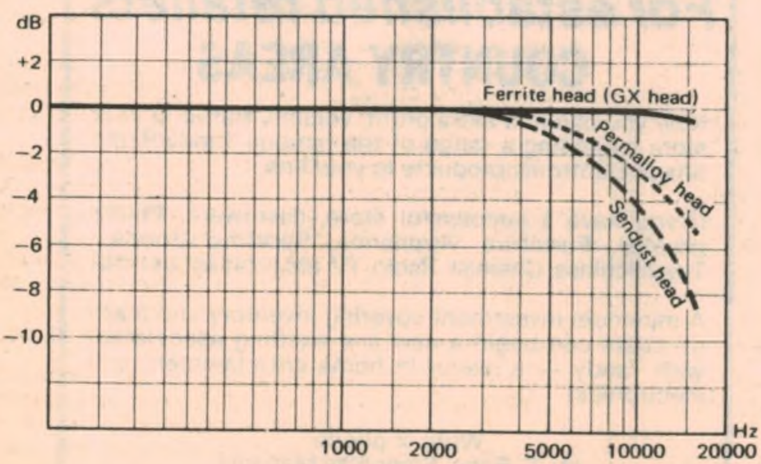
SMALL ANTI-MAGNETIC FORCE: extremely low residual magnetism.

HIGH WEAR RESISTANCE: long life, despite prolonged abrasion by tape.

Having listed these basic requirements, Akai set out the make-up and the salient features of a range of typical core materials used in the manufacture of hifi tape heads including, of course, their own "GX" series.

The first term "permalloy" has become virtually a generic name for a whole range of nickel-based alloys but Akai quote the constituents of a typical permalloy tape head as nickel (79%), iron and molybdenum. High hardness permalloy contains nickel, iron, titanium and niobium.

While permalloy exhibits excellent magnetic qualities in most respects, its hardness factor (Hv = 132) is the lowest of all the core materials listed. Even the so-called "high hardness" permalloy is only fractionally better (Hv = 200) and still lies towards the bottom end of the



According to Akai, eddy current losses in the high conductivity alloys more than offset their advantage in terms of "static" permeability at frequencies above about 2 to 3kHz. To counter the losses, alloy heads have to be assembled with a narrower gap, which has its own further problems.

range.

From the last syllable, one might infer that "Aluperm" also belongs to the permalloy group but, in fact, it is shown as an alloy of iron (84%) and aluminium. As such, it has a hardness factor (Hv = 300) greater than the permalloy group but obtained at the expense of overall magnetic qualities.

"Sendust" is also an iron-based alloy, despite what one might assume from the name. It contains silicon in addition to aluminium, resulting in much greater hardness (Hv = 500) and quite impressive magnetic qualities. The implication would seem to be that, of the metallic alloys, it is the one to beat.

The other four materials listed by Akai are all "ferrites" processed and compacted from metallic oxides.

"Sintered" ferrite is shown as containing oxides of iron, nickel and sodium. Its hardness (Hv = 450) is somewhat less than that of Sendust and its magnetic properties not particularly impressive.

The other three ferrites shown are "Single Crystal", "Hot Press" and "High Density". All exhibit high hardness (Hv = 650) but with magnetic properties which, in general, fall short of the better metallic alloys.

By way of broad comment, Akai say that the basic problem with metallic alloy heads has been to achieve high resistance to wear, with "Sendust" showing the greatest promise.

Ferrites are intrinsically better in this important respect but they are less homogenous, tending to shed crystalline particles under stress. In addition, their inherent noise level has tended to be higher. Both characteristics have been the subject of intensive research, presumably with a good deal of success.

Akai research resulted in the production of a successful low-noise ferrite head in 1969 which led to the now well established "GX" (Glass and Crystal Ferrite) design. The work was formalised in a paper presented at the 10th International Conference of the Society of Applied Magnetics (1972).

Concerning the magnetic properties of alloy versus ferrite heads, Akai claim that it can be misleading to attach too much importance to the static figures.

Those figures can deteriorate considerably asa result of forming, machining and other processes and there have been notable problems with Sendust in this respect. As a result, the behaviour of head materials under actual dynamic conditions is much more significant.

In particular, the higher initial permeability of the metal alloys is offset by their low internal resistance, which produces much higher eddy current losses. Since these losses increase with the square of the frequency involved, they reverse the initial advantage and impose a nett loss in treble response. Thus, for a given gap dimension, according to Akai, their GX head offers a markedly better response in the region 5-15kHz, than either permalloy or Sendust.

To offset this high frequency disadvantage a narrower gap has to be used: 0.9 to 1.3um to Sendust, as compared with 1.4 to 1.9um for GX ferrite. In recording mode, this necessitates a manipulation of the bias current and (possibly) compensation which, in the end result, produces an increase in the distortion level of the reproduced signal.

(Continued on page 30)

TAPE RECORDER CLEANING KIT

Tape recording enthusiasts, who are uncertain about how best to keep their equipment clean, will welcome the recent release by Maxell of a tape recorder care kit. It is being marketed by Hagemeyer (Australasia) BV distributors of Maxell tape and JVC hifi components.

Most tape users are aware that oxide tends gradually to build up on surfaces which are in constant contact with the coated face of the tape during recording and replay. In particular, any build-up on the surface of the heads can gradually lift the tape away from the magnetic gaps causing a loss of sensitivity, especially at the higher frequencies.

However, tape users are also conscious of repeated warnings about the dangers of chipping or scratching heads with coarse abrasives, or causing other damage to heads or rollers by using an inappropriate cleaning agent. As often as not, caution plus an element of "she'll be right mate" can result in heads and rollers remaining neglected for months on end, with an inevitable loss of performance.

The new head care kit from Maxell should go a long way towards offsetting this disinclination. If anyone knows the proper method and the proper cleaning fluid to use, it should be a specialist in the tape business — like Maxell.

The kit comes complete in a plastic box, with black base and a clear lid, and with the components disposed in a grey moulded tray. It is obviously intended to sit close to the tape deck, if need be exposed to view. Packaged with it is a booklet explaining the rudiments of tape recording — most of which will be familiar to the average enthusiast. There is also a small instructional leaflet, indicating how the kit should be used.

According to the leaflet, it is wise to clean a deck every eight to 10 hours when recording is involved, every 15 to 20 hurs for playback useage, and immediately before making any critical recording.

The plastic box contains two probes (or handles) about 12cm long to which can be attached a variety of tips, which should enable the user to penetrate out-of-the-way spaces. A mirror is provided to give visual access and a brush to dispose of ordinary loose dust and lint.

For more deliberate cleaning, there is a plastic package of felt-like probes and adhesive pads and un unbreakable bottle of Maxell head cleaning fluid, with which they are to be moistened. According to the instructions, the fluid evaporates after application, leaving no significant residue.

Recommended retail price for the kit is $13.85. For further information: Mr W. Topic, Hagemeyer (Australasia) BV, 25-27 Paul St, North Ryde, NSW 2113.

Glimpses from the CES

Consumer Electronics Show — Sydney 1979

For metal coated tape:

Metal coated cassette tape, and decks to handle it, have shown up on the Australian market rather sooner than expected. Pictured below is Pioneer's new flagship model CT-F950, which has provision for metal, standard, chromium or ferro-chrome tapes. In addition to an array of controls and facilities, it features a twin fluorescent recording level display. In a slightly lower priced bracket, the new Pioneer CT-F750 deck also accommodates metal tape, uses the same metering system, and includes an auto-reverse facility.

That's Life!

Epitomising the "rack" look, Sanyo's new F3 hifi system offers a power output of 22W RMS per channel. Apart from normal facilities, the amplifier features a precision volume control, loudness compensation and a separate mic input circuit. The AM/FM tuner has good sensitivity and full metering, while the phono deck is semi-automatic with belt drive. Speakers and stand complete the system which retails for $849. The cassette deck (bottom) is an optional extra.

The PRO-300, one of the new PRO series recently released by AKAI. All are designed to fit into an optional metal rack; all include turntable, tuner, amplifier, cassette deck and speakers. The PRO-100 at 25+25W sells for under $1000, while the top-priced PRO-400 runs to $1750.

A pair of Celestion Ditton 551 speakers as exhibited by M&G Hoskins Pty Ltd. The controls at the top right provide a variation in the mid and top response of +3 and -6dB.

HIFI TOPICS — continued

There is more, but enough has been said to emphasise that Akai are rather proud of their GX series heads.

They have now announced a new "Super GX" design which offers an MOL (maximum output level) 3dB higher than the existing GX heads and 2dB higher than the best available Sendust heads. They will probably be used in both 2-head and 3-head decks and lend themselves to use with the new metal particle tapes which themselves offer a 5dB increase in MOL over existing oxide tapes.

FOOTNOTE: Akai have not been alone in up-dating their cassette tape heads. A release to hand from Technics foreshadows their SX (Sendust Extra) head. They say that special additive agents, head processing and a molten casting technique have increased the Vickers hardness rating from 500 to 590, with a considerable extension in the useful life of the heads.

The metallic powders are also being formed into thinner laminations allowing four per head instead of the previous three. This has reduced eddy current loss, and yielded a 3-4% increase in flux density. Combined with a 1 micron gap, the end result is a 2-3dB improvement in the region of 14kHz. An accompanying overall record/replay curve with CRO2 tape is ruler-flat to 16kHz.

Technics claim that the distortion content has been further reduced.

All of which makes it rather difficult for the purchaser to pick and choose. Perhaps the message is not so much which head material is best; rather an assurance that keen competition is keeping rival manufacturers on their toes, and the end result can only be good for the consumer!

SCHOBER ORGANS (AUSTRALIA) have substantially reorganised their Australian operation. They are now centred at 177 Fairfield Rd, Guildford, 2161, a Sydney suburb. The telephone numbers are 632-8583 and 632-4719. Mentioned in the release are Ronald F. Salmon (Managing Director), Russell Baker (Executive Director) and R.A.B. (Alan) Tarrant (General Manager). At present, Alan Tarrant (pictured) is in New York, spending time at the Schober laboratories. He will be studying, in particular, a new 3-manual instrument, the Schober Symphony Trio,

ATRAM for European hifi

Under the guiding hand of Manager Sepp Schembera, Atram Electronics are agents for an interesting array of European sourced audio equipment.

Included are: ELAC turntables and hifi equipment; STENOCORD dictation systems; UHER tape recorders, amplifiers, tuners; ISOPHONE loudspeakers; HECO loudspeakers and hifi.

A sample brochure covering the Uher range is particularly comprehensive. On one side it features equipment most commonly associated with Uher; a comprehensive selection of portable and mains operated reel-reel recorders, microphones, headphones and other accessories.

On the other side is an impressive array of hifi equipment, including, again, a number of battery operated cassette recorders. Of these, the CR 240 AV is adaptable for slide and movie sync. sound. But there are also conventional domestic hifi modules in both "Miniset" and conventional formats, suitable for mounting in racks or "towers". For further details: Atram Electronics, 5 McLaren St, North Sydney 2060. Phone (02) 92 4177.

A batch of 12-inch Australian-made "Etone" loudspeakers air-drying in the Company's factory at Peakhurst, NSW. Etone manufacture an extensive range of single and twin-cone drivers for use in public address, disco and hifi systems, as well as supplying units for big-name commercial hifi suppliers. To supplement their Australian-made range, they also import special-purpose mid-range and treble dome drivers under the Novik brand. Many of the drivers combine high acoustic efficiency with a generous power rating. For literature describing the Etone/Novik range, plus recommended enclosures and pre-assembled crossover networks: Etone Pty Ltd, 53 Stanley St, Peakhurst, NSW 2210. Phone (02) 534 3569.

which will have the capacity to cope with the needs of classical or popular music at will. Schober President, Richard Dorf, says that it operates on a completely different principle from previous Schober instruments and hints at the incorporation of a microprocessor. Other units in the pipeline include an electronic equivalent of the rotating loudspeaker and an all-electronic replacement for the Schober Reverbatape.

VIDEO VISION are now operating from new premises at 20 Henry St, Abbotsford, Vic; telephone Melbourne 419-8199. The company specialises in production, editing and dubbing on full broadcast standard ¾-inch cassettes for television, management, industry and education organisations. RCA video cameras are to hand, also two ENG crews and six film camera crews, plus sound recordists and Nagra equipment. Video Vision operates a full-time motorcycle courier in Melbourne, with free pickup and delivery for all dubbing services. For further information, contact Barry Thomas or Lin Chandler at the above address or telephone number.

WORD RECORDS AUSTRALIA is the new trading name which has been adopted by Sacred Productions Australia. There is no change in ownership or the nature of the company, which specialises in religious records, tapes, books and films. The head office remains at 18-26 Canterbury Rd, Heathmont 3135; telephone (03) 729-3777. Word Records Australia recently awarded a gold record to Billy Graham soloist Evie Tornquist at a function in the Sydney Hilton. It was for her "Mirror" album which topped 20,000 units in Australia, as also did her earlier album "Never The Same". Sales of "Never The Same", plus five earlier albums, grossed over 100,000 copies in this country.

PIONEER ELECTRONICS have managed to reverse the familiar trend towards rising prices by announcing across-the-board cuts in the prices of Pioneer equipment. Managing Director Les Black says that the cuts have been made possible by the strengthening of the Australian dollar against the Japanese yen. The average reduction will be about 10% but could be greater in certain cases. For example, the popular Rondo 5000X hifi system could drop from $599 to about $499.

PHILIPS carried off the grand prize for an imported hifi stereo component organised by the Japanese magazine "Stereo Geijyutsu" ("Stereo Arts") and sponsored by the Radio Technique Company. The award was for their motional feedback loudspeaker (MFB) which is unique in the hifi industry. This is the second such award which has gone to Philips, the earlier one being for their top pickup cartridge.

AUDIO TALK

by LEO SIMPSON

Noise Weighting Filters

Elsewhere in the this issue, readers will find an article on the construction of weighting filters to the CCIR and DIN standards. We decided to make these up so that we could confirm the signal-to-noise ratios of equipment which were specified according to one of the above standards. But we did not do this because of a belief that weighted noise measurements are in any way valid. Far from it!

I have always been of the opinion that unweighted noise measurements are the most consistent and fairest method of objectively assessing the signal-to-noise ratio of audio equipment. At the same time I acknowledge that an objective measurement often does not bear a good relationship to the subjective signal-to-noise ratio.

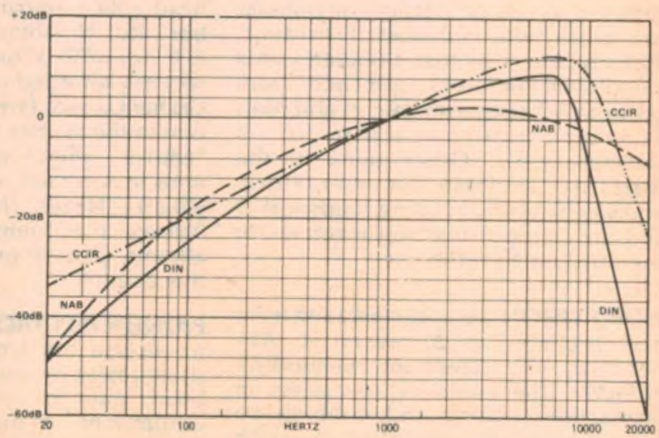
This means that sometimes we have to qualify a signal-to-noise ratio measurement with some subjective comment, eg, the S/N ratio may only have been 65dB but subjectively "the amplifier was quiet at all times" or perhaps "the amplifier was plagued with low level hum" or some other comment which attempts to overcome the shortcomings of the objective measurement.

The thinking behind the concept of weighting filters is similar to that advanced in favour of Loudness controls which we discussed in detail last month. Or more correctly: I preached and, I hope, you accepted. Well, the starting point for this month's homily is the same, the Fletcher and Munson graph of equal loudness contours. An updated version of these contours was featured in last month's column.

I recount part of the discussion on the equal loudness contours: at very intense sound levels, the ear shows a pronounced peak in its response in the region of 3 to 4kHz, of about 15dB. At much lower levels, the peak is less pronounced (to about 8 or 9dB) but the response below about 200Hz is markedly reduced. At these lower levels, the high frequency response is also slightly reduced but some parts of the high frequency response are actually slightly boosted.

Reference to the curves of weighting filters shown on this page will show how the framers of the CCIR and DIN standards have attempted to compensate for the characteristic of the ear at very low sound levels. The DIN curve, for example, shows quite a drastic approach. Noise in the region of 5 to 7kHz is boosted by more than 8dB, while below 1kHz the response tapers at a rate beginning at 6dB/octave but increasing to 12dB/octave at low frequencies. But above 9kHz, the DIN curve plunges at the rate of 48dB/octave. This means that the DIN people have made an assumption which really does not follow from the equal loudness contours.

At right are plotted three oft-used weighting filter curves employed in noise measurements. The NAB curve is less drastic than the CCIR and DIN curves.



The assumption appears to be that nobody can hear noise and hiss above 10kHz. Well, hands up all those who can hear frequencies above 10kHz. Yes, I should think that many of you can.

By contrast, the CCIR curve is less drastic in its attenuation of the high and low frequencies, but boosts the frequencies in the range 5 to 8kHz by 12dB or more.

I regard the amount of boost provided by the CCIR curve as exaggerated and so, apparently, does the American Institute of High Fidelity. When they use this curve for noise measurement, they set the unity gain point at 2kHz rather than 1kHz.

This latter approach makes the CCIR curve more realistic. But I feel the DIN curve has been designed more to produce good signal-to-noise ratio figures from mediocre equipment, rather than to reflect the subjective effect of various noise components.

A good illustration of the unrealistic measurements produced by the CCIR and DIN weighting curves concerns cassette decks with Dolby noise reduction Here, a DIN weighted measurement may produce a result of about 60dB with respect to OVU with Dolby switched out. But switching the Dolby in may give little or no improvement in reading. This is in spite of the quite audible and worthwhile reduction in hiss afforded by the Dolby system.

But there is another reason for my dissatisfaction with these weighting curves, and that is the apparent assumption that all noise originating from audio equipment is random or "white". This is not the case. For example, noise from turntables and cassette decks may be partly cyclic in nature, eg, noise from bearings, belts and motors.

Similarly, noise in amplifiers and tuners may be predominantly hum or "frame buzz". With these non-random types of noise, the ear no longer follows the equal loudness contours (inasmuch as any one person's ears follow those contours). Rather, the ear "tunes" these noises in and filters them out from the surrounding ambient "rubbish".

In fact, most high fidelity enthusiasts have at one time or another, found themselves consciously listening out for these defects, rather than listening to the music. This "fault-seeking" characteristic of the human ear, as far as the appreciation of audio equipment is concerned, makes nonsense of weighting curves.

Hence, I am sticking to my opinion that, for the time being, the unweighted signal-to-noise ratio is still the best objective test. All that seems to me necessary is that it should be qualified, where necessary, by subjective comment.

Dave Marett and Ampex at EMI Studios, Sydney

A new dynamic generation of Maxell tapes.

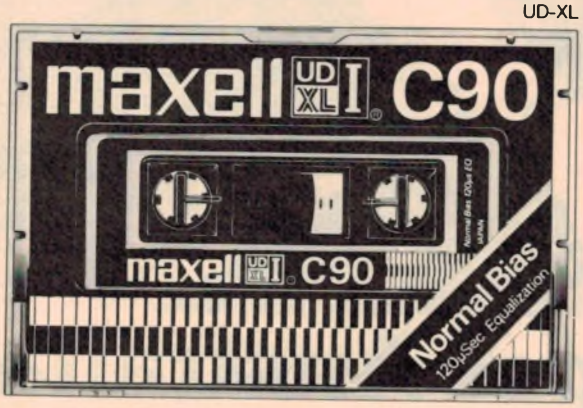
When Maxell announces an improvement in the quality of its tape, you can bet the improvement has to be pretty dynamic. In fact, we think our new generation has even gone beyond our own standards of superior sound reproduction.

Take our high level (CrO_2) position tape — the UD-XL II. Maxell engineers have succeeded in expanding its dynamic range in the middle-low frequency range by 1 dB, while also pushing its sensitivity by 1 dB in the high frequency range. Then look at our normal position UD-XL I, UD and LN tapes — our engineers expanded the dynamic range at all frequency points, while also boosting output in the high frequency range. The new dynamic range, of course, allows for better music reproduction even for LN-type tapes.

On the UD-XL I and II, we also added an exclusive shell stabilizer for significantly improved tape running and track positioning.

One thing hasn't changed on all Maxell tapes — our functional features like 4-function leader tape, replaceable index labels for UD-XL series tapes and Maxell's through-production system — your guarantee of quality and superior sound reproduction.

Tape selector position UD-XL I, UD, LN: Normal position (Normal bias/120 μsec. EQ)
UD-XL II: High level position (High level bias/70 μsec. EQ)



For details on all Maxell Recording Tape write to Maxell Advisory Service, P.O. Box 307, North Ryde, N.S.W. 2113

Available time length UD-XL I: 60, 90 min./UD-XL II: 60, 90 min.
UD: 60, 90, 120 min./LN: 60, 90, 120 min.

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Nakamichi T-100 Analyser

For audio enthusiasts and servicemen interested in maintaining or analysing the performance of audio equipment the T-100 audio analyser recently released by Nakamichi could provide an answer. It comes in a compact elegant case and features two bright orange plasma bar-graph displays.

This is the first such instrument that Nakamichi have produced and in fact at the present time there are no similar instruments on the market by other manufacturers.

The T-100 should however appeal both to enthusiasts and professionals since it conveniently provides facilities for a number of audio measurements which could not otherwise be obtained without much more expensive equipment.

The instrument is housed in an attractive low profile case measuring 343mm (W) x 75mm (H) x 240mm (D) and weighs only 4.3kg. It comes supplied with a carrying strap, leather pouch and a comprehensive manual clearly outlining the measurement procedures. Included also is a set of semi-log graph sheets which may be used for plotting frequency response measurements obtained with the analyser.

Most of the internal circuitry is discrete, and is arranged on seven plug-in PCBs which are easily accessible from the rear. The power supply is quite separate from the circuitry and is enclosed in a fully shielded metal box.

Connections to the analyser are made via RCA sockets at the side of the case; scope outputs are also provided for monitoring.

There are four main controls — the Function switch, Meter range, Input level and Oscillator frequency. The Function switch selects from five basic measurements which are speed, wow/flutter weighted and unweighted, total harmonic distortion (THD) at 400Hz, signal level and A-weighted noise.

All readings are displayed on two horizontal plasma-type bar-graph panels which occupy the entire left half of the front panel.

Both bar graph displays are calibrated from -20dB to +10dB for frequency response and noise measurements and have a resolution of 0.3dB. The input level range extends from -100dB to +30dB by virtue of the additional attenuation and gain obtained from the Input level switch, Meter range switch and the Function switch position "level -20dB", all of which act independently.

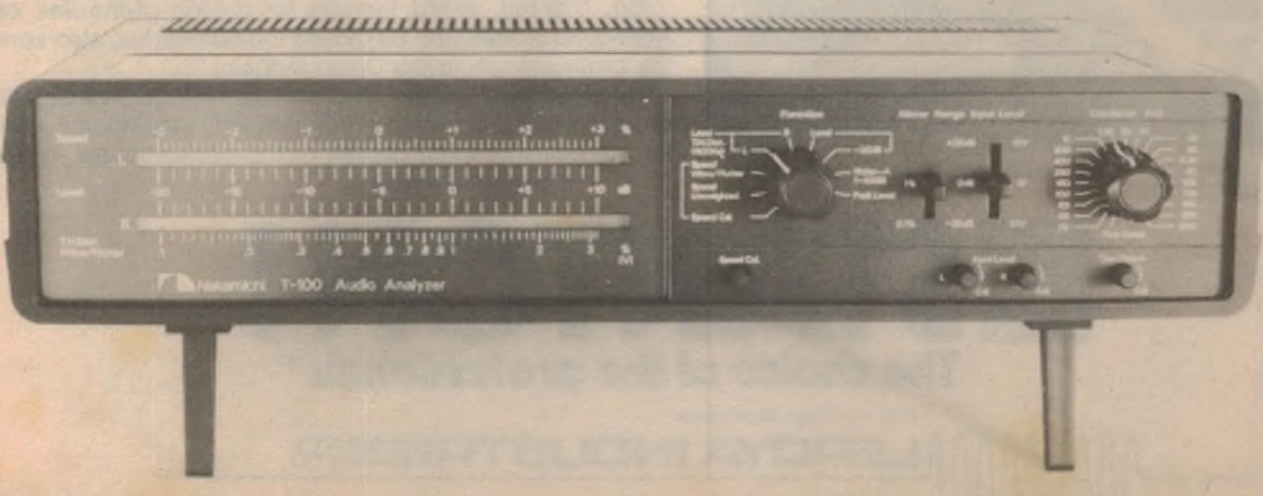
In the 'Noise A (-40dB)' function position, gain is increased by 40dB and a noise weighting filter is introduced. The purpose of the filter is to provide a weighted measurement of the noise which accentuates some frequencies and attenuates others according to the extent to which those frequencies are apparent to the human ear. There are three major weighting curves used in audio measurements: DIN, CCIR and IHF-A. Only the latter weighting is provided by the T-100.

The lower bar-graph is calibrated for percentage wow/flutter and THD from 0.1% to 3%, while the upper graph is calibrated for percentage speed deviation from -3 to +3%. The meter range switch increases meter sensitivity by a factor of 10 in the 0.1% position, allowing distortion and wow/flutter measurements down to .01%.

A wattage scale is also available and is included as an accessory. When fitted over the original scale it provides direct wattage and voltage readings for power amplifier measurements or monitoring purposes.

The oscillator control alluded to earlier sets the output frequency of the analyser when the Level function is selected. It provides the following output frequencies — 20, 40, 63, 100, 160, 250, 400, 630, 1k, 1.5k, 2k, 3k, 4k, 5k, 6.3k, 8k, 10k, 12k, 15k, 18k, 20kHz. These frequencies belong to a third octave series, though some of the low frequencies are missing and an extra high frequency has been included.

The oscillator output can also be



PROFESSIONAL

Ohio Disco Packager, SWB Electronics, uses Stanton Exclusively.

Larry L. Decker, Designer/Owner, examines finished control table for Disco use.

The trend to Portable Disco continues strong. An ambitious Company in Canton, Ohio, SWB, is achieving excellent success with their units (their goal is a national franchising operation). James C. Fravel, General Manager/Promotions, writes to Stanton, "We use Stanton cartridges in each and every unit we sell. Two of our units have been running for about a year and a half without failure. We are proud of the track record of our units and the Stanton cartridges."

They use the 500AL because it's a durable cartridge and "gives SWB a 4 dB base boost that we like to have with the music we play. It has been, by far, the best cartridge we have used (and we have tried many)".

So, Stanton, world famous for its top-of-the-line calibrated cartridges, the 881S and the 681 series, also serves the professionals in the Disco Industry.

Whether *your* usage involves recording, broadcasting, archives, disco or home entertainment, your choice should be the overwhelming choice of the professionals in every field . . . Stanton Cartridges.

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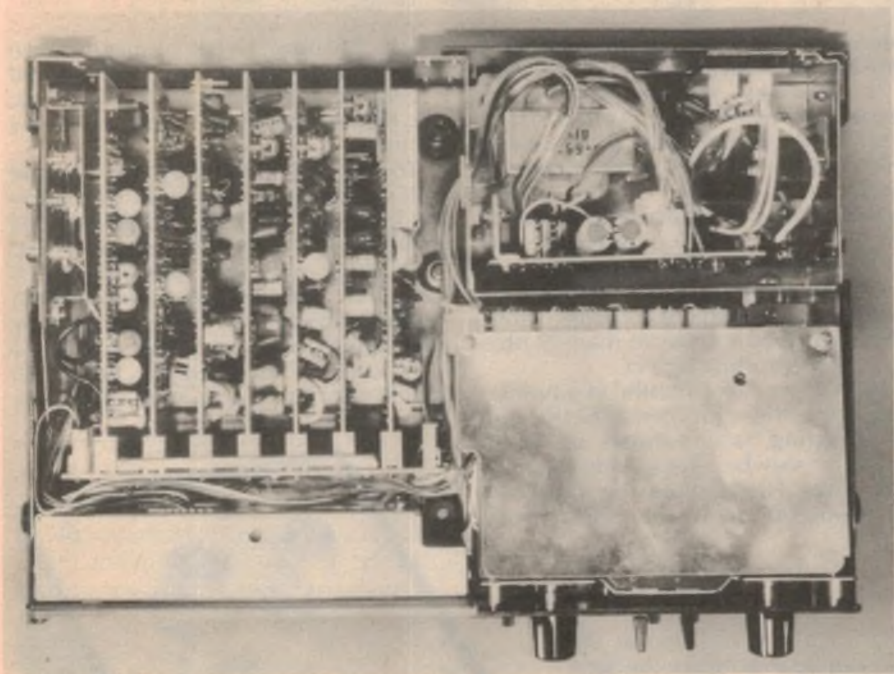
switched to provide a pink noise output, a useful feature that enables subjective tests to be made of the frequency response of tape decks and loudspeakers.

The only remaining controls not so far discussed are the Speed cal, Input level and Osc output. These are all mounted below the main controls and all of them actuate multi turn pots via miniature plastic knobs.

The function of these controls is fairly obvious, but it should be mentioned that the input level controls are only effective when the function switch is set to peak level. With the input level controls at maximum the operation of the peak level function is similar to the level function but now the metering can be zeroed. This is fine, but I would have preferred that this capability be available on all the level ranges including the A-weighted noise function.

limited. For tape decks especially it would be desirable to obtain distortion figures at three frequencies, namely 100Hz, 1kHz and 10kHz. This is our only major criticism however and in general we found the analyser simple to set up and use. The bar-graph displays were easy to read, in fact more so than conventional meters when it came to estimating wow and flutter where readings are apt to change continually.

As well as being versatile, the Nakamichi T-100 was also found to be accurate and well within the manufacturer's specifications. The frequency accuracy of the oscillator was within 0.5% for most frequencies; the maximum deviation was 1.1% at 20kHz. Measuring the amplitude of the oscillator output we found that it was flat from 20Hz up to 4kHz but dropped steadily from there, being 0.5dB down to 12kHz and 0.8dB at 20kHz.



To find out how well the T-100 performs in a typical test situation we used the T-100 to check the performance of a cassette deck which we also had in for review.

The usual tests were conducted, including wow/flutter, distortion, frequency response and signal to noise ratio — both weighted and unweighted. When making the frequency response measurements the "level - 20dB" function was particularly useful since as well as increasing meter sensitivity by 20dB it also reduces the oscillator output voltage by 20dB.

Distortion measurements can only be made at 400Hz, which is somewhat

The 3kHz signal used for wow and flutter measurements was found to be 3.001kHz, quite within the quoted figure of ±4.5Hz. Response of the metering was also good, being flat from 10Hz all the way up to 20kHz. The meter calibration was within the 0.3dB resolving limit of the display and the 20dB cut and boost provided by the Function switch, Meter range and Input level switches were all spot on.

Recommended retail price of the Nakamichi T-100 is $1054 including 15% sales tax. At the present time the T-100 is only available from Convoy International Pty Ltd, 4 Dowling St, Woolloomooloo, NSW 2011. Telephone (02) 358 2088. (R. de J.)

Masthead amplifier for TV and FM

Build it and improve your reception!

While a very high proportion of Australians are said to be able to receive television broadcasts, many people do not enjoy the full benefits of our high quality PAL system because they are plagued with poor reception. If you are one of these people, then this handy masthead amplifier could be the solution. You can also use it for FM and UHF reception.

by LEO SIMPSON

While many people claim that their colour set gives good reception, superficial examination will often show that the results are far below the full potential of the receiver. Sometimes the set is not adjusted correctly, but often the antenna system is at fault with resultant "ghosting" or "snow".

"Snow" is electrical noise which is reproduced on the screen if the signal from the antenna is not strong enough to activate the AGC of the receiver. Most sets require a signal of about 700uV (microvolts) to 1mV (millivolt) to produce a picture free of snow.

"Ghosting" is caused by multipath reception due to the reflection of the broadcast signal from hills and buildings. The multiple signal paths produce delayed and usually weaker versions of the main signal, which then produce multiple images on the screen.

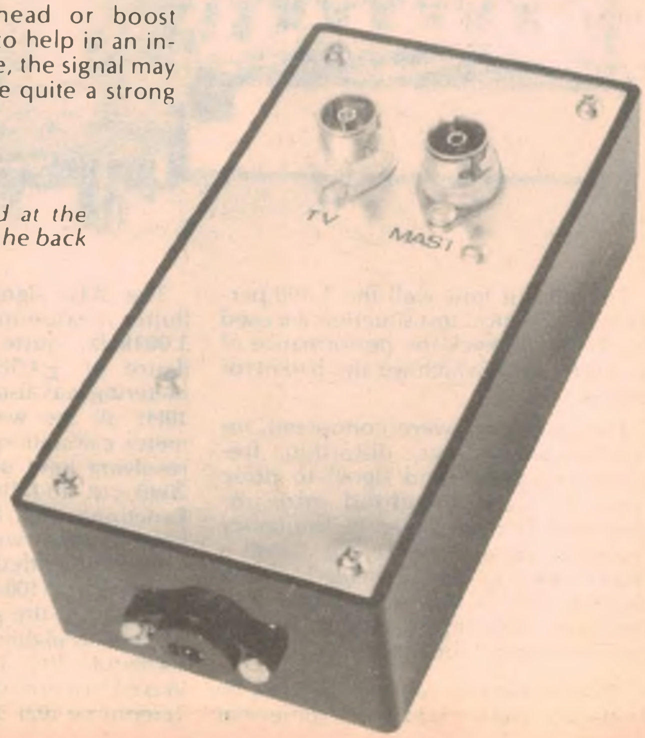
In some ways, ghosting is not as objectionable with a PAL colour TV as with a monochrome set. In the case of the colour set, each ghost produces partial de-saturation of the colour, making the ghosts less visible. But in the case of multiple ghosting the picture can be severely "washed out".

Ghosting can also be caused by signal pickup on the antenna feeder cable. 300 ohm ribbon is worse than 75 ohm coax cable in this respect.

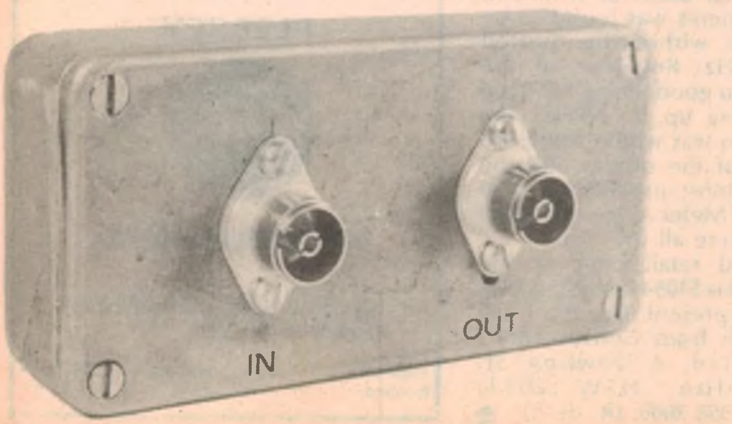
Well, how can a masthead amplifier help solve these problems? In the case of ghosting, a masthead or boost amplifier may be able to help in an indirect way. For example, the signal may be strong but may have quite a strong ghost. Rotating the aerial may remove the ghost by aiming one of the aerial "nulls" in the direction of the ghost, but this may result in a snowy or grainy picture.

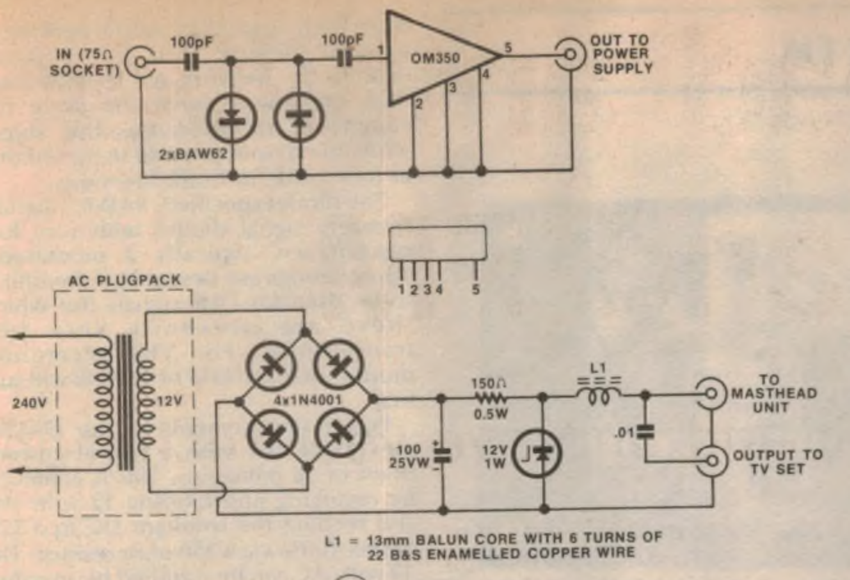
The masthead amplifier may then be able to restore the situation by removing the snow, while the ghost is still rejected by the deep null of the antenna.

In the case where the ghosting is caused by signal pickup on the 300 ohm feeder ribbon, this can be largely eliminated by using good quality 75 ohm coax cable. However, the signal losses associated with coax cable may



The amplifier is built in two parts. The diecast box is installed at the masthead, while the power supply box (right) can be attached to the back of the TV set.





The complete circuit diagram of the masthead amplifier. Power is fed to the masthead circuit (at top) via the signal coax.

PARTS LIST

1 Diecast box, 100 x 50 x 25mm
1 Utility box, 130 x 67 x 40mm
1 PCB, 80 x 50mm, code 79m8 (to be cut into two parts)
1 12VAC plugpack, Ferguson PPA 12/500 and 1 2-pin DIN socket and plug
OR
1 small transformer with 12V winding, Ferguson PF2851, A&R 64674, DSE 2851 plus mains cord and plug, cord clamp, insulated terminal block and solder lug.
4 Belling-Lee 75 ohm sockets and plugs
1 OM350 hybrid integrated circuit
2 BAW62 (1N914, 1N4148) silicon signal diodes
4 1N4001 silicon rectifier diodes
1 12V 1W zener diode
1 100uF/25VW PC electrolytic capacitor
1 .01uF ceramic capacitor
2 100pF ceramic capacitors
1 150 ohm ½W resistor

MISCELLANEOUS
Screws, nuts, solder, balun core and enamelled copper wire for inductor, 75 ohm cable, 300 ohm to 75 ohms balun (if required for antenna), caulking compound.

weaken the signal to the point where a masthead amplifier is again required.

If your problem is merely lack of signal, then the masthead amplifier may be able to improve this situation also. But note that if the antenna is only able to pick up a very weak signal, then the addition of a masthead amplifier may not give any improvement at all. In this case, the solution is either to obtain a higher or better aerial, or move house!

There are two other common situations where a masthead amplifier can be useful. The first occurs in home units where the tenant finds himself with a 75 ohm outlet which gives insufficient signal for good reception — the picture may be snowy or just slightly grainy. Using the boost amplifier described may well cure this problem.

A final application exists where the viewer has good reception from local stations, but desires reception of a regional station. This situation occurs in the northern suburbs of Sydney, where viewers have the potential to receive transmissions from Newcastle. This would probably require a separate antenna aimed at Newcastle, with a masthead amplifier to ensure a good signal. Some sort of signal switching or mixing would be required to mix the local signals with those from the masthead amplifier.

Many of our readers must find themselves in at least one of the situations described above and so will be interested in this project. For a modest outlay you could have the benefit of much improved TV reception. The same could apply to FM reception.

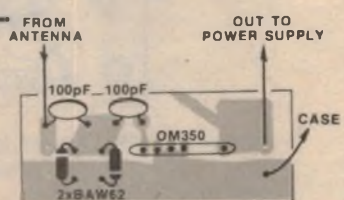
A most important point to remember is that a masthead amplifier (this one or commercial models) cannot handle very large signals without overloading. It does not have anywhere near the signal handling capability of the average TV set tuner, which has channel selection and AGC to help it cope with signals ranging from a few microvolts up to perhaps several volts.

This means that it you live in an area where very strong signals are present, then it is of no use trying to use a masthead amplifier to improve the reception of signals from distant stations. The amplifier will just overload hopelessly. If you are interested in TV DX, this is not the way to go.

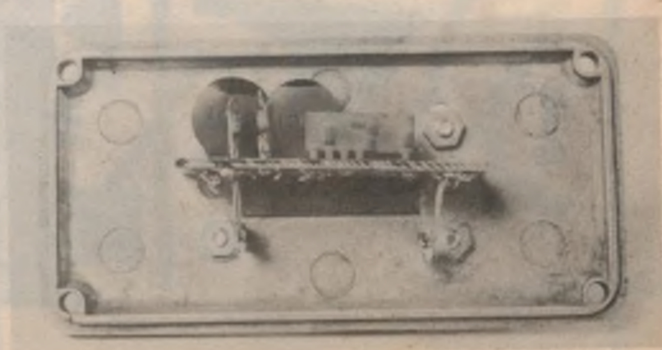
Our new masthead amplifier is simple to build and uses only a few parts. You can get it going in a few hours.

Heart of the amplifier is a new hybrid integrated circuit manufactured by Philips. Designated OM350, this device has the advantage over earlier hybrid amplifiers made by Philips, such as the OM321, in that it is smaller, operates from 12V instead of a 24V supply and, best of all, it is cheaper.

The appearance of the OM350 will probably come as a surprise to most hobbyists since it bears no resemblance to the familiar DIP or TO-5 can IC package. Instead, it has five leads, in line and has a very small resin-coated body. It looks rather like a multi-lead miniature ceramic capacitor.

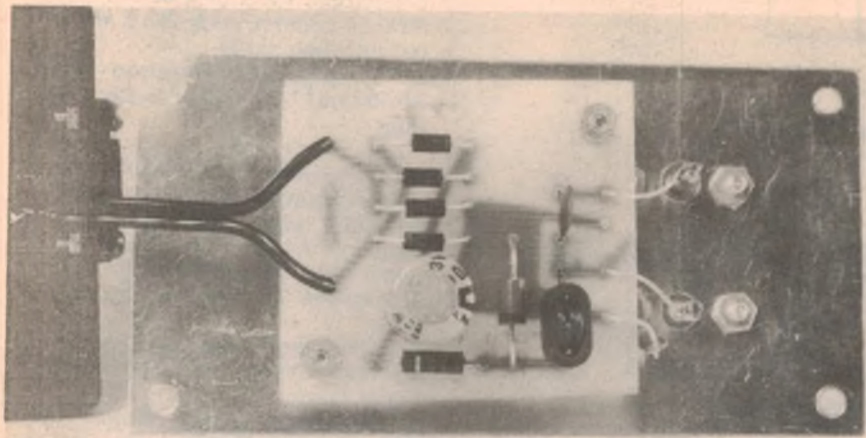


Component overlay for the masthead module. Install the diodes and capacitors first.



Right: view showing the masthead module soldered to the 75 ohm socket terminals. Note earth leads running to solder lugs.

Masthead amplifier for TV & FM



The power supply PC board mounts on the lid of the case. Short lengths of tinned copper wire make the connections to the socket terminals and to earth.

This innocuous package has a stated frequency range of 40 to 860MHz within ±1dB, with an overall gain of 18dB and a noise figure of 6dB. Maximum output voltage at -60dB intermodulation distortion (measured by DIN 45004 method) is 100mV. These figures, which are stated as typical rather than guaranteed minimum, are directly competitive with the superseded model OM321 which operated from twice the supply voltage.

Examination of the OM350 circuit shows that it is basically a feedback pair using NPN transistors. There are three capacitors on the thin-film substrate. Philips engineers have cleverly contrived the circuits, so that, when used in masthead applications, the output and DC supply leads are common. This means that the 12V DC supply can be piped up the coaxial cable to the masthead unit.

The complete circuit diagram of the masthead amplifier is split into two parts. The top part, containing the OM350, is built into a diecast box and installed at the masthead. The remainder of the circuit is the power supply and output load for the OM350, and is installed in a separate box which can be attached to the back of the TV receiver.

Characteristic source and load impedance of the OM350 is 75 ohms. This means that the input and output must be via 75 ohm coax cable, preferably the best quality that can be obtained. If the existing antenna uses a 300 ohm ribbon down lead, then it will have to be fitted with a 300 ohm to 75 ohm balun.

Input signal is coupled to the OM350 via a network consisting of two signal diodes and two capacitors. This network provides protection against nearby lightning strikes, which can induce high amplitude signals peaking at around 100kHz into the antenna system. The network acts to limit these high amplitude signals by using the capacitors to attenuate the signal while the diodes provide sharp limiting at 0.6V peak, in both directions.

The diodes specified, BAW62, are fast recovery signal diodes with very low capacitance, typically 2 picofarads. These diodes are desirable if the unit is to be used for UHF signals (for which there are presently very few transmitters). For VHF reception, diodes such as IN914 or 1N4148 will suffice.

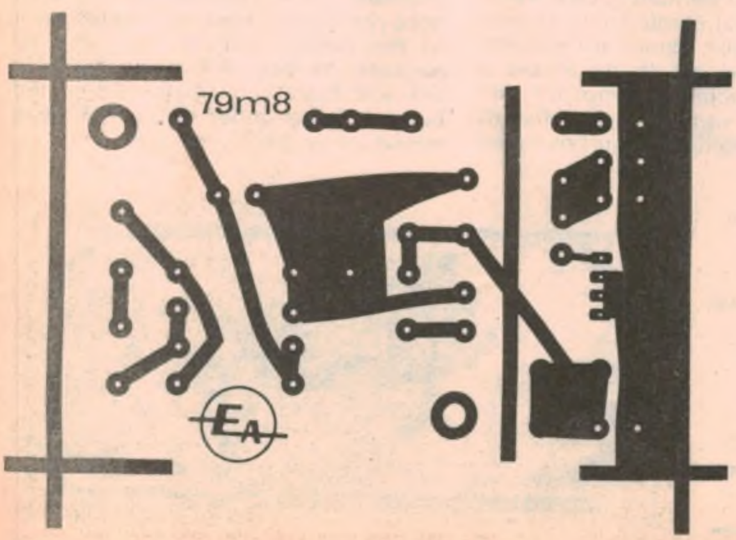
Power requirements of the OM350 are 12V ±10% with a typical current drain of 18 milliamps. This is achieved by rectifying and filtering 12 volts AC and feeding the resultant DC to a 12V zener diode via a 150 ohm resistor. The 12 volts AC can be supplied by an external plugpack such as that made by Ferguson Transformers Pty Ltd or by a built-in transformer such as the Ferguson PF2851, A&R 6474 or DSE 2851.

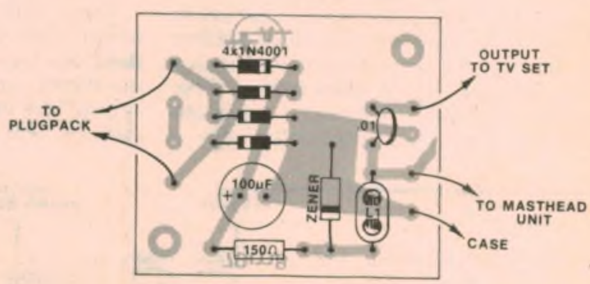
Inductor L1 is the output load for the OM350. It is wound on a 13mm balun core with six turns of 22 B&S enamelled copper wire. The .01uF capacitor separates the output signal from the DC supply.

As noted above, the masthead amplifier is usually built into two separate boxes but if it is to be used as a signal booster in a home unit situation, it could be built into the one box. To this end, we have produced a single PCB which may be used as is or cut into two sections. Our prototype was built using the latter approach.

The masthead module was built into a diecast box measuring approximately 100 x 50 x 25mm. The shallow depth of the box means that the PCB section accommodating the OM350 must be only about 17mm wide. This PCB is actually supported and mounted on the centre electrodes of the 75 ohm sockets.

Install the capacitors and diodes on





Above: the PC board layout for the power supply unit. Take care to ensure correct polarity of the capacitor and diodes.

Left: actual size reproduction of the PC pattern. The board should be cut into two sections, as indicated by the component overlay diagrams (see text).

the PCB before soldering in the OM350. Use a small iron for this job.

The power supply module is built into a plastic utility box with a light-gauge aluminium lid. Its measurements are 130 x 67 x 40mm. The PCB section for this module measures 60 x 50mm. Assembly is straightforward, but make sure that you observe correct polarity of the capacitor and diodes.

If you are using an AC plugpack to power the unit then the AC input (12V) can be made via a 2-pin DIN socket. If you are going to build in the transformer, you will have to juggle the PCB and sockets so that they do not interfere with the transformer core. Make sure that the mains cord is correctly terminated: terminate the active and neutral leads to a two-way insulated terminal block and connect the earth wire to a solder lug secured by one of the transformer mounting screws.

If you intend to use the masthead amplifier as a signal booster in a home unit situation, you will need a larger plastic utility box to accommodate both sections of the PCB (in one piece). If you are building this version you can dispense with two of the 75 ohm coax sockets since the connection from the output of the OM350 to the inductor load is made already via the copper pattern.

> We estimate that the current cost of parts for this masthead amplifier is approximately
>
> **$30**
>
> This includes sales tax but does not include the power transformer.

Leave installation of the inductor L1 till last. This enables the 12V supply to be checked before powering up the OM350.

Having checked that the circuit is working correctly, the masthead amplifier can be installed. The power supply module can be attached to the rear panel of the receiver while the OM350 module can be installed at the masthead (where else?). The diecast box should be mounted so that the 75 ohm sockets point downwards, to prevent the entry of water. The seam of the box and all screw heads should be sealed with a non-hardening caulking compound.

In is also important to ensure that water does not enter the coax down lead via the 75 ohm plug. The caulking compound can help here too. The diecast box can be attached to the mast with a U-clamp.

Build a solid state refrigerator . . .

Experiment with Peltier effect devices!

Ever thought you'd like to experiment with one of those fancy Peltier-effect thermoelectric modules they use in space craft and other way-out applications? Well, they're now available to the hobbyist at quite moderate cost. Here's your chance to build a no-moving-parts solid state refrigerator!

by GREG SWAIN

Ever heard of the "Peltier effect"? I certainly hadn't — at least not until I began to work on this article.

What's sparked all the interest is that thermoelectric modules based on the Peltier effect are now readily available at quite low cost. A Peltier effect device is basically a solid state refrigerator/heat pump, and is used in many specialised heating and cooling applications. The devices have been around for quite some time, but have previously been too expensive for the hobbyist to consider.

You won't find reference to the Peltier effect in any general electronics text. One has to go to a specialised text on thermal physics or thermodynamics for that. So before taking a closer look at the Peltier effect device, let's first find out what the Peltier effect is all about.

The Peltier effect was discovered quite a long time ago — in 1834, to be exact — by the French physicist Jean C. Peltier. It is the heating or cooling effect produced when a direct current is passed through the junction of two dissimilar metals. The junction liberates heat energy (becomes hot) when the current is passed in one direction, and absorbs heat energy (becomes cold) when the current is passed in the opposite direction.

The P/N 601-4000 Peltier effect device comes packaged in a plastic bubble pack that includes application notes.

In practice, it is quite difficult to observe the Peltier effect in a single junction circuit. We won't go into the reasons for this. Suffice to say that more practical circuits are based on the classic thermocouple, a device with two bimetal junctions.

The basic idea behind the thermocouple is illustrated in Fig. 1.

If you look closely at Fig. 1 you will see that the two metals making up one junction are connected in the opposite sense to the metals at the other junction, at least as far as current flow in any one direction is concerned. What happens now is that, when a direct current is passed through the thermocouple, one bimetal junction becomes hot while the other becomes cold.

As with a single junction device, the heating and cooling effect in each junction of a thermocouple is reversible. All one has to do is reverse the direction of the current flow. The same amount of heat is liberated by a junction when the current flows in one direction as is absorbed when the current is reversed.

This is a fundamental concept of the Peltier effect and differs from the heating effect of current flowing in a resistance. In the latter case, heat is always generated regardless of the direction of the current flow. Another difference is that the heat produced by

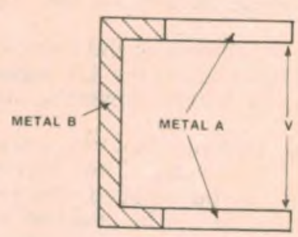
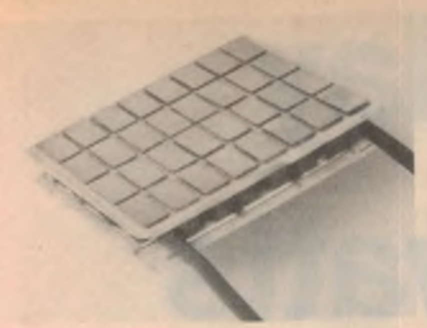


FIG. 1

Specifications

Minimum temperature differential:	30°C
Power requirements:	8A at 3.5V DC
Hot side temperature:	50°C
Dimensions:	32 x 32mm
No. of thermocouples:	30
Maximum device temperature:	100°C



Close-up view of the P/N 601-4000 Peltier device. Outer plates are held together by semiconductor pillars which form the thermocouple array.

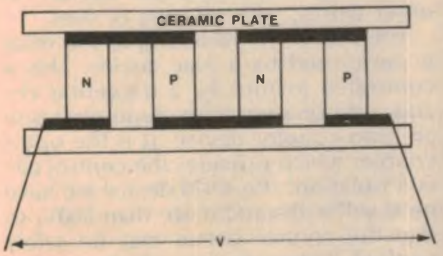


FIG. 2

the Peltier effect is proportional to the first power of the current, whereas the heat produced in a resistance is proportional to the square of the current.

The Peltier effect is reversible in another way. As we've already seen, the application of DC power to a thermocouple causes one junction to become hot and the other to become cold. By the same token, if we take a thermocouple and maintain the junctions at different temperatures an EMF will be generated across the terminals of the device.

This latter effect is called the Seebeck effect, and was discovered by Thomas J. Seebeck in 1821 — some thirteen years prior to the discovery of the Peltier effect!

The electromotive forces generated by the Seebeck effect are quite small, so a thermocouple is not really a useful source of electricity. The effect is, however, usefully exploited in the measurement of temperature and temperature differences, and the measurement of high frequency AC currents in RF circuits.

A practical Peltier effect device consists of two (or more) parallel plates bonded together by pillars of P and N type silicon semiconductor material. These pillars form an array of series connected thermouples, arranged with all the cold junctions in contact with one plate and all the hot junctions in contact with the other. The plates are made of ceramic and carry a regular pattern of copper pads, each pad corresponding to a thermocouple junction.

Electrical leads are attached to the device to allow convenient connection to a power supply. Note that the use of semiconductor thermocouples makes the device polarised. It must be connected to the power supply with the correct polarity, and cannot be reversed like ordinary bimetal thermocouples.

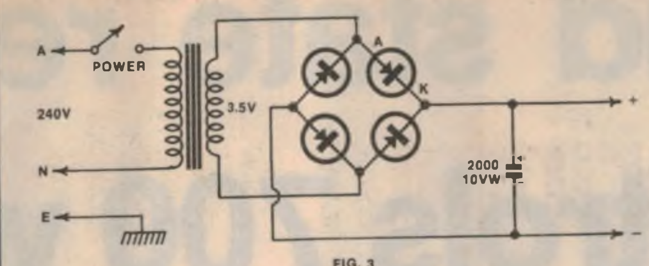


FIG. 3

Typical power supply configuration. A soldering iron transformer makes a handy power transformer for this project.

When the required DC power is applied to the module, the top surface becomes cold while the bottom surface (on which the leads are attached) is heated up.

Think of a Peltier effect device as a heat pump if you like. The applied electrical energy serves to pump heat energy from the cold side of the module to the hot side.

Typical of the devices now available is the P/N 601-4000 thermoelectric module made by Cambridge Thermionic Corporation, USA. This device is imported into Australia by Electronic Development Sales Pty Ltd, and sold through various outlets. Our sample came from Stewart Electronics (33 Sunhill Rd, Mt. Waverley 3149), who sell the device for $15.50 plus packaging and postage, where applicable.

The accompanying table sets out the specifications of this device. As you can see, it requires a pretty hefty power supply to achieve the maximum temperature differential across the module — 8A at 3.5V in fact! The specifications also indicate that, with the hot side at 50°C, a minimum temperature differential of 30°C will be attained by this device in a normal ambient condition.

So what can the device be used for? One application suggested by the manufacturer is to use the device to make a small solid-state refrigerator. This could be used to cool a small amount of fluid in a container, for example.

Just imagine — Peltier-effect-cooled beer!

The general scheme is shown in Fig. 4. Here are the main construction steps:

- Smear a thin layer of silicon grease on the bottom surface of the module and attach the module (as shown) to a heatsink. An extrusion type heatsink with fins and measuring around 80 x 80 x 40mm should do the job; insulate the module from the heatsink using a mica washer.
- Connect and position a small blower in such a way that it throws air onto the heatsink.
- Apply a thin layer of silicone grease to the top surface of the module and place a small metal container on it. Use a mica washer to insulate the module from the container.
- Insert hold-down screws through the container and the heatsink, and tighten using evenly applied pressure. Do not overtighten, as damage to the module may occur.
- Cement foam insulation in place all around the container to minimise heat leak from ambient.

Any liquid placed in the container will now start cooling the moment DC power is applied to the module. You can increase the cooling capacity or reduce the cool-down time by increasing the number of modules in the system. If more than one module is used, connect them electrically in series.

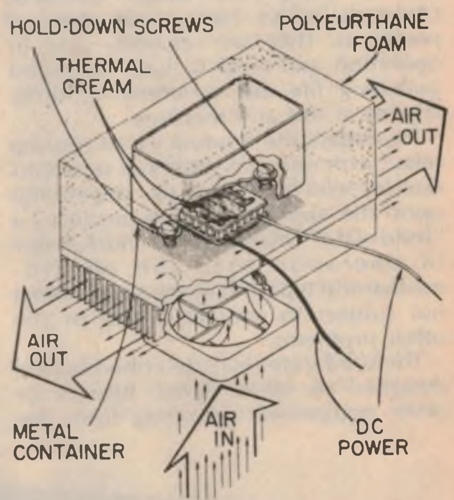


Fig.4: basic scheme for a simple solid state refrigerator.

Note also that the more efficient your heat sink, the more efficient will be the cooling capacity of the module.

That's one application of a Peltier effect device. Other uses could include: controlling the temperature of photographic solutions, providing temperature control for crystal oscillator circuits, cooling heat sensitive components and equipment, and temperature control of laboratory specimens. We'll leave it to you to apply a Peltier effect device to your own particular application.

Solid state relay controls 700 watts

You can use this low-cost device to control mains-operated equipment of up to 700 watts rating, using just a few milliamps at low voltage. It's just the shot for remote switching of equipment or lights in another building, or for controlling equipment with a microcomputer.

by RON de JONG

The traditional way of controlling high currents or voltages with a small control signal has been to use an electromechanical relay: a sensitive electromagnet which operates one or more sets of heavy-duty switch contacts. However relays have a number of problems. They are relatively slow in operation and tend to have a limited switching life due to contact pitting, ingress of dirt and moisture.

Nowadays the tendency is to replace relays with one of a variety of semiconductor switching devices, depending upon the application. This produces a "solid state" relay which is much faster in operation than the electromechanical type, yet at the same time is not subject to contact pitting or the other problems.

The solid state relay described here is designed to allow lights, heaters or other equipment operating from the 240V AC mains to be controlled by a few milliamps of direct current. It has an operating time of less than 10 milliseconds, and will control loads of up to 200 watts. With the addition of a small heatsink, this can be increased to at least 700 watts. And the control signal is completely isolated from the mains, for full safety.

What can you do with it? Well, you can use a single unit to turn a light or transmitter on and off in another building, using a low-voltage control line run in light duty cable or even bell wire. Or you can use three or four units with a simple digital counter, to drive a few dozen lamps for a "light chaser" or dynamic advertising sign.

You can also use a number of units to interface between a microcomputer and a group of power-operated devices, so that the computer can turn each one on and off as desired.

It's a general purpose device, in other words, with all sorts of uses.

The actual AC switching in the relay is performed by a triac device. This is controlled in turn by a triggering circuit, whose operation depends upon an opto-coupler device. It is the opto-coupler which provides the control circuit isolation: the 4N28 device we have used will withstand more than 500V, so that the control circuit may be safely earthed. Other devices which are pin-compatible with the 4N28 may be used for even higher isolation if required — up to 2500V.

The triac is a bidirectional switching device which forms part of the thyristor family. It behaves rather like two SCR devices, connected in inverse parallel. The two main terminals are labelled MT1 and MT2, with the control terminals known as the G or gate.

Like an SCR the triac can be triggered into conduction by a small gate current; in this case it can occur when the mains is of either polarity, and the triac will conduct in the appropriate direction. It will remain on for the remainder of the current half-cycle, until the load current falls below the triac's holding current.

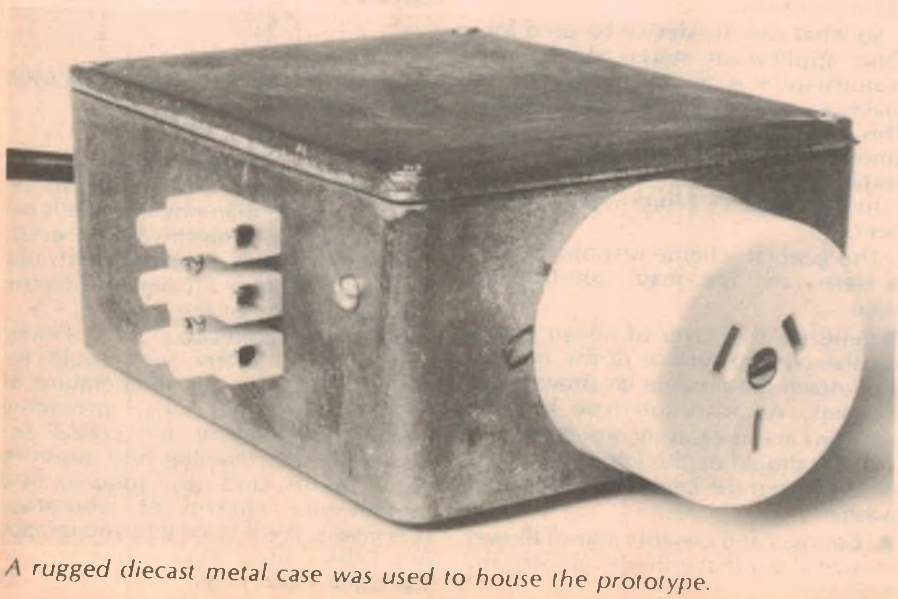
The trigger circuit we've used is a common one, as can be seen by referring to the circuit diagram. It is similar to those we've used in previous light dimmer projects and consists of an asymmetric trigger diode (ST4), a resistor R1 and capacitor C1. The trigger diode has a similar forward voltage characteristic to a triac, but it has a much lower breakover voltage.

The operation of the trigger circuit is quite straightforward. Assuming that the triac was conducting in the previous half cycle, the voltage across capacitor C1 will have decayed to about zero via R1 and the triac itself. Now as

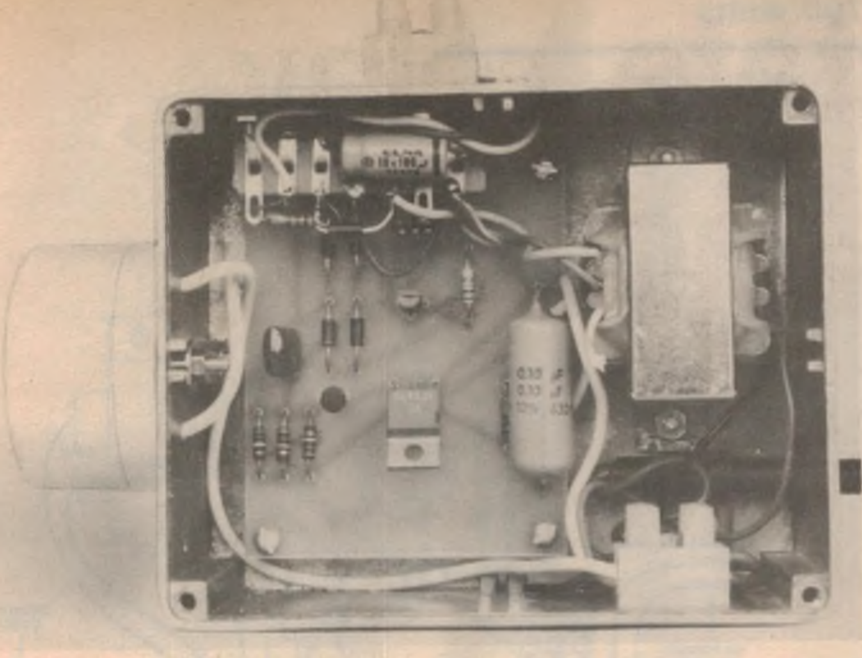
We estimate that the current cost of parts for this project is approximately

$22

This includes sales tax.



A rugged diecast metal case was used to house the prototype.



A small heatsink should be attached to the triac if loads greater than 200W are to be switched. Terminal block at top facilitates connections to trigger circuit.

the present half cycle begins, capacitor C1 will charge up via R1 until the voltage across the capacitor exceeds the breakover voltage of the trigger diode. When this happens capacitor C1 will discharge into the triac gate, triggering the triac into conduction.

The lower the value of R1, the faster C1 can be charged and the sooner the triac can be triggered on at the start of each half cycle. This is desirable because it allows the maximum power to be fed to the load; it also means that the triac switches on when the voltage is still low, minimising radio frequency interference (RFI).

Unfortunately reducing the value of R1 also increases the power dissipated in the trigger circuit, so a compromise must be struck. With the trigger circuit values shown the conduction angle is about 18 degrees, giving close to 99% of full load power — so close it doesn't matter.

The 100 ohm resistor and 0.1uF capacitor directly across the main terminals of the triac are not involved with the trigger circuitry, but form a "commutating" network. This is to reduce the rate of change of voltage (dv/dt) across the triac when inductive loads are switched. The dv/dt must be kept below the critical value for the triac concerned, otherwise the triac will trigger into conduction spontaneously.

The actual relay switching is performed by enabling/disabling the triac trigger circuit. This is done by the BC547 transistor, controlled in turn by the 4N28 opto-coupler. A diode bridge is used to connect these to the trigger circuit, as the transistor and opto-coupler can only conduct in one direction. The diode bridge allows them to control triggering on all half-cycles of the AC.

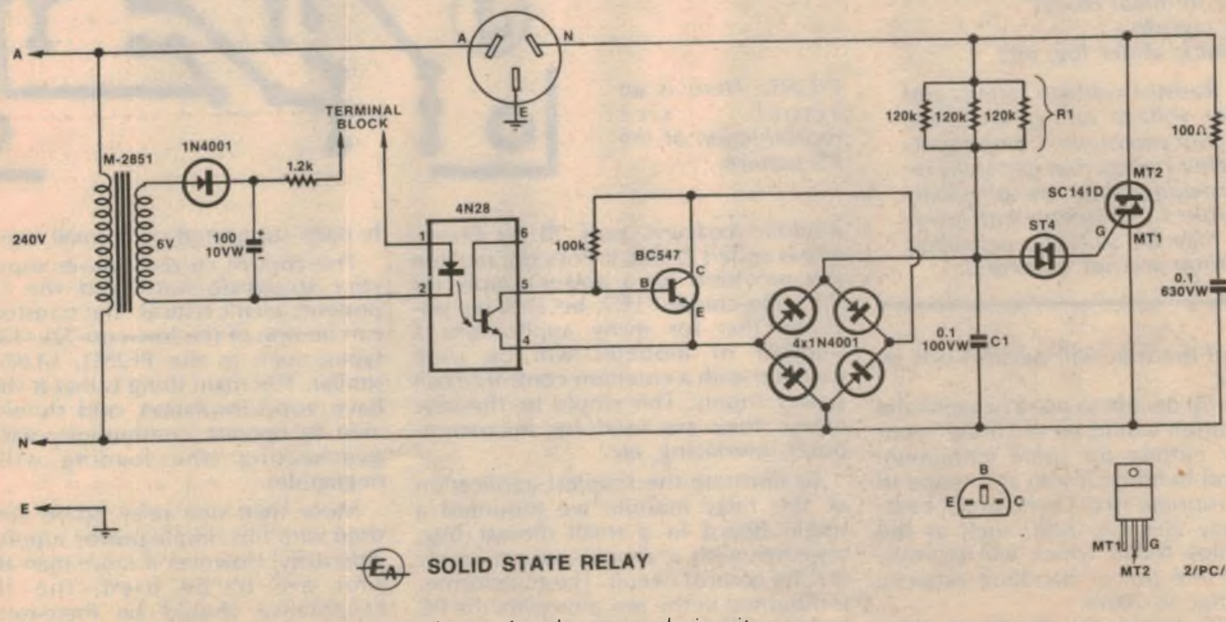
The opto-coupler is a most important part of the control circuit, because it provides the electrical isolation between the control circuit and the triggering and triac circuitry — which all floats at mains potential. The opto-coupler is essentially quite a simple device, consisting of a gallium arsenide (GaAs) infra-red emitting LED (light emitting diode) optically coupled to a light-sensitive silicon transistor. The electrical isolation between the two is provided by a thin sheet of transparent silicon dioxide (quartz).

By connecting the opto-coupler's phototransistor between the base and emitter of the BC547 as shown, the transistor is allowed to conduct if the phototransistor is not conducting. The BC547 thus shunts C1 in the triac triggering circuit, via the diode bridge, preventing the triac from triggering.

If on the other hand current is passed through the LED of the opto-coupler, so that the phototransistor is turned on, then this cuts off the BC547. As a result C1 is able to charge up at the start of each AC half-cycle, and the triac conducts to pass power to the load.

The whole relay circuit thus acts as a "normally off" switch, which is turned on whenever a current of 5mA or so is passed through the LED section of the opto-coupler.

Incidentally, if desired it is possible to change it into a "normally closed" switch, by dispensing with the BC547



The 4N28 opto-coupler provides mains isolation for the control circuit.

transistor and the 100k resistor and simply connecting the opto isolator across the bridge itself. There should be no problems with this arrangement. The maximum breakdown voltage of the asymmetrical trigger diode is 18V, which is well within the Vceo rating of the phototransistor.

All the circuitry except the power supply for the opto-coupler LED is mounted on a small PC board and there is some extra space on the board for a heatsink for the triac. This may be used when switching large loads, but free mounted the triac will switch loads up to 200W.

If you do decide to use a heatsink the best solution would be to "brew" your own by cutting up some aluminium sheet and bending it into a U shape of the appropriate size. Commercial heatsinks may also be used, such as the Thermalloy 6106B which will typically increase the power handling capacity of the triac to 700W.

The PC board for the basic relay module measures only 79 by 64mm, and is coded 79SR8. It does not include any provision for a power supply for the opto-coupler LED, because we envisage that for many applications a number of modules will be used together with a common control circuit power supply. This would be the case where they are used for microcomputer interfacing, etc.

To illustrate the simplest application of the relay module we mounted a single board in a small diecast box, together with a simple power supply for the control circuit. The transformer is mounted in the box alongside the PC board, with the remaining power supply parts supported on a small tagstrip.

The control current power supply is very straightforward and the components aren't critical. The transformer can be one of the low-cost 12V/150mA types, such as the PF2851, M2851 or similar. The main thing is that it should have good insulation, and should be able to operate continuously without overheating (the loading will be negligible).

More than one relay board can be used with this simple power supply, incidentally. However if more than about four are to be used, the filter capacitance should be increased in

(Continued on p 133)

PARTS LIST

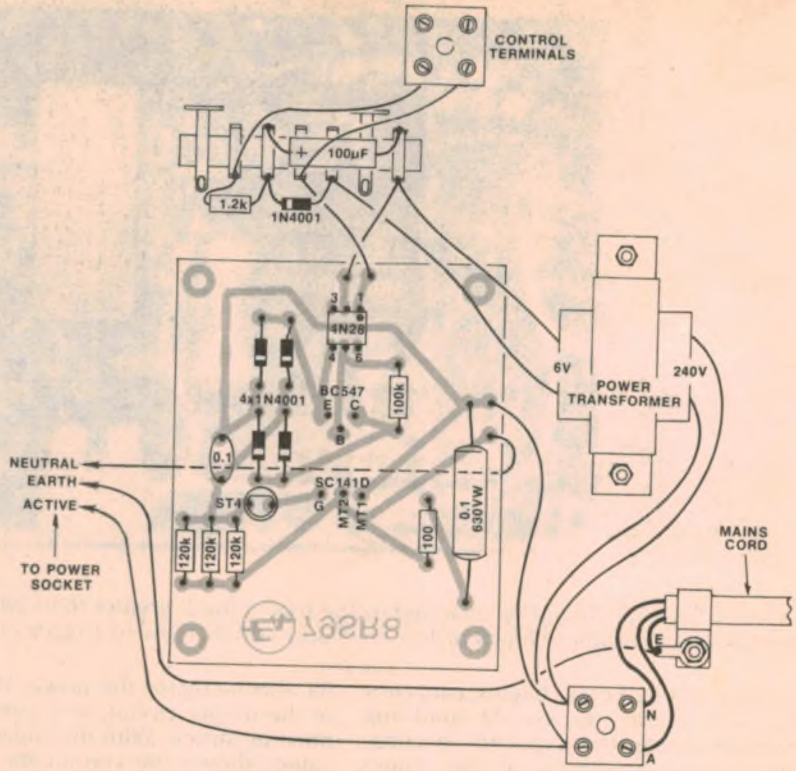
BASIC RELAY MODULE

- *1 PC board, 79 x 64mm, coded 79SR8*
- *1 Triac, SC141D or similar*
- *1 Trigger diode, ST4 or similar*
- *1 Opto-coupler; 4N28, TIL116 or similar*
- *1 BC547 or similar NPN transistor*
- *4 1N4001 or similar 100V diodes*
- *3 120k ½W resistors*
- *1 100k ½W resistor*
- *1 100 ohm ½W resistor*
- *1 0.1uF 630VW polyester capacitor*
- *1 0.1uF 100VW polyester capacitor*

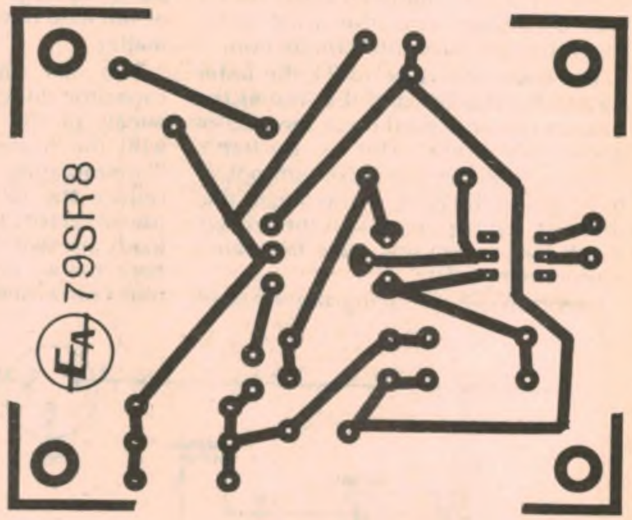
REMAINING PARTS FOR SIMPLE MAINS RELAY

- *1 Diecast aluminium case, 120 x 95 x 55mm*
- *1 12V/150mA power transformer*
- *1 3-pin mains socket*
- *1 3-wire mains cable and 3-pin plug*
- *1 1N4001 or similar diode*
- *1 100uF 10VW electrolytic capacitor*
- *2 3-way terminal blocks*
- *1 7-lug tagstrip*
- *Nuts, bolts, solder lug, etc.*

NOTE: Resistor wattage ratings and capacitor voltage ratings are those used on our prototype. Components with higher ratings may generally be used providing they are physically compatible. Components with lower ratings may be suitable, providing their ratings are not exceeded.



TOP: This wiring diagram shows the PC pattern as viewed from the component side. Make sure that the mains cord is securely anchored.



RIGHT: Here is an actual size reproduction of the PC pattern.

DIN/CCIR weighting filters

Recently, we decided to produce a set of filters to enable us to perform weighted measurements of signal-to-noise ratios of audio equipment. This article gives brief details of the filters, which give weighting according to the DIN and CCIR standards.

by RON DE JONG

Signal-to-noise ratios of audio equipment can be quoted in two forms, either "weighted" or "unweighted". The term "weight" in this context refers to the method by which noise in the midrange is given emphasis and noise at the upper and lower ends of the audible frequency range are attenuated.

An unweighted signal-to-noise ratio measurement is made by simply using an AC millivoltmeter to measure the residual noise of the equipment under test. The millivoltmeter will have a frequency response which is flat, ie, within say ±0.5dB from 20Hz to 20kHz. The value of the noise voltage measured is then referred to a reference level (say 1 volt RMS) to obtain a signal-to-noise ratio of so many decibels.

The argument which is put forward in favour of weighted signal-to-noise ratios is that the human ear does not have a flat frequency response, and therefore does not hear different types of noise equally. A given level of hiss may sound much louder than the same level of rumble or hum. Noise weighting filters are an attempt to overcome this shortcoming.

We have designed a composite filter to provide weighting characteristics conforming to the DIN and CCIR standards, as these are the most commonly used in measuring high fidelity audio equipment. The filter characteristics are shown in the graphs below.

Both filter characteristics emphasise midrange noise and severely attenuate noise at the high and low ends of the audible spectrum. The DIN characteristic, for example, boosts noise in the region of 5kHz by more than 8dB. Above 10kHz, the response takes a nosedive at the extreme rate of 48dB/octave. At the low frequency end, the DIN response starts off at a rate of 6dB/octave below 1kHz but the rate approaches 12dB/octave around the 20Hz mark.

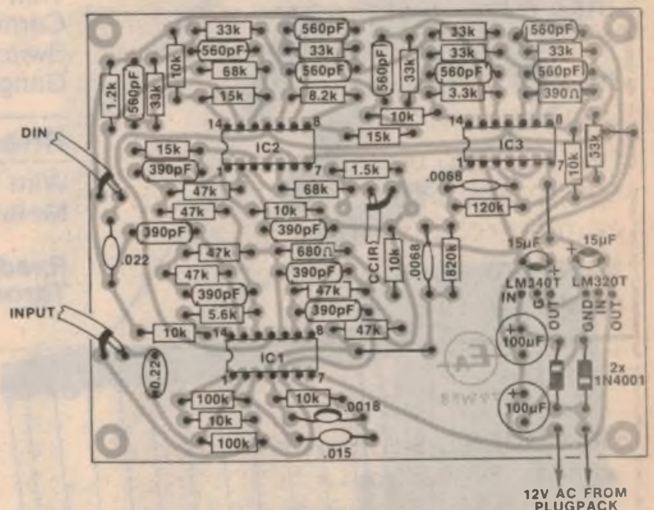
By comparison, the CCIR characteristic boosts the noise centred on about 7kHz by almost 13dB. Above 10kHz, the response slopes off rapidly at about 13dB/octave, which is not quite as drastic as the high frequency roll off for the DIN filter. The low frequencies are rolled off below 1kHz at the modest rate of 6dB/octave.

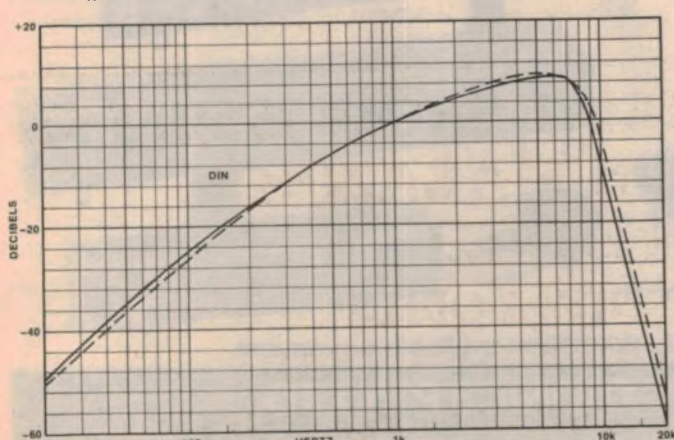
Our approach to the design of this composite filter was to use basic second and third order filters in cascade to make up the desired response — DIN or CCIR. The third page of this article shows the basic circuits of second and third order filters, each using an op amp in the non-inverting mode.

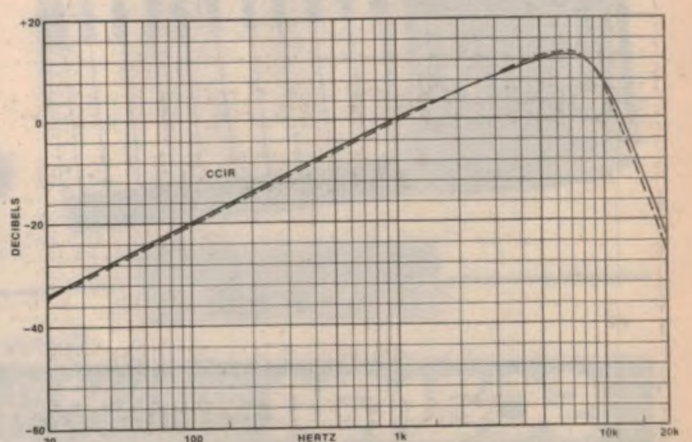
As shown in the diagram, the second order filter has two resistors and capacitors marked R and C, respectively. The R and C values determine the "corner" frequency of the filter, ie the frequency at which rolloff begins. Since this is a second-order filter, it has two RC time-constants and gives a maximum slope beyond the corner frequency of 12dB/octave.

As shown, the op amp circuit is a low pass filter, which means that it passes the frequencies below the corner frequency (also known as the

Three uA4136 quad op amps provide the active circuitry for these weighting filters.







The dotted lines on these two filter curves show the deviation from ideal response obtained with the circuit published here.

DIN/CCIR weighting filters

"breakpoint" or "-3dB point") and blocks those above. By interchanging the positions of the components marked R and C, the circuit can be changed to a high pass filter, which has the opposite function to a low pass filter.

In the same circuit, resistors R1 and R2 control the negative feedback around the op amp and thus the "Q" of the filter. "Q" is a term originally used to describe the sharpness of tuned circuits. Used in this context, "Q" describes the sharpness of the filter characteristic in the region of the corner frequency.

By the way, the filters used in these circuits have a "Butterworth" response. For the purpose of this article, we can define Butterworth filter response as providing a reasonably sharp corner characteristic together with minimum phase anomalies in this region and having a flat frequency response within the pass-band.

Together with the second-order filter is shown the circuit for a third-order filter. This is merely a second-order filter with a passive RC network tacked on the end and followed by a unity-gain op amp buffer (or "voltage-follower"). A third-order filter gives a maximum slope beyond the corner frequency of 18dB/octave.

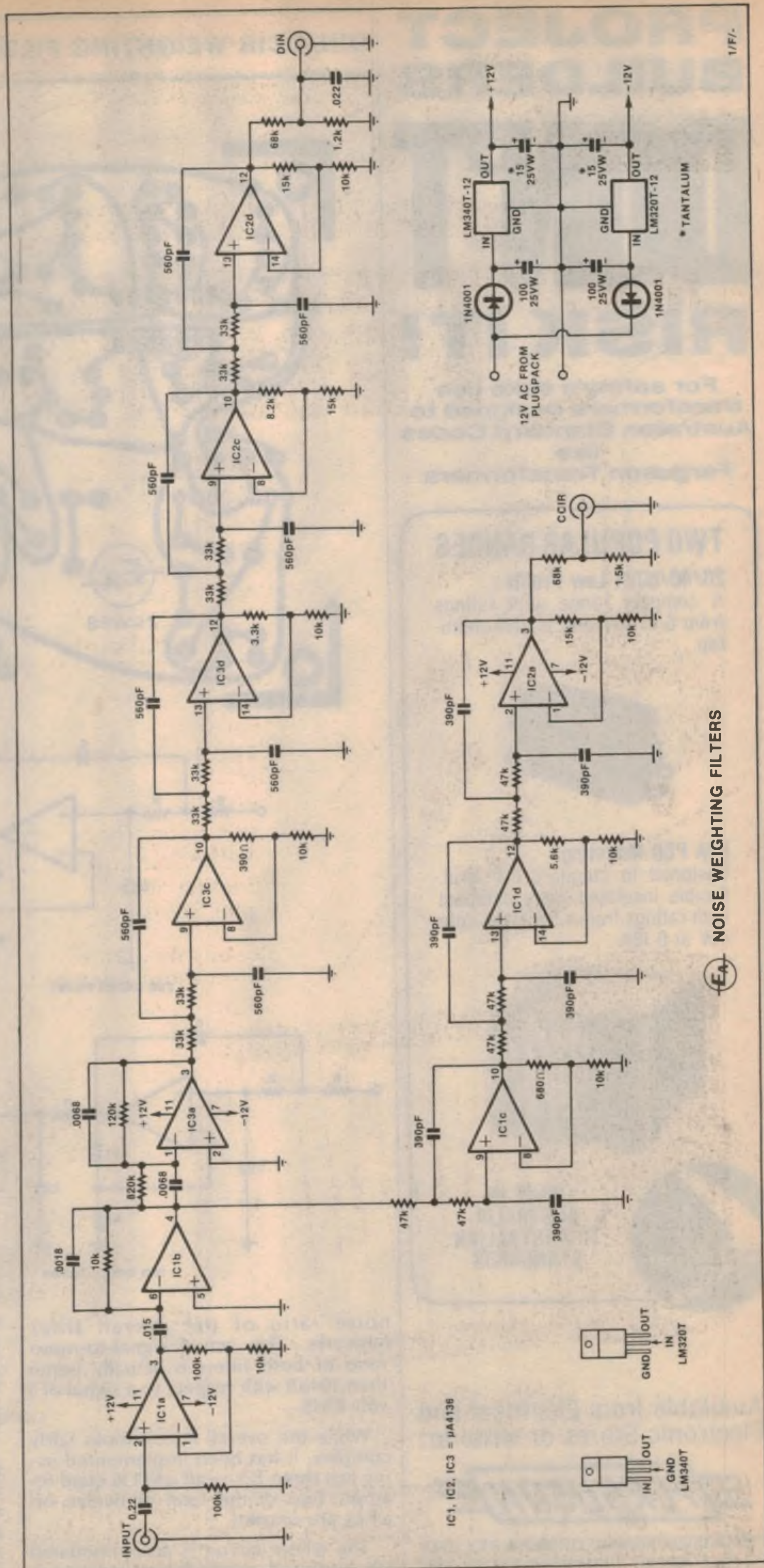
In the same way, a 4th-order (24dB/oct) filter can be made by cascading two second-order filters. A fifth order (30dB/oct) filter can be obtained by cascading second and third-order filters.

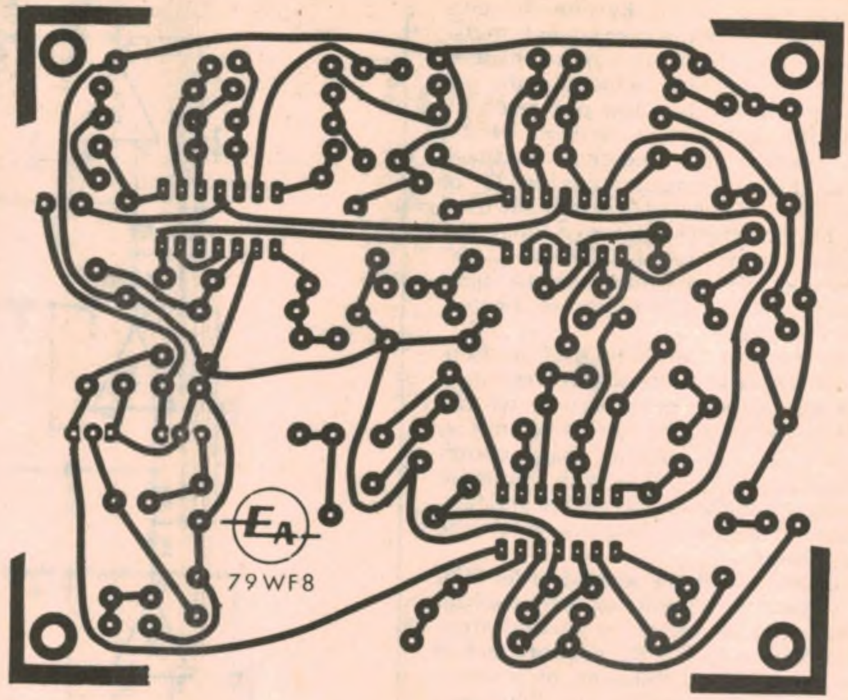
Reference to the complete circuit of the composite DIN/CCIR filter will show how we have used combinations of second-order filters to obtain the desired slopes. The CCIR filter for example uses three second-order filters in cascade, to obtain the 36dB/octave treble cut-off slope. Similarly, the DIN filter uses four second-order filters to obtain the 48dB/octave treble slope.

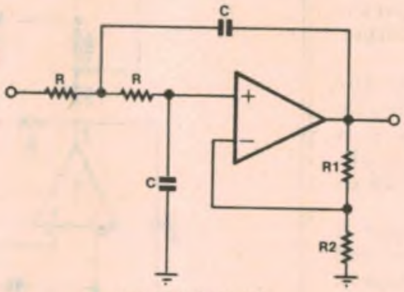
The bass rolloff slope of the CCIR filter (6dB/oct) is provided by op amp IC1b, acting as a high-pass filter. The more complex bass rolloff slope for the DIN filter is provided by the combined effects of IC1b and IC3a.

One of the design assumptions for these filter stages is that each will be driven by a low source impedance. This condition is met automatically when cascading filters, since each stage has a low output impedance. However, the first filter stage still needs a buffer and this function is provided by IC1a. This stage also provides a signal gain of 10. This is balanced by a passive attenuator at the output of the DIN and CCIR filters, to restore the overall gain to unity.

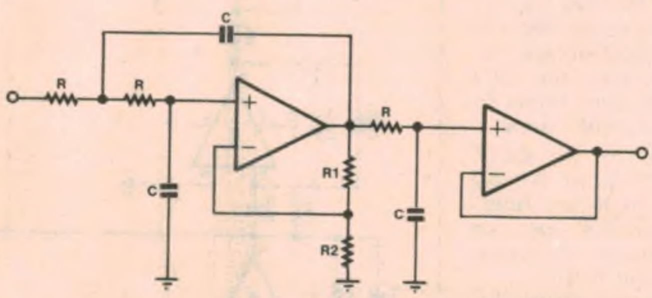
The reason for first amplifying by ten and then attenuating by the same amount is to improve the signal-to-







2ND ORDER FILTER



3RD ORDER FILTER

At top is the full size artwork for the PCB. At left, diagrams of the basic second and third-order low-pass filters. Interchanging capacitors and resistors marked R & C produces high-pass filters.

noise ratio of the overall filter networks. The actual signal-to-noise ratio of both filters is actually better than 104dB with respect to a signal of 1 volt RMS.

While the overall circuit looks fairly complex, it has been implemented using just three ICs — all uA4136 quad op amps. Two of the total of twelve op amps are unused.

The whole circuit is accommodated on a printed circuit board measuring 105 x 86mm (coded 79WF8). This includes the power supply rectifier and filters and the positive and negative regulator ICs. We powered our prototype from a 12VAC plugpack transformer.

We mounted the PCB in a diecast box to obtain effective shielding. The combination of effective shielding and external power transformer keeps hum to an absolute minimum and helps achieve the excellent signal-to-noise ratio quoted above.

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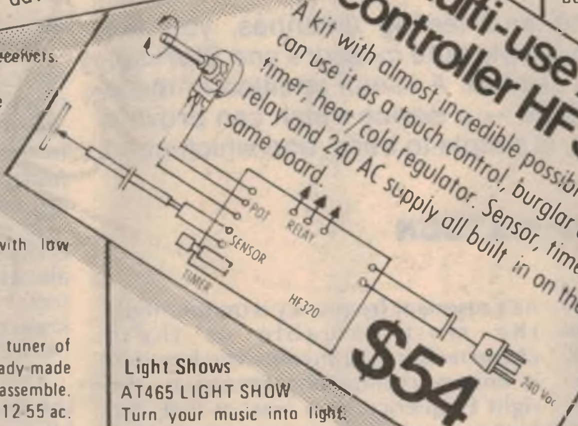

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This quality kit uses microphone input instead of connection to the audio output. 1599w max.
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JK07	DUAL TONE DECODER FOR R/C MODELS	$43.00
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Bridge checks impedance, resonance, and SWR

If you are involved in building and testing antennas, you are probably already aware that the simple tape measure and SWR approach leaves something to be desired. A useful addition to these basic tools is an impedance bridge — a device which can provide valuable data about an antenna, is simple to build, and which need not cost a fortune.

by PHILIP WATSON

To set the record straight, let us look first at the SWR meter and consider its capabilities and limitations. The SWR meter is a useful device but, unfortunately, many people have forgotten, or never fully appreciated, its limitations.

For an SWR reading to be free from ambiguity, the following conditions must prevail:

(1) The antenna must be known to be resonant at the test frequency.

(2) The probable impedance of the particular antenna type should be known and the resultant SWR accepted if it is reasonably close or

(3) If the SWR is not acceptable, then a matching device of some kind — T match, gamma match, stub, etc — must be provided and the SWR meter used to adjust it.

It is in this last role that the SWR meter is most valuable: where there is a matching device which should be capable of providing a near-perfect match, but which needs to be adjusted. But, always, condition (1) must first be satisfied. If the antenna is not resonant, no amount of feedline fiddling will alter that fact.

This is where the impedance bridge fits into the scheme of things. As well as measuring the antenna impedance, it can indicate — by the nature of the impedance measurement — whether the antenna is resonant at the test frequency or, by varying the frequency, indicate at what frequency it is resonant. Additionally, with simple auxilliary equipment it can identify any reactive component as either inductive or capacitive, and measure its value.

But the ability to measure the antenna's resonant frequency is undoubtedly the most valuable of these characteristics. As anyone who has tried it knows, cutting an antenna to the right frequency — at least at VHF and higher — is not always as easy as theory suggests. Conductor diameter, often tapered or stepped, must be allowed for, along with other variables such as the physical layout of the feedpoint, and these can add up to a significant error.

Such problems can be avoided if we first use a bridge to determine the resonant frequency, and adjust it if necessary. At the same time we can measure the load the antenna is presenting and, from this, get a good idea of the likely SWR.

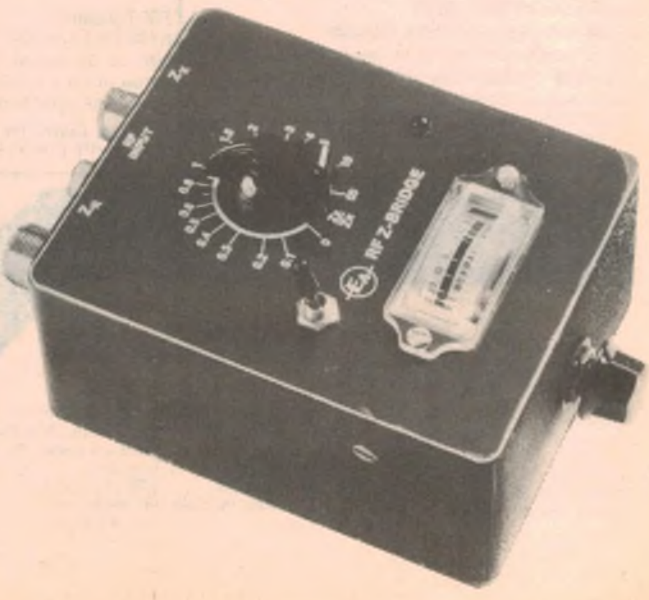
When the SWR has been determined, a decision can be made as to whether anything needs to be done about it. And if matching devices have to be made and adjusted, the impedance bridge will confirm when they are working as intended.

It is also very useful for cutting quarter-wave and half-wave stubs — always a tricky operation if the velocity factor of the cable is not precisely known, or where allowance has to be made for a terminating connector.

This particular bridge will do these things, and work all the way from the HF bands up to 432MHz if required. It is simple to build, uses readily available components and should cost less than $50.

All of which adds up to a very attractive proposition.

In one sense, this is not really a new project. It is a re-presentation, in modified form, of the Impedance Bridge described by Editor, Jim Rowe, back in June 1971 as part of his Powermatch system. For a number of reasons we felt that the time was opportune to



The bridge is built in a diecast box. Three sockets: "Zr", "Zx", and "RF In", are mounted on the left hand end, and there is a meter sensitivity control at the opposite end. The toggle switch and LED are part of a bias network which improves the null reading.

take another look at it.

In fact, it was work on some antenna projects which prompted the author to build this bridge, in an effort to clarify the problems already discussed. It started out as a purely private project but several points which arose suggested that there could be some merit in re-presenting it. Further emphasis resulted from the fact that the amateur scene, particularly on two-metres, has changed significantly since the original article appeared.

For example, the original article conceded the disadvantage that the bridge needed a source of RF at the relevant frequency, from either a high output generator or a low power transmitter. Not many amateurs have access to such a VHF (or UHF) generator, and doctoring an existing transmitter to deliver a fraction of its intended power was not always convenient.

But it is a rather different story today. Most commercial two-metre transceivers feature a low-power facility, typically from one to two watts, which is ideal for this application. In addtion, those sets using phase locked loops provide coverage across most or all of the band in steps (typically 5 or 10kHz) which are both usefully close together and highly accurate. For our purpose they are a good deal better than most VHF generators.

The popularity of commercial equipment raised another point; the almost inevitable use of the PL259 plug and its matching S0239 socket for antenna connections. The original unit used Belling-Lee connectors, which were then quite appropriate, and these made possible a very compact unit. But when we considered fitting two S0239 sockets and one Belling-Lee connector to the same box it was immediately evident that it would be a squeeze at best.

The upshot was a decision to use a slightly larger die-cast box and, from this, came another idea. There was now room to fit a small meter in the same box, making it more of a self-contained unit than if we retained the original idea of using the meter in the Powermatch unit. The most logical meter seemed to be one of the low-cost edge type, the only query being whether the best sensitivity available, 200uA, would be adequate; the original circuit was designed for a 50uA meter. In the event, this was not a problem.

A further refinement was subsequently developed, in the form of a bias network for the detector diode, and which gives a somewhat improved null indication. We will have more to say about this later.

Apart from these minor changes, this version is electrically and physically similar to the original design. As the name implies it is a bridge; the classic wheatstone bridge configuration in fact, and a study of the circuit will confirm this. The four arms of the bridge are made up as follows: (1) A reference or standard resistor which plugs into the "Zr" socket and which may, typically, be a 50 ohm or a 75 ohm dummy load. (This need not have more than a 1W power rating.)

(2) The antenna or other device under test, which plugs into the "Zx" socket. Since it is seldom practical to operate the bridge directly at the base of an antenna, connection is made via a length of appropriate impedance cable. This must be either one half wavelength long, or an exact multiple of half wavelengths, in order that the impedance at the base of the antenna is reproduced as closely as possible at the bridge terminals. (Note: The length of an antenna cable is not critical, once it has been correctly matched.)

(3 & 4) These two arms are made up from the two sections of the 100-ohm pot, either side of the moving arm. When these two sections are exactly equal, the bridge will balance (or null) when the resistors "Zr" and "Zx" are also equal (to each other).

Conversely, if they are not equal, the amount by which the pot has to be moved from its centre position to achieve balance becomes an indication of the inequality, and the pot can be calibrated accordingly.

The null indicator consists of a diode in a simple shunt detector circuit, fed from the bridge via the two 470pF capacitors, and feeding the meter via two 560 ohm multiplying resistors. A 1k pot in parallel with the meter serves as a sensitivity control.

This brings us to the biasing network for the null indicator. The need for this arises from the fact that the diode has a

> We estimate that the current cost of parts for this project is approximately
>
> **$50**
>
> This includes sales tax.

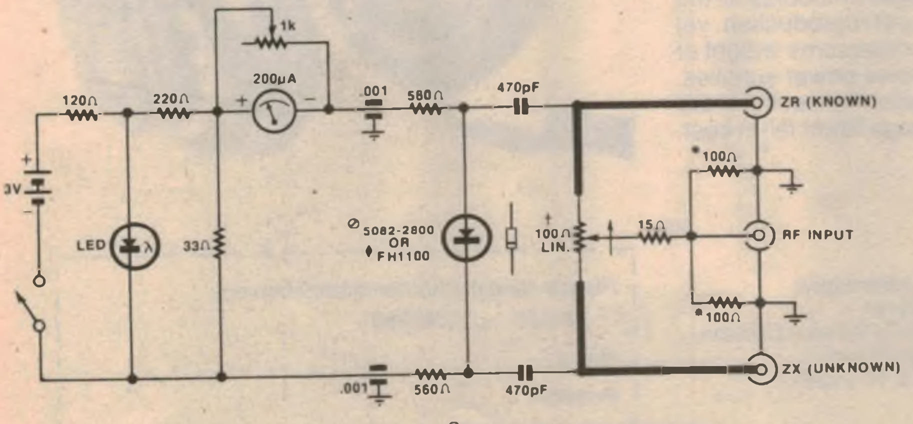
PARTS LIST

1 Die cast box, 115 x 90 x 50mm O.D. Eddystone 6908P or similar
1 200uA edge type meter
2 S0239 sockets
1 PL259 plug
1 Belling Lee socket
1 Belling Lee plug
1 Miniature toggle switch
1 Hot carrier diode, 5082-2800 or FH1100
1 LED
1 Label
1 Plastic battery holder to suit 2 x "AA" cells
1 Pair terminals to suit above
2 "AA" cells
1 8 terminal miniature tag strip
1 Pointer knob
1 Round knob

RESISTORS
(½W unless specified)
2 560 ohm
1 220 ohm
1 120 ohm
2 100 ohm
1 33 ohm
1 15 ohm
1 1000 ohm "C" taper pot
1 100 ohm linear moulded carbon pot, Plessey type 02000/326

CAPACITORS
2 .001uF feedthrough type
2 470pF disc ceramic

MISCELLANEOUS
Co-axial cable, impedance and length as required, hookup wire, solder lugs, nuts and bolts, brass for partition, etc.



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EA RF IMPEDANCE BRIDGE 7/SW/-

The circuit is simple electrically, the main requirement being short leads and symmetrical layout in the RF portion, to the right of the feedthrough capacitors. The heavy lines indicate straps from the sockets to the pot.

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threshold level, amounting to a few hundred mV, below which it will not conduct in either direction. Thus, as the bridge approaches a null condition, and the voltage across the detector falls below this threshold, the meter ceases to read before a true null is reached. It remains at zero until the bridge becomes unbalanced by a similar amount in the opposite direction, resulting in a "dead" zone around the true null.

With a little skill it is possible to interpolate the null between the threshold points and, also, to judge the depth of the null by noting the distance between them. But the need for such judgement is best avoided and this is the purpose of the bias circuit.

By applying a small voltage, at least equal to the diode's threshold voltage, in series with the meter and diode, the diode is made to conduct before a signal is applied to it from the bridge. As a result, the meter remains active right down to the null point, making the bridge more accurate and easier to handle.

The voltage is obtained from a battery and divider network. Part of this network is a LED which performs the dual function of warning indicator, to safeguard the battery, and a simple voltage regulator to compensate for changing battery voltage. The 120-ohm resistor is the normal current limiting resistor for the LED, while the 220-ohm and 33-ohm resistors across the LED divide the LED voltage to that required by the diode. These two resistors may need some adjustment to suit the individual LED.

The bias voltage should be such that the meter just starts to read, and is not particularly critical once this value is reached. The fact that the meter operates with a false zero in no way affects the accuracy of the system.

So much for the circuit and theory. To put this into practice at VHF or UHF calls for a very carefully designed physical layout; one that will minimise the effects of stray lead inductance and capacitance, and which is inherently symmetrical. Also, for practical reasons, it is necessary that the RF source, the antenna, and the reference resistor can all be earthy on one side.

This design takes care of these points particularly well, and the reader need only follow our layout to be assured of a bridge which is inherently balanced from the start. This should not be difficult if the photographs are studied carefully.

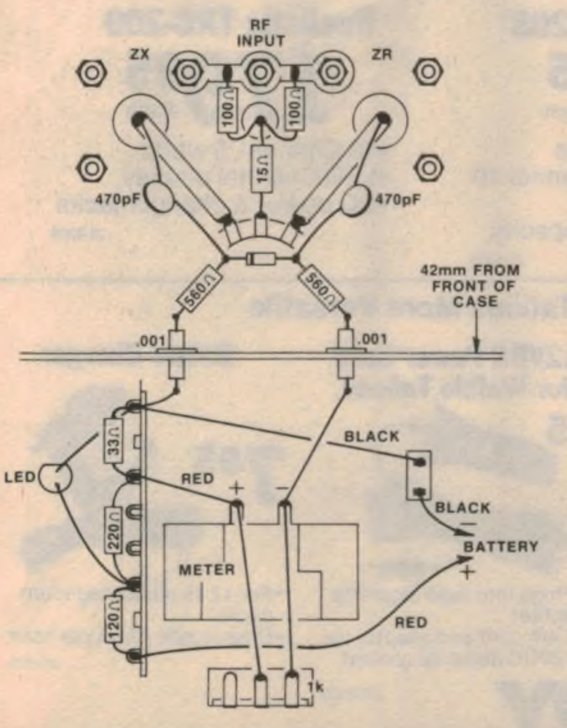
Most of the components are standard off-the-shelf items, but one special item is the 100 ohm pot. It must be a good quality carbon track (not wire wound) with a linear law. They are supplied by Plessey Components and at least one advertiser, Radio Despatch Service, has acquired stocks in anticipation of this project.

The meter is simply a null indicator and so the ultimate accuracy, calibration, or scale are not important; a simple "0-10" scale would be a logical choice if available.

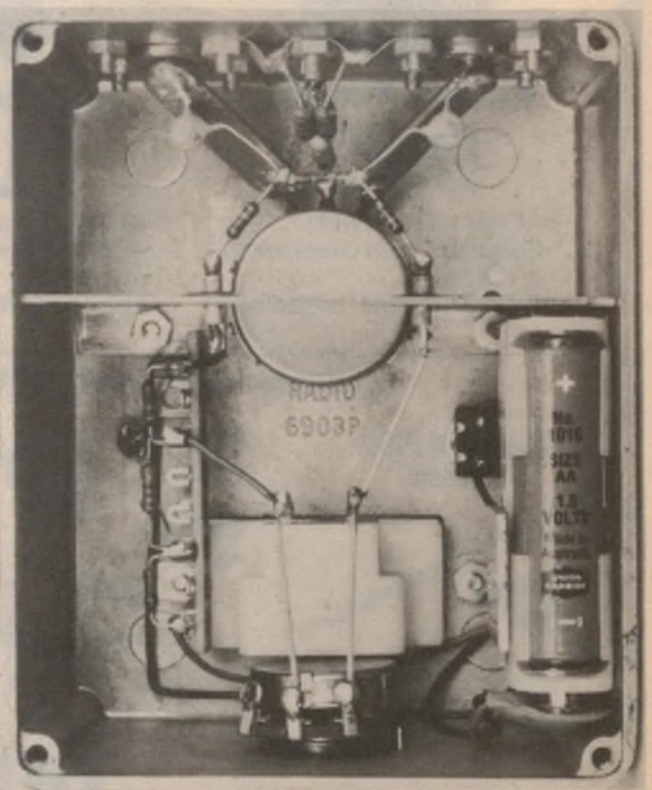
About the only other component worthy of comment is the detector diode. This is a hot carrier type to cope with the frequencies involved, and should have an adequate PIV rating. Two suitable types are specified and the Hewlett-Packard version is in good supply. The Fairchild version is no longer being imported, but small stocks may be available from individual dealers. Note that, while the polarity of the diode is not critical as far as the circuit is concerned, the way we fitted it suits the polarity of the meter terminals and the associated wiring.

The unit is constructed in a die-cast box measuring 115mm (L) x 90mm (w) x 50mm (D) O.D. Three holes need to be drilled in one end to accommodate two S0239 sockets and one Belling-Lee socket, or, at a pinch, three S0239 sockets. A hole is needed in the opposite end for the sensitivity pot. Several circular holes and one rectangular cut-out are required in the top of the box, and the panel label, reproduced here, can be used as a template. (Art work for this label will be distributed to manufacturers and labels may be available through your parts supplier.)

The photographs clearly show the short leads and symmetrical layout which are the essential features of the unit. The central (Belling-Lee) connector provides the RF input and three resistors connect to its active pin. Two



This diagram shows the relative position of components, and should make wiring very simple. The layout is critical only for components above the partition.



This photograph shows the finer points of layout and should be compared with the diagram at left. Note particularly the symmetrical layout above the partition.

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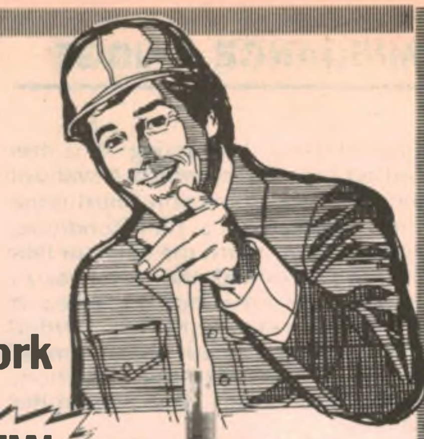

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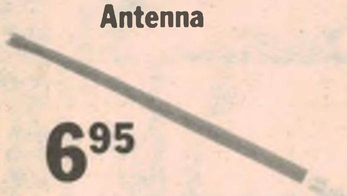

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IMPEDANCE BRIDGE

are 100-ohm resistors which connect to a network of chassis lugs under three adjacent bolts. These resistors provide a 50-ohm load for the transmitter or other RF source, which is coupled via a 50-ohm cable. (Two 150-ohm resistors should be used for 75-ohm cable.)

The third resistor is a 15-ohm unit which connects to the moving arm of the pot. This is to prevent a dead short being presented to the transmitter in the event of careless handling in some test configurations.

The active pins from the "Zr" and "Zx" S0239 sockets connect to the outer terminals of the pot. To minimise inductance we used two strips of copper about 8mm wide. One end of each is drilled to enable it to slip over the active pin of the S0239.

From these same active pins two 470pF capacitors run to the hot carrier diode, which is suspended between them and, from these two junctions, the 560-ohm meter multiplying resistors run to the two .001 by-pass capacitors. These are feed-through types mounted on a metal shield straddling the pot.

The main purpose of this shield is to minimise the chance of stray RF from the transmitter reaching the bridge components. However, it also provides a couple of handy anchor points on which to support the bridge components via the feed-through capacitors.

Ours was made from a piece of 18g scrap brass, cut to the pattern shown. Alternative materials would be tinplate or blank P/C board. In the latter case, feet would have to be provided by brackets or solder lugs, possibly with extra support points on each side.

Wiring and layout on the other side of the shield is not particularly critical, the arrangement we chose being simply one that happened to be convenient. The battery is held to the side of the box by a clamp made from a scrap of aluminium.

Having built and wired the unit, it is simple enough to get into operation. The first job is to adjust the null indicator bias network. Ideally, it should cause the meter to read slightly when switched on, but it may be necessary to modify the 220-ohm resistor, decreasing it if there is insufficient movement or increasing it if there is too much.

Fit the knob to the 100-ohm pot so that it swings evenly to each end of the scale, then set it to "1" at mid-scale. Set the sensitivity pot for maximum resistance and switch on the bias. Then feed about 1W of RF into the "RF Input" socket.

The meter may read slightly, but it should be possible to adjust the pot for a virtually perfect null, ie, no movement of the pointer when RF is either applied or removed. If the null does not coincide exactly with the "1" position, this is probably due to slight nonlinearity of the pot. Re-set the knob on the shaft to allow for this.

Incidentally, although the meter will go hard over with gross imbalance, it is unlikely to be damaged, the order of overload being only about five times. The sensitivity pot is needed to bring such a reading back on scale so that the effect of the balance pot can be more easily observed.

To use the bridge you will need an antenna cable which is a multiple of a half wavelength long. In theory, it should be possible to use any convenient number of half wavelengths but, in practice, various losses and tolerances have a significant effect and the cable must be kept as short as possible.

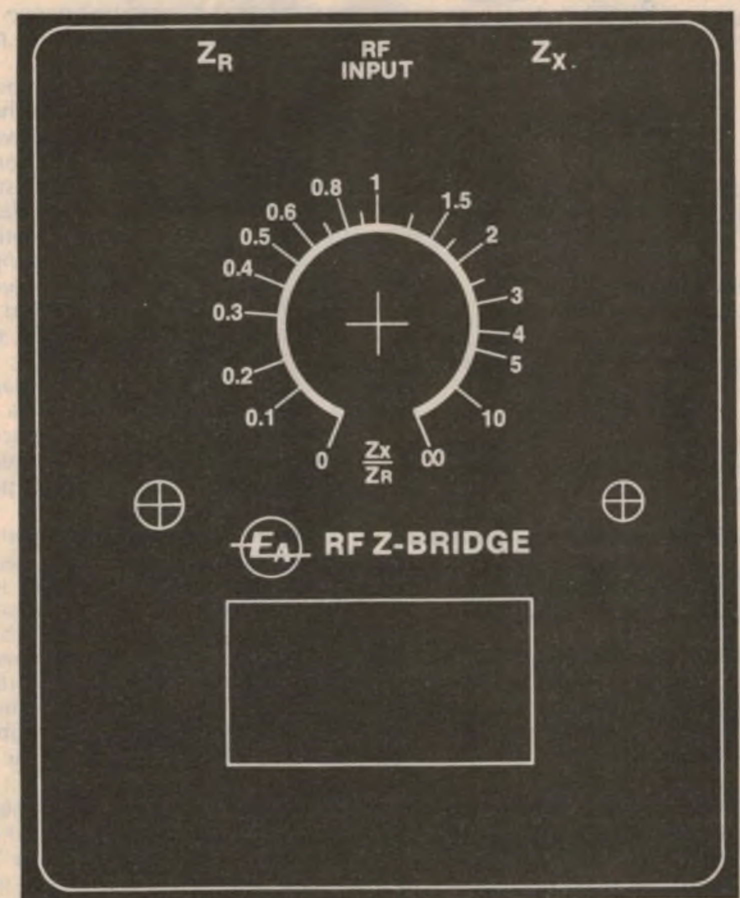
The author suggests that two half wavelengths for the 2m band is a good compromise between keeping losses to a minimum while still being able to set up the antenna reasonably clear of the test gear and operator — plus, of course, the ground, trees, buildings, and other objects. If necessary, the transmitter can be connected via any convenient length of cable, but it will be necessary to extend the press-to-talk circuit in some way.

Another potential source of minor inaccuracies is the dummy load, and how it is connected to the bridge. Ideally, such a device should be purely resistive and of exactly the same value as the characteristic impedance of the connecting cable. In these circumstances, the length of such a cable should not be critical.

Unfortunately, such ideal conditions seldom occur in practice. Dummy loads are seldom purely resistive, particularly at VHF. Nor do they necessarily exactly match the cable impedance, due to either their own minor inaccuracies, or to tolerances in the cable itself, which can be as high as 10%.

As a result, the length of this cable can also be critical and the author suggests that it, also, be made two half wavelengths long. At the same time, it is worth going to some trouble to provide the best dummy load possible. At the very least, check and, if possible, trim the resistance to the nominal cable impedance.

A further check is to measure the SWR of the dummy load on the end of its length of cable. Ideally, it should read "1/1" and we actually achieved this with a simple arrangement using two 100-ohm resistors and a Belling Lee socket (see photograph). The resistors were old fashioned IRH carbon types, without a spiral, and Radio Despatch Service have some stocks if needed for this application.



The front panel reproduced actual size. It can be used as a template to set out the holes on top of the box, and as the panel for the finished instrument, possibly under a transparent sheet for protection.

IMPEDANCE BRIDGE

A half wavelength of cable is equal to 150 divided by MHz, then multiplied by the velocity factor of the cable, which is usually .66. The frequency chosen should be in the centre of the band of interest, say 147MHz for the FM portion of the two-metre band.

The author suggests that the cable to be used be first fitted with a PL259 plug. Then calculate the required length and measure it from the mating end of the plug (but not including the pin). Mark this length with (say) a piece of sticky tap, but cut the cable at least 75mm longer. Insert the plug in the "Zx" socket, and leave the "Zr" socket open.

Ideally, a cable any number of half wavelengths long should reflect the open circuit at its far end exactly, allowing this to be compared with the open circuit "Zr" socket. In practice, this works out well for one or two half wavelengths and a good null should be obtained close to "1".

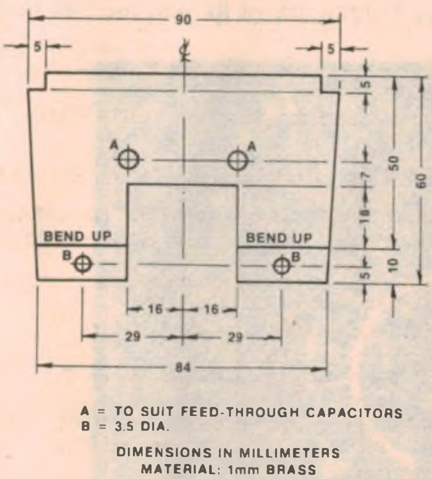
Unfortunately, for greater numbers of half wavelengths the cable losses begin to become apparent, mainly as a tendency for the null to become less perfect and to shift to less than one.

If the transmitter is tunable (PLL), make the first tests at the lowest available frequency; say 144MHz if you are aiming for 147MHz. Assuming the cable is too long (even at 144) the result should be a poor null at a value well below "1". As the cable is shortened the null should improve, and move towards "1". Immediately the null worsens, even if it is slightly short of "1", it indicates that you have, in fact, overshot for that frequency. Moving up in frequency will confirm this, by restoring the null.

At this point proceed very carefully, trimming only a few millimetres at a time. At these frequencies, 1MHz is equal to something less than 5mm of cable. A new blade in a trimming knife is a convenient tool for cutting the cable.

It is also necessary to consider the ultimate termination for the open end of the cable. Fitting an S0239 socket, for example, will probably shift the frequency back from 147MHz to near 144MHz, and it will be necessary to trim it still further. Other fittings, such as the Belling Lee plug for example, may not extend the cable significantly, or may even shorten it slightly, so proceed very carefully. On the other hand, if it is planned to fan the cable out to terminals, this portion should be treated as additional to the effective length.

This simple dummy load was made from two 100-ohm carbon resistors mounted on a Belling Lee Socket. The third resistor was used to trim the value to exactly 50 ohms. Checked on an SWR meter it gave a 1/1 reading.



The partition enclosing the RF section can be made from sheet brass, tinplate, or blank printed board material.

Unfortunately, the unshielded section of cable, even if only a few inches long, will radiate, and this makes it difficult to get a good null. Keep the unshielded section as short as possible and use the braid to bridge the gap between terminals.

All the foregoing probably suggests a process which is both tedious and hopelessly critical. This isn't really so, because practical experience indicates that very good results can be obtained using a cable which is somewhat less accurate than we can actually achieve. Provided the foregoing instructions are followed, things will work out okay at these frequencies.

It should also be appreciated that the various cable losses are greatest when the load provides a poor match to the cable impedance. When the match is correct, the losses are at a minimum.

Which brings us to the antenna measurement itself. Connect the antenna cable to the "Zx" socket, the dummy load to the "Zr" socket, and energise the bridge. Adjust the 100-ohm pot in search of a null, and note carefully the depth of the null. If it is shallow the load (antenna)) is reactive, meaning that it is off resonance. If it is on resonance it should give a perfect null.

If it is off resonance, and you have the means to do so, try it at other frequencies to determine which way it is in error. Then it can be lengthened or shortened accordingly. If a suitable range of frequencies is not available try lengthening the element(s), with clips or similar devices, while checking for a better null. If the nulls worsen, the element(s) should be shortened.

Once the antenna is resonant, we can take note of the dial reading, which gives the ratio of antenna resistance to "Zr". This should give at least a rough idea of the SWR, but a more accurate reading will probably be obtained with an SWR meter. The important point is that it will now be of real value, because the antenna is resonant.

Whether you decide to do anything about it depends on how bad it is, how fussy you are — and what can be done about it! But remember this: at anything less than 2 to 1 the transmitter will probably be quite happy, provided it sees a resistive load, while the cable losses will be negligible in a mobile installation, and only slightly worse in the average base station.

If you want to do something about it, you will have to consult the text books regarding matching stubs or other devices, or consider a different type of aerial which, but its nature, provides a match to the chosen cable.

But at least you will know what you are doing.

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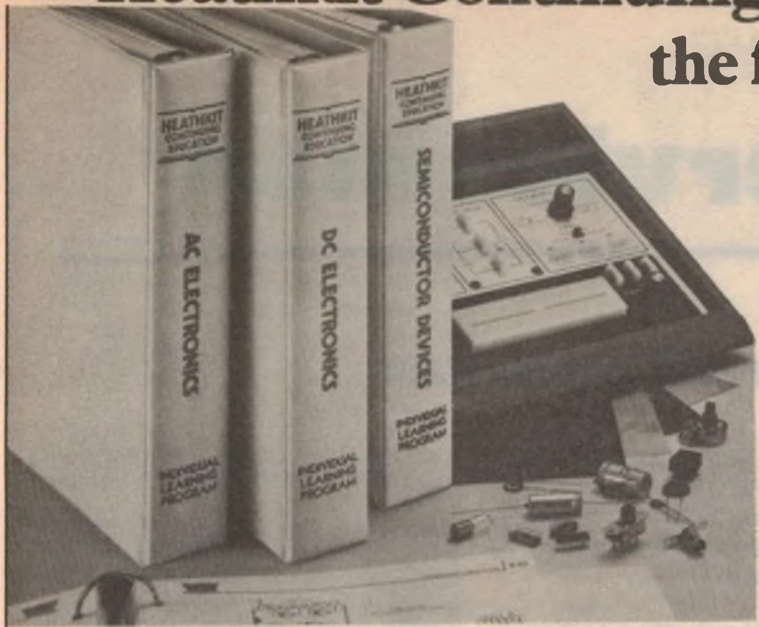

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The Serviceman

Funny (peculiar) faults which defy explanation

While the faults in most service jobs have a logical explanation when they are finally tracked down, there are always a few which create an air of mystery. Even after the set has been restored to normal, and returned to the customer, it is sometimes difficult to explain why the fault occurred in the first place.

I have had two such cases recently. The first one involved an 18in National colour TV set in which the sound was normal, but there was no sign of a picture, or even a raster. The owner happens to be a personal friend and, although he lives on the other side of the city, he still likes to bring his problems to me.

In this case he did that literally, putting the set in the car and bringing it across to my workshop. I confirmed the fault and told him to call back in a couple of days. When he had gone I removed the back, switched the set on again, and almost immediately spotted the trouble, at least in general terms. None of the picture tube heaters was alight.

The meter confirmed that there was no voltage on the socket pins, but that was not all. When I started to make continuity tests around the filament circuitry I also checked across the tube heater pins and was somewhat staggered to discover that they also showed an open circuit. So there were two faults; no power to light the heaters, and no heaters to be lit!

The heater leads run from the tube socket to a small printed board near the power transformer, and the transformer connects to the other side to the board. I could find no voltage at the lead side ot the board, but all was normal at the transformer end.

On turning the board over I could see why. Part of the heater track just wasn't there; in its place was a charred pattern on the board. Why? That was simply a mystery. It suggested a short somewhere in the heater circuit, yet I could find no evidence of one.

I bridged the missing copper pattern, then switched on and stood by for signs of distress. Nothing happened except that normal heater voltage was now available at the tube socket. And having let it run like that for a while, I could no longer put off fitting a new tube.

Again all went well. The tube heaters came up normally, the images were converged without any trouble, and the set was delivering a first class picture. but, just to be sure, I let it run as much as possible until the owner picked it up. When he did, I reckoned that was the end of the story, even though I was still puzzled as to what had started it all.

It was a nasty shock, therefore, when my friend was on the phone the next moring with the bad news that he still couldn't get any picture. With visions of another picture tube burnt out, and convinced that there must be some problem peculiar to his location, I told him not to touch the set and that I would come out and see for myself.

I wasn't very happy at the prospect, in view of the distance involved, but I just had to know what was going on. When I finally arrived and switched the set on I was relieved to see that the picture tube was working. The real problem was that his picture was so far down in the snow as to be virtually invisible.

Granted, his location is not a good one, being behind a hill, but he had always managed to get an acceptable picture until now. For a start I simply put a finger on the aerial terminal and this was enough to lift the picture level quite noticeably, though it was still poor.

Thus encouraged I took a closer look at his aerial cables and discovered that there was a balun between the set and the incoming coax. A few quick tests suggested that the balun might be faulty, so I substituted a new one which I happened to have in the kit. Sure enough, the picture came good and there were sighs of relief all round.

But I was curious as to why the balun had failed, and opened it on the spot. The reason was obvious; the inside was an unrecognisable charred mass. So that seemed to provide a partial answer to the mystery; there was little doubt that the aerial had suffered a lightning strike.

If so, was this an explanation of the other fault? Had the lightning strike caused a surge on the power line sufficient to burn out the heaters and the copper track? And if so, when had this happened, since it must have been while the set was switched on. (The set was not one in which the heaters are energised continuously.)

Strangely, everyone was quite vague about these points; they weren't even sure that there had been a thunderstorm anywhere near their suburb that day. All they were sure of was that the set had no picture when they turned it on for the evening news.

Frustrating as this is, there is a limit to the extent that one can cross-examine customers, particularly when they are also personal friends. We just have to accept the fact that many people are not very observant. Things which we would notice and remember almost automatically, often mean nothing to the non-technical person. (Either that, or someone has been fiddling and is not prepared to admit it.)

So I was left with a first class mystery, and one which is unlikely to be solved. I can only recall the story I told in the June 1978 issue, about a multiple lightning strike, and accept the fact that lightning does some funny things.

The second case involved a Kriesler 26in TV set model 59/1 which was also suffering from total loss of picture, but there the similarity ended. In this case the deflection seemed to have collapsed upwards — for want of a better way to describe it — and now consisted of two lines, one red and one white, near the top of the screen.

Checking waveforms confirmed that there was virtually no signal being fed to the deflection coils but, on the other hand, the vertical oscillator (subassembly CU-601) seemed to be working correctly. Further checks along the chain suggested that the signal was disappearing somewhere after the final drive stage, and in the vicinity of either the vertical deflection yoke or, more probably, the associated transductor (T699).

Further checking in this region brought me to a BYX55/300 fast rise-time diode (D791) forming part of the transductor circuitry. This checked out as a dead short and appeared to have taken out its associated 33 ohm resistor (R791). This is a fusible resistor, based on an IRH 3W resistor fitted with spring leads soldered together. Rather strangely, however, the spring contacts had not tripped, even though the resistor was open circuit. Just why this was so is a minor puzzle in itself, but I shrugged it off as just one of those things.

Replacing the diode and resistor half cured the fault — deflection was restored, but the picture was only half the height it should have been.

This led me back to sub-assembly CU601 and the height and vertical linearity controls, although I didn't expect that a problem of this order could be corrected as simply as this. Sure enough there was height adjustment available, but nothing like what was needed.

Then I tried the linearity control, a 2.2k trimpot (R620). There was no response here at all, and a closer look at the pot showed why. Somehow or other the moving arm had been lifted completely clear the track, such that there was something like ⅛in between them.

Replacing the pot restored the full deflection capability but the mystery, as far as I am concerned, is how the moving arm came to be like that. When questioned, the owner denied that anyone else, professional or otherwise, had touched it and, as I said earlier, there are limits to how far one can push such questioning.

On the other hand, metal wiper arms do not just up and bend themselves by this amount of their own accord. So what is the answer? Had the owner tried to fix the first fault and accidentally damaged the pot? or had it been one of his mates, "who knows a bit about TV sets"? or had it been one of the kids, fiddling while the parents were out?

They are all possibilities, but it is unlikely that I shall ever know. I can only put it down as another unsolved mystery.

In somewhat lighter vein, here is an amusing incident which happened to me recently — though I didn't see the funny side at the time.

It involved a D.O.L. (Dear Old Lady) and, as many readers will appreciate, it doesn't take much to get a D.O.L. into a flap. It started when her colour TV set went on the blink and she called me in to fix it. I made the call about 4 o'clock in the afternoon and found that it was a fairly routine failure. By 4.30 the set was going full bore, the D.O.L. was delighted, and I was on my way.

Unfortunately that was one of the few bright spots of the day. For the rest it been one stupid frustration after another. By the time I arrived home about 6 o'clock I had developed a stinking headache and could hardly wait to get stuck into a cup of tea and a couple of headache tablets.

I was just about to down the tablets when the phone rang. It was the D.O.L. (she happened to have my home number) and she was so agitated as to be almost incoherent. Finally, she burst out, "My TV set's going to blow up."

"What?"

"It's going to blow up. It's making a dreadful noise, I had to switch it off."

"Well, all right", I replied, "I'll come down and have a look at it in the morning."

"Oh no, you'll have to come now."

"Why now?"

"Because it's still making this noise."

I was feeling a bit exasperated by now.

"Look", I said, "pull the plug out of the power point."

Then came the punch line.

"But I've already done that. I've pulled the plug out of the power point and it's still making the noise. Listen."

Then she apparently held the phone as close as she could to the TV set, allowing me to hear a quite raucous high pitched squeal. I shook my head and mentally pinched myself. Was I dreaming? And if not, how could the TV set possibly be making any kind of noise with plug out of the power point? I pinched myself again.

When that didn't work I grudgingly agreed to go down and find out what it was all about. In any case, I doubt whether I could have slept that night with a puzzle like that hanging over my head.

But I was determined to have my cup of tea and tablets first. Then I reached for my coat and made for the door. Just then the phone rang. It was the D.O.L. She came straight to the point.

"Oh dear. I'm afraid I've made a dreadful mistake. The noise isn't coming from the TV set; its coming from the clock radio that sits on top of it."

Then the penny dropped. I remembered putting the clock radio on the floor while I worked on the set, then putting it back when I finished.

"It's the alarm", I said, "It's the alarm in the clock radio."

"Alarm? What alarm? I don't know anything about an alarm. My daughter gave me the clock radio for Christmas. I didn't know it had an alarm."

"Well", I said wearily, "pull the clock radio plug out and next time I'm around your way I'll call in and show you how to operate the alarm."

And that's how we left it.

I realised, of course, that the whole thing had been my fault, albeit inadvertantly. In handling the clock radio I must have accidently moved the alarm control, the alarm itself having been set, apparently, for 6 o'clock.

But why did it have to be me that picked a D.O.L. with a clock radio she didn't know how to drive?

Letters to the editor

Service information

With reference to your editorial in the June 1979 issue. Being an electronics engineer by profession, I maintain my own electronic equipment and fully concur with the views presented in your editorial.

I have attached a letter I received in reply to a request for a service manual for a sound movie projector that I purchased, which may be of interest. If you have any suggestions on obtaining same, I would welcome them.

I have forwarded a letter to the minister, supporting the TESA proposal and including the B&H letter as an instance of service information being unavailable.

John Haupt
Ringwood, Victoria.

Attached to Mr Haupt's letter was a photocopy of a letter addressed to him which reads as follows:

Dear Sir,

Reference your request for a service manual for your Chinon projector.

We regret to advise that under the terms of our contract with the Chinon company we are unable to supply this item.

Our service department in Melbourne will be only too happy to assist should you have any problem with your projector.

Yours faithfully
Bell & Howell Australia Pty Ltd
J. D. Mackay,
Victorian Service Manager.

COMMENT: It would be unwise for us to attempt to comment on the specifics of this particular situation. However it raises some further general issues, which are discussed in this month's editorial on page 3.

Dream 6800

I have read the articles on the Dream 6800, which you say is designed especially for beginners. While not a complete beginner, having read many of the EA articles on microcomputers, I found the articles fairly heavy going. I put this down to the fact that they were written by the designer of the unit.

It sounds like a really good little system, but would it be possible to write an introduction to it which really is for beginners, and does not require constant looking back to be reminded what VDU means, or looking up the glossary and a computer dictionary to find out what macro means, etc?

Also a question: does the unit control a tape recorder, and if so, how?

I am really interested, but do not want to be "turned off" by never-ending jargon. Much of it is completely unnecessary, and things like I/O, PIA etc can be put in brackets for those who like reading shorthand.

Frank Rees
Boort, Victoria

COMMENT: Thanks for the reaction, Frank, and we sympathise with the difficulty facing yourself and many others. It's surprisingly hard to produce really easy to understand material of the sort which we know is needed, but we'll see what we can do.

Tracking stars

In spite of the good advice which you gave to JC in your Information Centre (EA, May, 1979), I feel that he would be well advised to consult the Observations Officer of the Canberra Astronomical Society concerning his particular problem.

I suggest this, since even a telescope driven at the sidereal rate will not track a "fixed" star for very long — certainly not long enough to obtain an unblurred image on a photographic emulsion held rigidly in the focal plane of the instrument. Assuming that the polar axis of the telescope mount is accurately pointing at the apparent position of the South Celestial Pole (atmospheric refraction makes the apparent position different to the true position), a star still will not appear to move from the eastern to the western horizon at the constant sidereal rate. This again is another effect of atmospheric refraction, which, while it allows the star to appear to move at the sidereal rate at the zenith (directly overhead), causes the star to appear to move slower than the sidereal rate, in proportion to the star's closeness to the horizon.

Hence, in order to obtain an unblurred image of the star, frequent corrections have to be applied to the drive of the telescope, even in the case of the best professional instruments. J.C. could obtain advice on the methods of applying such corrections from Mr D. Herald, 14 Vansittart Cres., Kambah, ACT, phone 31 9214, who is the current incumbent of the abovementioned office, in the said society.

V. L. Matchett,
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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.

W1JR HF broadband balun

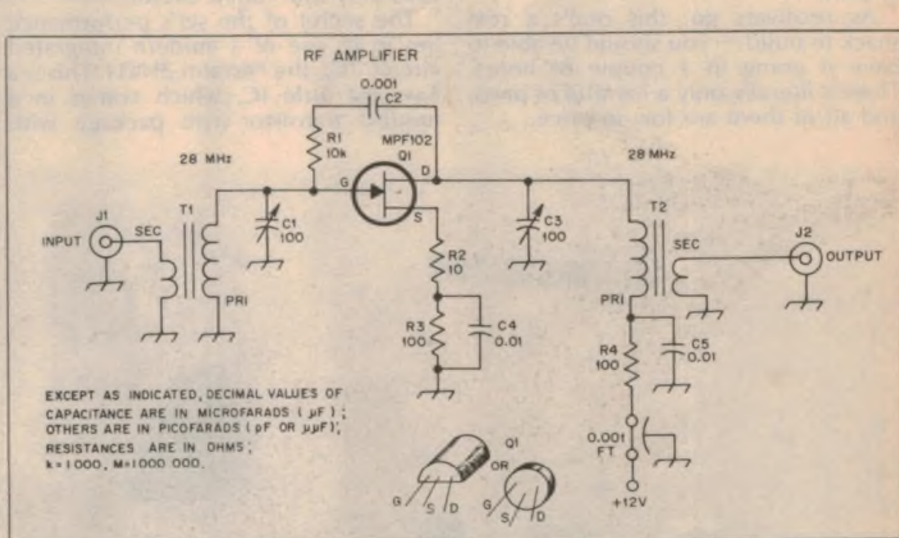
There is a demand for baluns at the transmitter end of the aerial feeder, in order to facilitate the use of a balanced line with transmitters having unbalanced output. A recent design for a simple and efficient HF broadband balun by Joe Reisert, W1JR uses an improved highpermeability ferrite toroid core on which is wound a short length (12 turns, 36-40in of cable) of thin coaxial cable of the required impedance. The W1JR unit uses the Indiana General F568-1 Q1 core with RG-141/U cable; it covers 3.5 to 30MHz (with reduced efficiency on 1.8MHz).

For use over 7-30MHz, 10 turns of cable should prove sufficient, and TC9 core material might prove more suitable for lower frequencies. With RG-141/U cable the unit is designed for 50 ohms impedance, but other impedances may be selected provided the turns impedance on the lowest frequency band is at least ten times the cable impedance. The design can be used at VHF if attention is paid to layout and lead lengths. W1JR states: "The beauty of this type of balun is that it does not introduce any additional reactive components to the feedline".

The balun as described is intended primarily for use directly at the dipole element but there seems to be no reason why this approach should not be adopted instead to power a balanced transmission line from the unbalanced output of a typical modern transmitter. Such short lengths of cable however, do require the use of a high permeability core material.

(From "Radio Communication".)

JFET preamplifier for tired receivers



Oscar enthusiasts and those who chase DX on 10 and 15 metres may not have the hottest receivers, especially if low-cost or early design receivers are being used. When receivers run out of front end gain and noise figure, it usually happens on 15 and 10 metres. This problem can often be resolved by adding a preamplifier between the receiver input and the antenna.

A design objective with any amplifier should be unconditional stability — no self-oscillations at any frequency regardless of the load connected to the amplifier. Properly applied feedback ensures unconditional stability. Circuits of this kind are ideal for amateur builders who have limited practical experience in the workshop.

The circuit shows the toroidal input transformer is tuned to the operating frequency by means of trimmer C1. R1 and C2 form a shunt feedback network, coupling RF energy from the drain of Q1 back to the gate out of phase with the input. This improves stability by lowering the gain. R2 provides additional stability by introducing degenerative feedback.

The drain circuit contains a second tuned transformer,T2. R4 and C5 form a decoupling network in the 12V supply line. This helps prevent unwanted signal energy from entering the preamplifier via the power supply leads.

A 3dB bandwidth of 1MHz is characteristic of this amplifier. The measured gain is 15dB. Stability is excellent under all conditions, including an open-loop situation (no termination at either end of the circuit). The noise figure is under 3dB at 30MHz.

For 10 metres, T1 and T2 consist of 12 turns of 24B&S enamelled wire on Amidon, Palomar, or G.R. Whitehouse T50-6 powered-iron toroid core. Spread turns evently around core and cement in place. Then add 1½ turn secondary link at centre of primary winding. Operation on 15 metres can be had by adding two turns of wire to the main windings of T1 and T2. No other changes are necessary.

(By Doug DeMaw W1FB, in "QST").

Getting started in electronics?

Build this simple radio receiver

If you haven't built up many electronic projects as yet, why not have a go at this simple little radio receiver. It's easy to build, low in cost, and there's a special thrill when you turn it on and tune in those first few stations. In fact the performance is surprisingly good, thanks to the use of a modern IC.

by GERALD COHN

Even though you can walk into a shop nowadays and buy a complete radio receiver for $5 or less, there's a special satisfaction in building one yourself — particularly if you're still a little new to electronics. The fun of tuning in those first few stations is so much greater when you've just finished putting the receiver together from a "bag of parts".

As receivers go, this one's a real snack to build — you should be able to have it going in a couple of hours. There's literally only a handful of parts, and all of them are low in price.

Despite the simplicity, the performance of the little set compares very favourably with most of the small "transistors" currently available. Its sensitivity is excellent, allowing you to pick up distant stations even in daylight. At the same time the selectivity is sufficient to separate all of the closely-spaced local stations in Sydney, even though the set uses only one tuned circuit.

The secret of the set's performance lies in its use of a modern integrated circuit (IC), the Ferranti ZN414. This is a low-cost little IC, which comes in a modest transistor-style package with only three leads — just like a transistor. Yet inside that mild-mannered package lurk no less than 10 transistors, providing all of the amplification and detection required for an AM radio "front end".

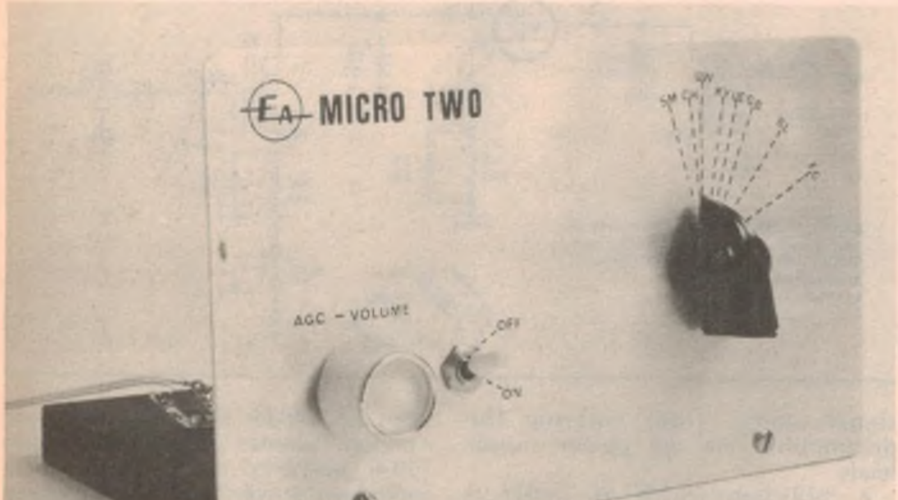
Add a few parts to the ZN414, and you have a complete "tuned radio frequency" or TRF-type AM radio tuner. The term TRF means that the incoming radio signals are tuned and amplified solely at their existing radio frequency (RF), before being detected to extract the modulation. This is in contrast with the more complicated "superheterodyne" method of reception, where the signals are changed into a lower frequency before being amplified and detected.

Inside the ZN414 are four stages of radio-frequency amplification. These stages are not tuned, but have resistive loads so that they are capable of amplifying over a broad range of frequencies. Selection of the wanted signal is done outside the IC, by one or more tuned circuits at the input. The input impedance of the IC is very high, so that it doesn't load down the tuned circuit and upset its tuning. This allows good results to be obtained from a single tuned circuit, as we are using here.

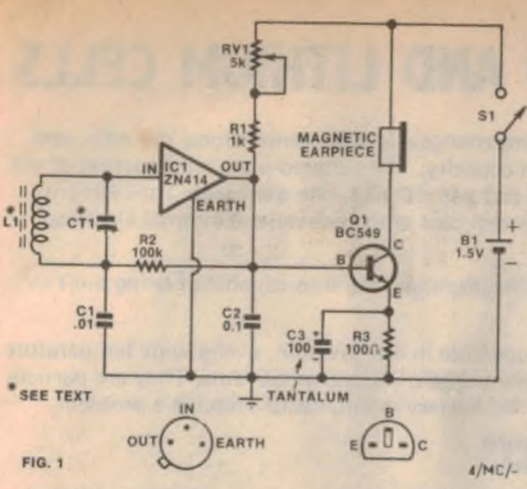
Inside the ZN414 at the end of the amplifier stages is an AM detector, which rectifies the amplified RF signals and produces a series of DC pulses. By connecting an RF filter capacitor between the output of the IC and ground, these pulses are added together to produce a smoothed audio output.

Along with the audio signal which appears across the output filter capacitor, there is a DC voltage which varies according to the strength of the signal. This DC voltage is fed back to the input of the ZN414 and used to control the amplifier gain.

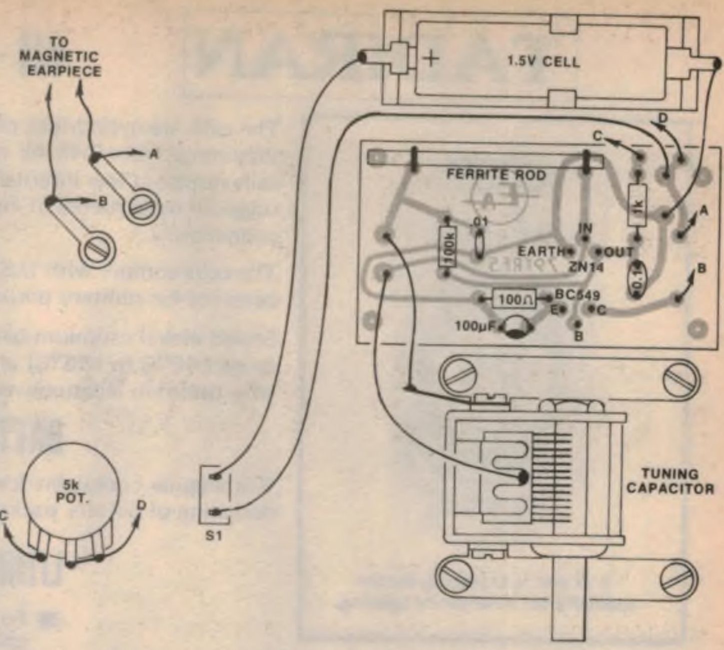
The result is "automatic gain control" or AGC, where the ZN414 automatically adjusts its gain to suit the signal strength. Weak signals receive plenty of



Our radio was made on a small piece of particle board and fitted with a simple aluminium front panel. Rub-on lettering was used for front panel markings.



ABOVE: Here is the complete circuit diagram for our simple TRF receiver. RV1 acts as a volume control.



RIGHT: Assembly is easy — all you have to do is follow this simple wiring diagram. ▶

gain while strong signals receive less, so that they are all received at much the same volume.

With the ZN414 this AGC action is pretty good, although if the feedback is fixed it is not capable of adjusting completely for very large changes in signal strength. In particular if you set the feedback for full gain on very weak signals, the IC tends to overload and distort on very strong signals. When overload occurs its input impedance also falls, loading down the tuned circuit and making the selectivity very poor. This means that it is a good idea to make the feedback adjustable, so that the IC can cope with both very weak and very strong signals.

If you look at the circuit you'll see that's just what we have done. Resistor R1 and pot RV1 are the ZN414's output load, while R2 is the feedback resistor taking the DC control voltage back to the bottom of the input tuned circuit. By varying RV1 we can vary the DC voltage generated at the output, and hence vary the AGC effect.

Actually as well as varying the AGC effect, RV1 also tends to vary the audio signal produced at the ZN414 output. In other words, it acts as a volume control. And the two functions work together, so turning the volume down for a loud signal automatically helps the IC cope with the signal and prevents overload.

C2 is the detector filter capacitor, while C1 is an RF bypass capacitor which ensures that the "cold" end of the input tuned circuit is kept at AC ground potential.

Note that we have used a ferrite rod aerial for the coil in the tuned circuit, so that no additional aerial is needed. This means that the set is not tied to a fixed aerial and earth, but can be made portable if you wish.

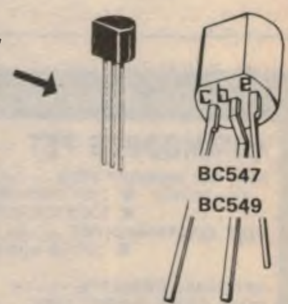
As you can see from the circuit, we have added a simple one-transistor amplifier stage to the basic ZN414 circuit. This is so that you can use the receiver with a low impedance magnetic earpiece. Nowadays these are the most readily-available type of earphone, and they are low in cost. However they are not as sensitive as the older type of high impedance 'phones, and their low impedance makes them rather unsuitable for direct connection to the ZN414 output, hence the amplifier stage.

The transistor we have used is a readily available NPN type, BC549 or similar. It is directly coupled to the out-

Help with components

The Transistor

The transistor must be connected into circuit the right way round. It has three leads (called emitter, base and collector) and these are arranged according to the diagram at right. Any of the following transistors may be used: BC107, BC108, BC109, BC237, BC238, BC337, BC338, BC547, BC548, BC549.



The Resistors

Resistor values are indicated by three colour bands, while a fourth band gives the resistor tolerance:

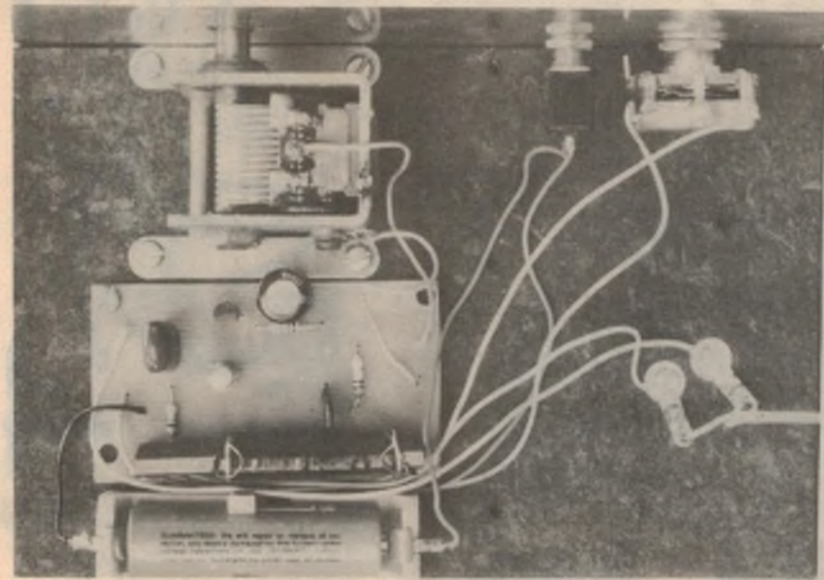
100 ohms: brown — black — brown — gold
1k: brown — black — red — gold
100k: brown — black — yellow — gold

The Capacitors

TANTALUM CERAMIC POLYESTER

The positive lead of a tantalum capacitor is indicated eithr by a "+" sign or by a small dot, or is the right hand lead with the centre dot facing towards you.

* *Component diagrams courtesy Dick Smith Electronics.*



The "works" of the completed receiver. The tuning capacitor shown is a relatively modern one, but much older types in good condition will serve equally well.

PARTS LIST

SEMICONDUCTORS
1 ZN414 receiver IC
1 BC549 or similar transistor

CAPACITORS
1 .01uF LV polyester or ceramic
1 0.1uF LV polyester
1 100uF 6VW tantalum
1 415pF variable (see text)

RESISTORS
All ¼W 5%: 100 ohm, 1k, 100k.
1 5k linear carbon pot.

MISCELLANEOUS
1 PC board, 68 x 38mm, code 79TRF5
Piece of particle board, piece of aluminium sheet; 55mm length of 10mm ferrite rod; 32 SWG enamelled copper wire; 8 ohm magentic earpiece; on-off switch; 1.5V dry cell and holder to suit; pointer knob for tuning capacitor; knob for volume/AGC pot; hookup wire, solder, etc.

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

put of the ZN414, connected as a common emitter stage with the earpiece as the collector load. R3 and C3 in the emitter circuit stabilise the transistor's operating point and set its collector current to a suitable value.

The entire circuit works from a single 1.5V dry cell, making it very economical.

Now that you have a reasonable idea how the set works, let's talk about putting it together.

Perhaps the best place to start is the rod aerial. You can buy ferrite rods with coils already wound on them, but it's more satisfying to "roll your own". All you need is a length of 10mm diameter ferrite rod and some enamelled winding wire of about 32 SWG size, and both these are available at electronic parts stores.

The ferrite rod only needs to be about 55m long for this little receiver, although you can make it longer if you wish. You might not be able to buy a length of rod this short, but don't worry. You can easily break it to length. Ferrite is handled like glass — you simply file a little nick at the place you want it to break, and apply pressure by holding it in both hands with the thumbs touching just opposite the nick. It should snap cleanly right at the nick.

Before winding the coil itself, wind a layer of plastic insulation tape on the rod to provide a little "give" and protect the wire's enamel insulation. Then use a small piece of tape to anchor the wire about 5mm from one end of the rod, leaving say 5cm of free wire for the connection. Then wind on 80 turns of wire, with the turns "close wound" or tightly up against one another. Keep the winding flat and tidy, and you should have about 20mm of rod left at the end after winding the 80 turns. Use another short piece of insulation tape to anchor the end, then cut the wire after leaving another 5cm or so for the connection.

If you like, you can wind a full layer of insulation tape over the entire coil. This won't affect its operation, and will protect it and hold the turns in place more securely.

Having wound the coil, the next step is to find a suitable tuning capacitor for CT1. You can buy a suitable capacitor from any of the usual electronics supply stores; either the conventional type with air separating the fixed and moving plates, or the miniature type with plastic sheets may be used.

Ideally a single-gang capacitor with a maximum capacitance of about 400pF should be used, as this will give the widest tuning range. However these may not be too easy to get nowadays, and you may have to use a small two-gang type with the two sets of fixed plates connected together.

Actually if you have an old valve-type radio gathering dust around the house, you can probably salvage the tuning gang from this and press it into service. It will be rather larger physically than a more modern type, but will work just as well providing you blow the dust out and ensure that none of the plates are touching. Just use one of the groups of fixed plates and ignore the others, if there are a number.

Note that with most air-type tuning capacitors, the moving plates are connected to the frame, which is connected to the "cold" end of the circuit (in the present circuit, to C1 and R2).

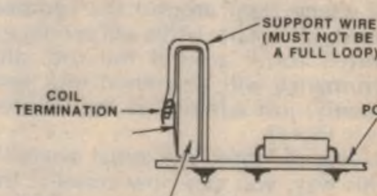


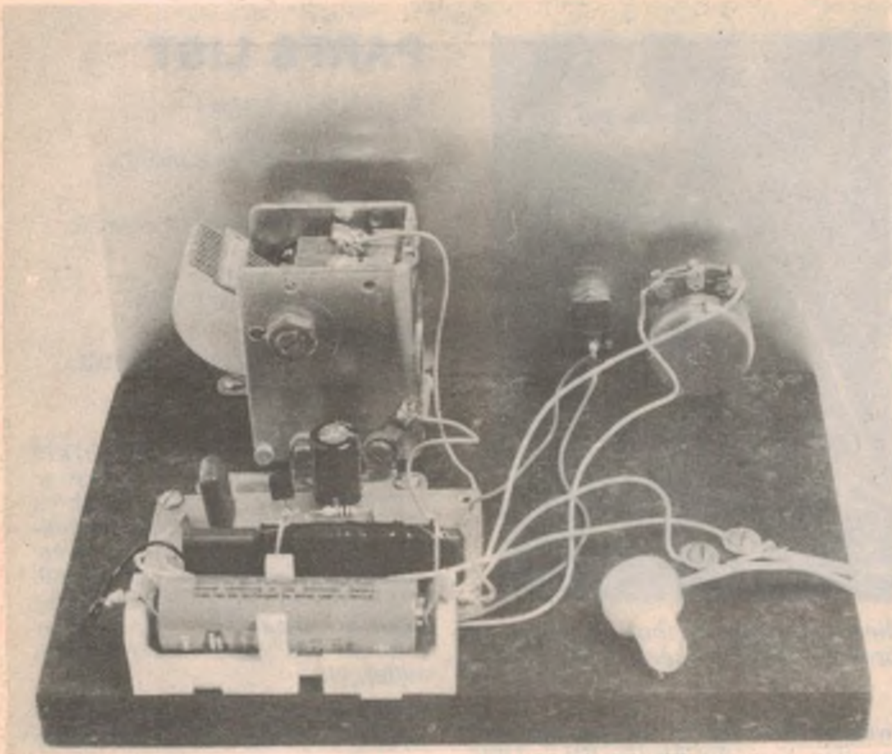
FIG. 3

This diagram shows how the ferrite rod aerial is secured to the PC board.

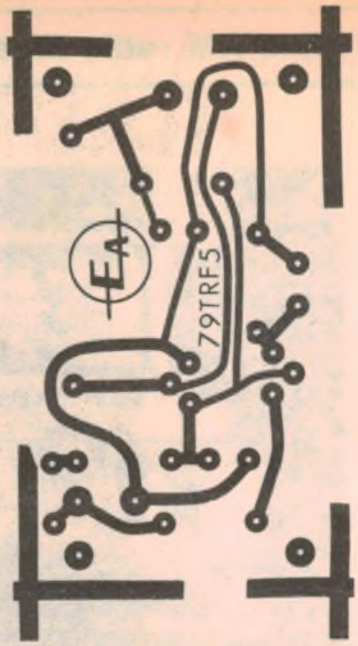
The next step is to wire up the printed circuit board (PCB). This measures 68 by 38mm, and is coded 79TRF5. First wire in the resistors and capacitors, using the overlay diagram of Fig. 2 as a guide. Keep the component leads short, but don't strain them. Also to prevent overheating the components during soldering, use a pair of long-nose pliers or a spring "heatsink" clamp to grip the lead between the body of the part and the PCB.

Now you can mount the rod aerial. This is attached to the PCB by two pieces of stout tinned copper wire, about 25mm long. One end of each

Simple AM radio receiver



Another rear view of the receiver. Keep all wiring neat and tidy.



Actual size reproduction of the printed circuit board pattern.

> **Estimated cost**
>
> We estimate that the current cost of parts for this project is approximately
>
> **$14**
>
> **This includes sales tax.**

wire is soldered to the PCB, then each is bent into a large question-mark shape around the rod assembly. Make sure that the free end of each wire does NOT come right around the rod and touch its own start — this will produce a "shorted turn" around the rod, and performance will be ruined (not permanently, just while ever the shorted turn is there).

Having mounted the aerial assembly in this way, you can now connect the ends of the coil to the appropriate support wires. Cut the ends to a suitable length, then carefully scrape away the insulating enamel with a razor blade or modelling knife. Don't overdo the scraping, or you might break the fine wire.

The last components soldered to the board are the BC549 transistor and the ZN414 integrated circuit. Special care should be exercised when soldering the ZN414 to the board as it is by far the most complex and most expensive component used in the whole project.

Once the PCB is fully assembled, proceed to wire the remaining components to it. The first is the tuning gang, followed by the 5k pot and then the wiring for the switch, battery and earpiece.

How you mount the PCB, tuning capacitor and other parts will depend partly upon the tuning capacitor and its size, etc. It will also depend upon your plans for the receiver — whether you want to make it for experimental use only, as a bedside radio or as a portable. We assembled the parts on a simple rectangle of particle board, with a piece of aluminium sheet attached as a front panel. You can see the construction from the photographs.

When you get the set going and tune in your local stations, you can mark their positions on the front panel in pencil. The marks can then be made more permanent with a felt pen, Indian ink or rub-on lettering, to produce a "dial scale". Needless to say it will help if you provide the tuning capacitor shaft with a suitable pointer knob.

Finally, a few words about other things you can do with this little receiver.

Instead of using it as a small personal radio driving an earpiece, you can use it as a simple tuner for use with a tape recorder or public address amplifier system. For local stations, it will give quite good results. Simply wire in a 22 ohm ½ watt resistor in place of the earpiece, and connect an output cable across the resistor with a 0.1uF low voltage polyester capacitor ("greencap") in series. Fit the other end of the cable with the appropriate plug for your recorder or amplifier, and you're ready to go.

Another thing you can do is adapt the receiver to tune other frequencies. As the ZN414 is capable of operating anywhere from 150kHz to about 3MHz, you aren't just confined to the broadcast band. You can make it into a low frequency receiver, or one tuning the marine bands and other signals in the 2-3MHz region.

All you have to do is alter the tuned circuit at the input in order to shift the tuning range. In practice, the easiest way to do this is to change the number of turns on the aerial coil. Fewer turns will make the set tune to higher frequencies, while more turns will make it tune lower.

If you would like to try listening to the low frequency or "long wave" stations below the broadcast band, try winding an aerial coil with say 150 turns instead of 80. This should let you tune in some aircraft, weather beacons and other services.

On the other hand if you wind the coil with only say 40 turns, you should be able to pick up ship-to-shore messages and other lower shortwave signals. Patient listening might also turn up a few radio amateurs using the 1800kHz or "160 metre" amateur band.

So there you have it — a simple little set, but one which can give a lot of fun and satisfaction. Next month we hope to describe a simple amplifier which you can use with the set to drive a loudspeaker.

Based on the 555 timer IC:

Square wave oscillator

A simple circuit for checking audio gear & for IC experiments

Here's an ideal project for beginners: a really simple and easy to build multi-frequency square wave oscillator. The parts will cost you less than $10, and you should be able to put it together in one evening. But you can use it for all sorts of things — from testing amplifiers and radios to experimenting with digital ICs.

by GERALD COHN and JAMIESON ROWE

A square wave oscillator can be a very handy gadget to have on the experimenter's workbench — particularly if it can be used to produce a number of different frequencies. You can use it as a source of test signals, to test audio amplifiers, loudspeakers, headphones and other equipment. And because a square wave is rich in harmonics, you can also use such an oscillator as a "signal injector" to test radio receivers.

It can also be used as a simple pulse generator, to provide a train of pulses for operating counters, shift registers and other digital circuitry. This makes it just the thing if you are experimenting with digital integrated circuits (ICs).

The little square wave oscillator described here is about as simple as you could get. It uses only a single low-cost IC, the well known 555, with a handful of other parts, and operates from a small nine volt battery. This makes it very low in cost, easy to build and completely safe even for the really young experimenter.

Yet it will deliver any of five handy test frequencies: from a low 1Hz (one hertz, equal to one cycle per second) up to 10kHz (10 kilohertz), in multiples of 10 or "decade" steps. So you can get low frequencies for checking digital circuits, and higher frequencies for checking audio gear and radio sets — all at the flick of a switch.

The output is virtually a perfect square wave at all five frequencies, with short "rise" and "fall" times to ensure that there are plenty of harmonics. And the output is a healthy 8 volts peak-to-peak, able to drive just about any likely circuit. You can of course cut it down, by using an external series resistor or a variable "pot".

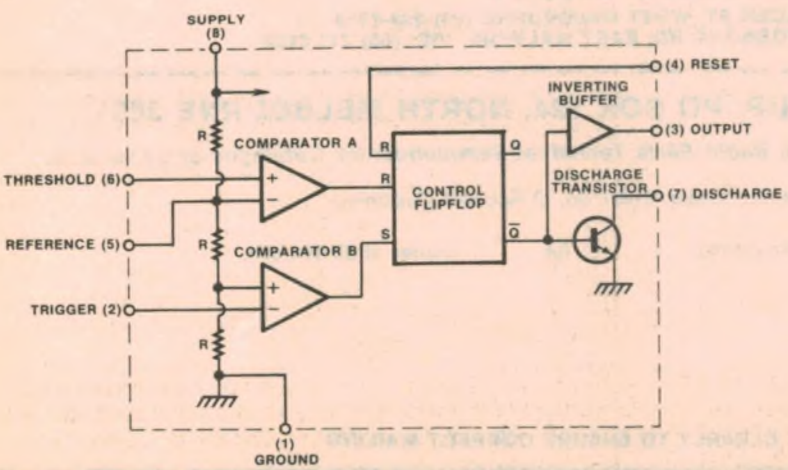


FIG. 1 : INSIDE THE 555

The oscillator is also provided with a light-emitting diode (LED) output indicator, so you can see that it is working. On the low frequencies you can actually see the LED flashing on and off; on the higher frequencies it flashes too rapidly for the eye to see.

Well then, how does it work? The circuit diagram may not give you much of a clue at this stage, particularly if you're not too familiar with the 555 IC. So let's look a little closer at this device and how it works.

Inside the 555 there are really quite a few parts — something like 28 transistors and 12 resistors, depending upon the particular brand of device you get. We're not going to worry about all the fine details of its internal circuitry, though; just the basic functions it performs.

The diagram of Fig. 1 shows the story. At the heart of the IC is a control flipflop, a circuit which can "flip" from one of two different sets of voltage and current levels to the other, in response to pulses fed to its R (reset) and S (set) inputs. The flipflop also has outputs Q and Q-bar, whose voltages show which of the two possible states the flipflop is in. The voltage at Q is high for one state, and low for the other; the voltage at Q-bar is always the opposite of that at Q.

When the flipflop receives a pulse on one of its R inputs, it flips to the state where Q is low and Q-bar high. On the other hand when it receives a pulse on its S input, it flips to the other state where Q is high and Q-bar low. And in

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

$8.50

This includes sales tax

We built our unit into a low-cost plastic Zippy box. The light emitting diode (LED) indicates when the unit is on and flashes in sympathy with the output frequency.

each case it stays at the state concerned until it is deliberately forced to flip to the other state by an input pulse.

So if you like, the flipflop has a memory: it "remembers" which sort of input pulse it received last.

Attached to the flipflop's Q-bar output is an "inverting buffer" — basically an amplifier whose output moves in the opposite direction to its input. The output of the buffer is connected to pin 3 of the 555, to become the output of the whole device. So when the Q-bar output of the flipflop is high, pin 3 goes low, and vice-versa.

Also connected to the Q-bar output of the flipflop is the base of an NPN transistor, known as the discharge transistor. The emitter of this transistor is grounded, while the collector is connected to pin 7 of the IC and labelled "discharge". The idea being that when the flipflop's output is high, the transistor is driven into conduction, and effectively shorts pin 7 to ground. This can be used to discharge an external capacitor, as we shall see shortly.

The rest of the 555 consists of two voltage level comparators, which are used to generate the input pulses for the control flipflop. The comparators are high-gain amplifiers, which each have two inputs and an output. The output goes high whenever the "+" input is connected to a voltage which is more positive than the "-" input. On the other hand if the "-" input is more positive than the "+" input, the comparator's output goes low.

Hence the name comparator: a circuit which compares two voltage levels, and indicates with its output which one is more positive.

As you can see from Fig. 1, one input of each of the comparators is taken to a tapping on a voltage divider, made up of three resistors R connected across the 555's power supply pins 8 and 1. The "-" input of comparator A is connected to the upper tap of the divider, while the "+" input of comparator B is connected to the lower tap. As the three resistors in the divider all have the same value, this means that comparator A's input is fed with a voltage of 2/3 the supply, and comparator B's input a voltage of 1/3 the supply.

The remaining input of each comparator is connected to an external IC pin: comparator A's "+" input to pin 6, labelled "threshold", and comparator B's "-" input to pin 2, labelled "trigger".

So what comparator A does is compare the voltage at pin 6 with 2/3 the supply voltage, and feed a pulse to the R input of the control flipflop if the voltage at pin 6 is more positive. Similarly comparator B compares the voltage at pin 2 with 1/3 of the supply voltage, in this case feeding a pulse to the S input of the flipflop if the voltage at pin 2 is less positive.

So much for what's inside the 555 IC. Now let's look at the main circuit again, to see how we turn all of this into a square wave oscillator.

As you can see, pins 2 and 6 are actually tied together in this case, and connected to the moving arm of switch SW1b. This in turn connects them to ground via one of the capacitors C2-C6. Pins 2 and 6 are also taken up to the +9V supply line, via series resistors R1 and R2.

Note that the junction of R1 and R2 is connected to pin 7, the collector of the 555's internal discharge transistor.

Let's consider what happens when the circuit is first turned on, with SW1a connecting the 9V supply from the

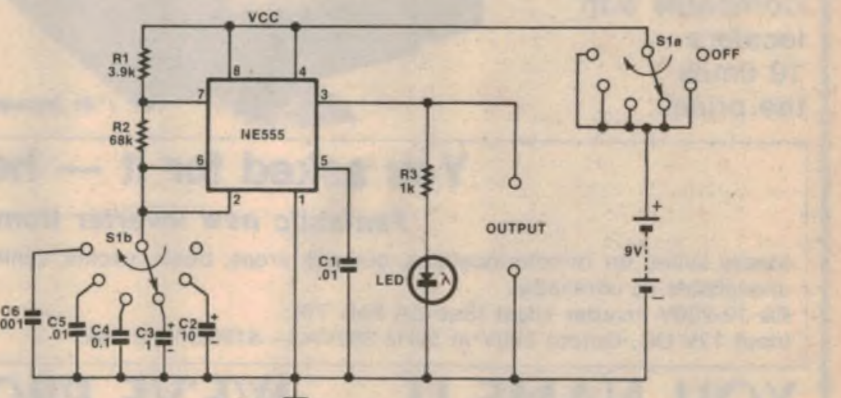
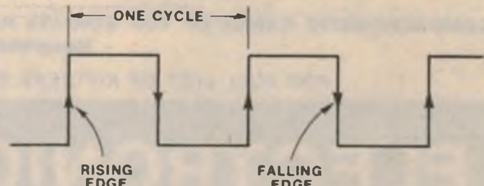


FIG. 2

The complete circuit. It provides 5 switched frequencies from 1Hz to 10kHz.

WHAT THE TERMS MEAN

SQUARE WAVE: In electronics, a square wave is an alternating voltage or current which does not reverse direction smoothly and gradually like a sine wave, but suddenly and sharply. A graph of voltage or current against time thus looks like the following:



OSCILLATOR: In electronics, an oscillator is a circuit which generates a continuously alternating voltage or current. So that a square wave oscillator is a circuit which generates a continuously alternating voltage or current which has a waveform as shown above.

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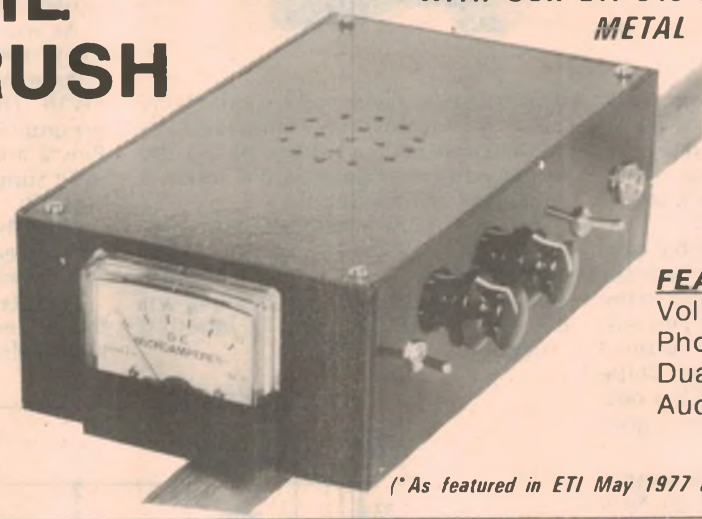

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battery and SW1b turned to connect say C3 into circuit between pins 2-6 and ground.

At first, C3 will contain no electric charge, so the voltage across it will be zero. As a result, comparator B inside the 555 will feed a pulse to the S input of the control flipflop. The flipflop will accordingly flip to its "set" state, with the Q output high and Q-bar low. The internal discharge transistor connected to pin 7 will be turned off, while the buffer amplifier will take the output pin 3 up to a voltage very close to the 9V supply rail.

With the discharge transistor off, C3 is able to charge up from the 9V rail via resistors R1 and R2. The voltage across C3 thus begins to rise, as it charges. The voltage rises in so-called "exponential" fashion: fast at first, then gradually slower and slower. The time it takes to reach 63% of the supply voltage will be found by working out the "time constant", which is equal to the product of the capacitance and the total series resistance:

$$T = C3. (R1 + R2)$$

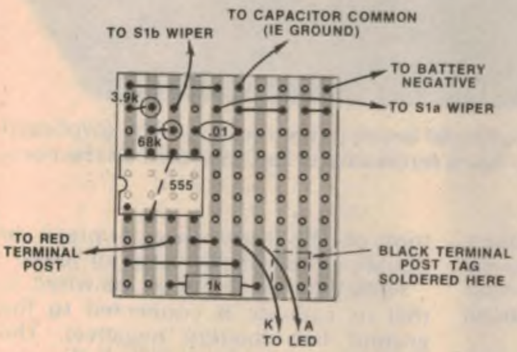
where T is in seconds, C3 is in Farads and R1 and R2 in ohms.

The capacitor will be able to charge up in this exponential fashion just a little longer than this time T — until the voltage across it reaches 2/3, or 67% of the supply voltage. What happens then is that comparator A inside the 555 triggers, resetting the control flipflop. Its Q-bar output goes high, turning on the discharge transistor and effectively shorting the junction of R1 and R2 to ground. At the same time the buffer transistor takes the output pin 3 down to ground potential as well.

What happens now is that with the junction of R1 and R2 shorted to ground, C3 stops charging and begins to discharge via R2 and the 555's discharge transistor. So its voltage begins falling, rapidly at first and then slower and slower in the same exponential fashion that it charged.

The discharging continues until the voltage across C3 has fallen to the point where it is just slightly below 1/3 of the supply voltage. Then the 555's comparator B triggers once again, causing the control flipflop to switch back to its set state. Then the output pin 3 goes high again, the discharge transistor turns off, and C3 begins charging again via both R1 and R2.

So the circuit settles down to a continuous cycle of events, with capacitor C3 (or whatever other capacitor is switched into circuit) being alternately charged and discharged under the control of the 555. While ever the capacitor is charging, the voltage at output pin 3 is high, and while ever it is discharging the voltage at pin 3 is low.



The components are assembled onto stripboard as shown in this component overlay diagram. Cuts along the copper strips are best made with a drill bit. Simply place the point of the drill in the hole closest to the required break and twist by hand so as to cut away the copper.

Each time it charges, the capacitor voltage rises from 1/3Vcc to 2/3Vcc. When it discharges, the voltage falls by the same amount: from 2/3Vcc to 1/3Vcc. And since R1 is small compared with R2, the resistance in series during the charging (R1 + R2) is really quite close to the resistance in series during the discharging (R2 alone). As a result, the charging and discharging times are very close to the same.

So what happens as a result of all this is that the 555's output pin 3 switches up and down, producing a continuous square wave. The rate at which it switches up and down will depend upon which capacitor we have in circuit — a large capacitor will produce a low rate (low frequency), while a small capacitor will produce a high rate (high frequency).

Hence the largest capacitor C2 gives an output frequency of 1Hz, while the smallest capacitor C6 gives an output frequency of 10kHz. Capacitors C3, C4 and C5 give intermediate frequencies of 10Hz, 100Hz and 1kHz respectively.

As you can see, the indicator LED is simply connected in series with a 1k current-limiting resistor from pin 3 of the 555 to ground. The resistor limits the LED current to about 7 milliamps, giving adequate brightness. This leaves the 555 output with plenty of current capability to drive external circuitry.

At this stage there's only one circuit component we still haven't explained: the .01uF capacitor (C1) connected between pin 5 of the 555 and ground. What does this do?

Well, as you can see from Fig. 1, pin 5 is actually connected to the upper tapping point on the 555's internal voltage divider. By connecting this point to ground via a capacitor, we filter out any hum or noise that might otherwise find its way into the divider and disturb the operation of the two comparators.

C1 isn't essential for circuit operation, and if you try leaving it out you'll probably find that the circuit seems to work just as well — at least most of the time. But by putting the capacitor in we ensure that the circuit works as it should all the time, even when the battery gets tired and noise gets into the circuit.

As you can see, the oscillator is housed in a small low-cost "Zippy" box. The box measures 130 x 68 x 71mm, and is available from most suppliers; the one we used came from Dick Smith Electronics, who list it as catalog number H-2753.

Inside the box, most of the components are mounted on a small piece

Simple oscillator

of drilled strip conductor board (Veroboard or similar), which measures 28 x 28mm. As the board strip and hole spacing is both 2.5mm, this means that the board is 10 strips wide and 10 hole spaces long.

The timing capacitors are not mounted on the board, as these can vary quite significantly in size and it is easier to mount them on the switch. You can see how they are mounted from the internal photograph; similarly you should be able to get a good idea of the way the board is wired from the wiring diagram.

Before mounting the IC and other components on the board, cut the tracks where we have indicated. The easiest way to do this is to use a twist drill of about 6-7mm (¼in), placing the tip in a suitable hole and turning it so that it "countersinks away" the copper strip around the hole. Continue until you are sure that the copper strip has been completely cut.

When wiring up the board, fit the resistors and capacitors on first, then add the 555 IC. Take care when soldering all of the components to the board not to overheat them — especially the IC.

The next step is to drill holes in the front panel for the switch, LED and output terminals. Use the front panel artwork we have reproduced in these pages as a guide in placing the holes, and choose the hole sizes to suit the parts. Those for the LED and terminals will be around 6mm, while the hole for the switch will be about 9.5mm.

Having drilled the holes, you can then provide the panel with suitable lettering. If you are adept at photography, you might be able to make a paper print of the artwork and stick it to the panel. Or you may have access to some "Scotchcal" photosensitive adhesive-backed aluminium, in which case you could use this to make a replica of our own unit. Alternatively you could make up your own version using "Letraset" or similar rub-on lettering.

With the panel suitably prepared, you can mount the switch, terminals and LED to it. Don't forget to insulate both terminals from the panel with fibre washers, and to fit solder lugs under the nuts for the inside connections.

The LED mounts on the panel via a small clip-together plastic bezel, and if you haven't assembled one of these before you might find it a little tricky.

You'll find the bezel consists of two parts: an inner sleeve, with the bezel proper at one end, and a locking ring which is of larger diameter and has "teeth" moulded inside. To assemble these with the LED, you first push the sleeve through the hole in the panel from the front, until the bezel portion meets the panel. Then push the LED through the sleeve from the rear of the panel, until it "clicks" into place (the front will now be protruding from the front of the bezel). Finally push the locking ring on the rear of the sleeve, working it forward until it meets the rear of the panel. The whole assembly should then be locked fairly securely in place.

You can now solder the component board to the solder lug on the rear of the "earthy" output terminal, as shown in the photograph. It is quite small and light, and this is adequate to hold it in place. Then add the wiring to the other terminal, the LED and the switch, and of course the battery lead wiring. The battery itself can be fastened to the bottom of the case using a piece of double-sided adhesive tape or foam.

Note that the LED must be wired so that its cathode is connected to the ground line (battery negative). The cathode lead of most LEDs is the one nearest the "flat" on the side of the LED, or else the shorter of the two (if they are of different length).

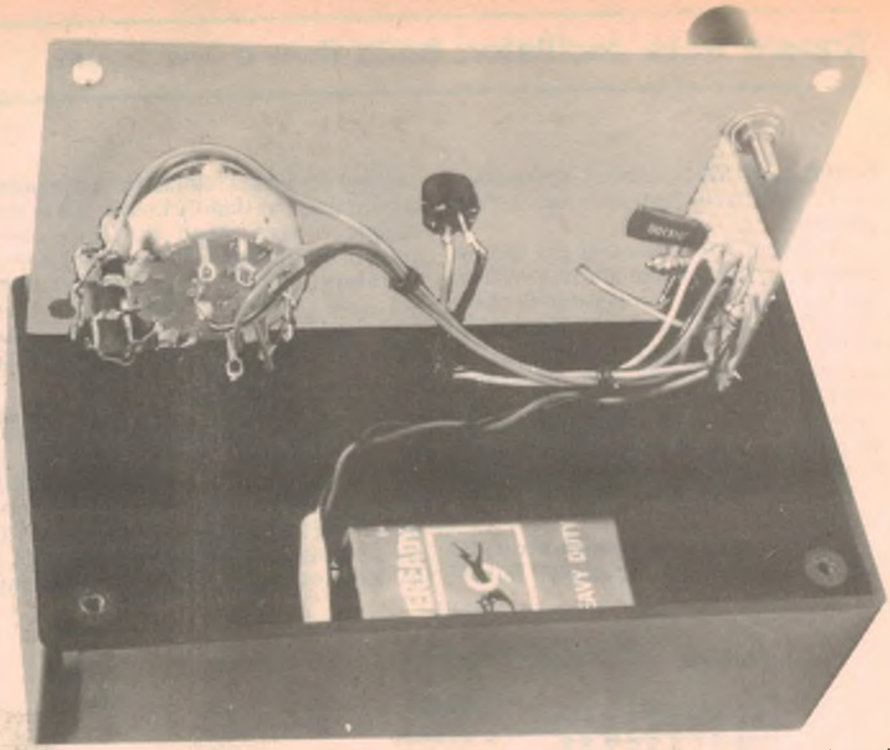
To complete the actual wiring, fit the various timing capacitors to the switch — wiring them as shown in the photograph. Then add a knob to the front of the switch, and your square wave oscillator should be ready to try out. But before you connect up the battery, just check that you haven't made any mistakes.

Have you got the 555 round the right way? The LED connections right? The polarised capacitors C2 and C3 round the right way? The battery connections right? These are all important.

If all seems well, connect up the battery and switch to the 1Hz position. You should be greeted by the LED flashing on and off, once a second. If not, switch off and check your wiring again for errors.

Switching to the 10Hz position should cause the LED to flash somewhat faster — 10 times per second. And if you switch to the three higher positions, it should flash so fast that your eye won't be able to respond. The LED will appear to be glowing continuously.

Your oscillator will now be completed and ready for use. Next month we'll start showing you how to use it for some simple experiments with digital ICs.



This view inside the case shows the general layout of the oscillator. The stripboard assembly is soldered directly to the black terminal post tag, as shown on the component overlay diagram.

Parts List

- *1 555 IC*
- *1 red LED*
- *1 1k ¼W resistor*
- *1 3.9k ¼W resistor*
- *1 68k ¼W resistor*
- *1 .001uF polyester capacitor*
- *2 .01uF polyester capacitor*
- *1 .1uF tantalum capacitor*
- *1 1uF tantalum capacitor*
- *1 10uF tantalum capacitor*
- *1 piece of Veroboard, 28mm x 28mm*

2-pole six-position rotary switch
Zippy box, 130 x 68 x 41mm
Hookup wire, solder, terminal posts, knob for switch, etc.

An improved 2650 disassembler

Here is an improved disassembler program for small 2650 microcomputer systems, designed to complement the mini line assembler. It will translate all 2650 machine code back into mnemonic form, calculating operand addresses as it goes — making it ideal for program troubleshooting. With a minor change and the addition of a small routine it can also be used to prepare fully commented "source" listings.

by JAMIESON ROWE

An assembler program can be a very handy piece of software when you've written a program and want to feed it into your computer. But when your program is in the machine and won't run properly or doesn't do what you expected (one of these is usually the case!), the assembler won't help you much. Far more useful when you've reached this stage is a disassembler program, which as the name suggests does just the opposite of an assembler: translate from machine code back into human-readable mnemonic language.

On the surface, a disassembler mightn't sound as if it would be of much help when you're trying to track down those elusive program bugs. After all, in translating back to mnemonic language it merely gets you back to where you started! This might be so in theory, perhaps, but in practice things generally aren't that simple.

What tends to happen is that after feeding your program into the system, either via an assembler or directly in code you have assembled yourself, you try running it and then discover the first batch of bugs. Generally these are silly mistakes, which you correct as you find them by patching in small corrections — changing the condition criterion for a branch, adding in missing instructions, and so on.

Unless you have a major change to make, the tendency is to code the patches yourself, as this is faster than loading in and firing up an assembler. But in doing so, you tend to make coding errors which themselves produce new bugs. In any case it is all too easy to forget to change displacements in nearby instructions which, while not directly involved in a patch, may be affected by it.

The end result is that after you have made a certain number of patches, the program has become rather different from the way it was when you started. This can make it quite difficult when it comes to tracking down the more subtle logical bugs, which are generally still in the program waiting to be discovered. At this stage of the proceedings it can be a big help if you can use a disassembler to provide an accurate mnemonic listing of the program as it now stands.

Another important area of use for a disassembler is when you acquire a program in "naked" machine language form, without any accompanying source listing or other descriptive literature. It may run on your system, but you want to see how it works in order to make sure that you use it properly. Or it won't run on your system, perhaps because it was written for a slightly different system and you want to work out how to modify it so that it will work on yours. Or you may want to see how to provide it with additional features, or how to adapt it to perform a similar but different job . . .

The listing produced by a disassembler won't give you all of the information in a good source listing, but if you can't get hold of a source listing it's certainly the next best thing.

```
*G1B00 1B9E 1BBD 30

2650 DISASSEMBLER VERSION 2

1B9E 1F1BBD      BCTA,UN    1BBD
1BA1 3F1D4E      BSTA,UN    1D4E
1BA4 0604        LODI,R2    04
1BA6 07FF        LODI,R3    FF
1BA8 0FBA42      LODA,R3    *1A42+
1BAB CF7A11      STRA,R3    1A11#
1BAE FA78        BDRR,N     1BA8
1BB0 0705        LODI,R3    05
1BB2 0FFA42      LODA,R3    *1A42#
1BB5 C2          STRZ,R2
1BB6 C3          STRZ,R3
1BB7 460F        ANDI,R2    0F
1BB9 47F0        ANDI,R3    F0
1BBB E60C        COMI,R2    0C
1BBD 1C1CC9      BCTA,Z     1CC9
```

Fig. 1: A sample of the disassembler's output. Its calling format is also shown.

As those with 2650 microcomputer systems are probably aware, a small disassembler for 2650 code has been available for quite a while now. One of the pioneering software programs produced by the 2650 Users' Group, it was written by Ian Binnie. A modified version of this program prepared by the present author was made available to EA readers on our 1978 Software Record.

Helpful though this early disassembler has been, it did have a number of disadvantages. One problem was that it didn't disassemble quite a few of the single-byte and double-byte instructions; another was that it made errors in calculating the absolute address referenced by forward referencing relative indirect addressing instructions.

A further problem was that it didn't fully disassemble absolute addressing instructions, and gave no indication of indirect or indexed addressing modes.

Taken individually, none of these shortcomings was all that serious. But collectively they have tended to limit the disassembler's value.

While I was working on the 2650 mini line assembler, it occurred to me that it should be possible to write a more comprehensive disassembler which could make use of the assembler's mnemonic lookup table. So as soon as the assembler was completed, I set about writing a new disassembler along these lines. It took a while to write and debug, but finally here it is!

As the foregoing suggests, the new disassembler is meant to be used in conjunction with the mini assembler. This is because it shares the same mnemonic lookup table, located from X'17CF—1A01. It also uses the same RAM buffer area (X'1A02—1A54) for its own line buffer and scratchpad area, to save memory space. Needless to say this doesn't mean that you can't use the disassembler by itself — all you need to do in order to do this is load it in together with the lookup table.

The disassembler itself is 726 bytes long, occupying memory from X'1B00 to 1DD5 — so that it fits into memory immediately above the assembler.

The starting address is 1B00, and you call it by typing an extended PIPBUG "GO" command. In other words you type an input GO command which includes information for the disassembler, telling it the memory range you want it to work on, and whether or not you want it to split the output listing into pages of a certain size, with headings.

The precise calling format required is similar to that for the earlier disassembler:

G1B00sAAAAsBBBBsCCr

where "s" stands for a space and "r" stands for a carriage return. AAAA is the start address (in hex) of the section of program you want disassembled, while BBBB is the end address. These are the only two essential parameters required, and of course the end address should be greater (higher) than the start address — otherwise the disassembler will throw you out with a peremptory "?".

The third parameter "CC" is an optional one used to specify the number of lines per page, where a long listing is to be produced. CC is a two-digit hex number, so you can specify pages of up to 255 lines each. Each page will be given the title "2650 DISASSEMBLER VERSION 2", and at the end of each page the disassembler will pause to allow you to advance the paper in a printer, etc. You can then prompt it to continue with the next page by hitting any key on the terminal keyboard.

If you omit the third parameter, or give it a value of zero (00), the disassembler assumes that you don't want pagination. Accordingly it will omit the titles, and simply provide an unadorned continuous listing. This mode of operation is very suitable for quick disassembly of numerous short instruction sequences, when you are troubleshooting — you don't have to worry about typing in the third parameter, and operation is faster and more efficient because the disassembler doesn't have to provide a title each time.

A hex listing of the disassembler is given in Fig. 2. This is complete part from the mnemonic lookup table given as part of the assembler.

In operation, the disassembler will provide mnemonic translations of all bytes it finds in the designated memory address range, providing they represent valid 2650 instruction codes. Bytes which are not valid 2650 codes will be printed at the start of the appropriate line, but will not be translated. Naturally enough the disassembler has no way of knowing whether the memory range you specify contains a program, or data — it is up to you to look after that.

If you do make a mistake and set it loose on some data, don't worry. Nothing will be damaged. All that will happen is that the disassembler will try valiantly to make some sense out of the data, translating it into whatever pseudo-program it may represent. The odds are that some of the data numbers won't even correspond to valid 2650 opcodes, so the listing will probably have a fair number of blanks in the mnemonic columns.

```
1B00 76 60 77 02 3F 02 DB 3F 1C 1C 3B F9 CD 1A 48 CE
1B10 1A 49 E9 AB 19 07 1E 02 50 EA AA 99 FA 3B E6 CE
1B20 1A 40 08 FC CC 1A 41 18 08 05 1D 06 9E 3F 1D 8A
1B30 C0 07 FF 04 20 CF 3A 02 E7 22 98 79 07 FF 0C 1A
1B40 46 3F 1D 30 0C 1A 47 3B F9 87 01 0C 9A 46 3B F2
1B50 75 09 77 02 07 00 06 12 EF 7B 6B 18 06 87 02 FA
1B60 77 1B 2C 05 19 0F 3B 6B C2 1B 36 74 2A 75 30 76
1B70 36 77 3C C0 72 40 78 BB A8 9B AE B4 B4 B5 BA 92
1B80 C0 93 C6 12 CC 13 D2 BF D8 9F DE 10 EA 11 F0 05
1B90 18 06 28 44 FC 3F 1D 55 E7 00 98 08 07 07 1F 1B
1BA0 ED 3F 1D 4E 06 04 07 FF 0F BA 42 CF 7A 11 FA 78
1BB0 07 05 0F FA 42 C2 C3 46 0F 47 F0 E6 0C 1C 1C C9
1BC0 E6 08 1C 1C 9B E6 04 1C 1C 65 E6 02 1C 1C 48 E6
1BD0 01 1C 1C 25 3F 1D 0D 3F 1C EF 3F 1D 70 C2 20 F6
1BE0 80 98 02 04 1F 07 18 3F 1D 30 02 3B FB 20 CF 3A
1BF0 02 05 1A 06 02 3F 1D 8A 3F 1C FB ED 1A 48 1D 00
1C00 22 1A 05 EE 1A 49 19 F7 75 09 04 FF 8C 1A 41 C8
1C10 FC E4 00 9C 1B 31 3F 02 86 1F 1B 22 CD 1A 46 CE
1C20 1A 47 17 C0 C0 F7 10 18 1A 0C 9A 46 C1 44 03 45
1C30 DC 25 14 98 04 06 EC 1B 02 06 D4 05 17 3F 1D 55
1C40 3F 1D 78 07 16 1F 1B ED F7 10 18 0D 0C 9A 46 44
1C50 03 05 17 06 D4 3B E7 3B E8 3F 1D 0D 07 18 3F 1D
1C60 30 07 1A 1B E1 0C 9A 46 C1 44 03 F5 10 18 04 06
1C70 D4 1B 02 06 EC 05 17 3F 1D 55 3F 1D 78 3B DB 3F
1C80 1C EF 3F 1D 70 C1 77 09 8C 1A 47 C2 3F 1D BD C1
1C90 3F 1D 23 02 3B C9 07 1C 1F 1B ED 0C 9A 46 44 03
1CA0 05 17 06 D4 3B D2 3B D3 3F 1D 0D 3F 1C EF 50 50
1CB0 50 50 50 44 03 18 07 C3 0F 77 CF CC 1A 1F 3F 1D
1CC0 23 3F 1D 17 07 1D 1F 1B ED 0C 9A 46 F4 40 18 04
1CD0 06 EC 1B 02 06 D4 05 17 44 03 3F 1D 55 3F 1D 78
1CE0 3B 2B 3B 0B 44 7F 3F 1D 2B 3B 2C 07 1C 1B D8 F5
1CF0 80 16 04 2A 07 17 CF 3A 02 01 17 77 0A 75 01 0D
1D00 1A 46 0E 1A 47 86 01 85 00 3F 1C 1C 17 3B 6C 0C
1D10 9A 46 07 06 3B 1A 17 3B 62 0C 9A 46 3B 12 07 08
1D20 3B 0E 17 45 1F 0C 1A 46 44 60 61 07 18 3B 01 17
1D30 C1 75 0A 50 50 50 50 3B 05 01 3B 02 01 17 44 0F
1D40 E4 0A 1A 04 84 37 1B 02 84 30 CF 3A 02 17 CD 1A
1D50 42 CE 1A 43 17 3B 77 07 04 EF FA 42 14 75 01 77
1D60 08 86 06 85 00 E5 19 98 6C E6 F6 1A 68 07 00 17
1D70 44 7F F4 40 16 64 80 17 04 2C CC 1A 15 06 02 07
1D80 FF 0F BA 42 CF 7A 16 FA 78 17 CD 1A 44 CE 1A 45
1D90 75 08 07 FF 0F BA 44 1C 00 8A BB A0 1B 76 0D 0A
1DA0 32 36 35 30 20 44 49 53 41 53 53 45 4D 42 4C 45
1DB0 52 20 56 45 52 53 49 4F 4E 20 32 0A 00 B5 01 98
1DC0 07 01 1A 0B 04 01 1B 08 01 9A 04 04 FF 1B 01 20
1DD0 75 09 8C 1A 46 17
```

Fig. 2: A full hex listing of the new disassembler, less its lookup table.

The main thing to note is that if you do force the disassembler to struggle through some data and then into some valid program coding in the one run, it may well be thrown out of kilter for the first few valid instructions after the data. This is becuase at the end of the data section it may be part-way through the disassembly of a "fake" multi-byte instruction, causing it to regard the first byte or two of the real instruction as the rest of the fake instruction.

If this happens the first few instructions after the data will be wrongly disassembled, until the coding forces the disassembler back into correct "phase" with respect to the start and finish of each instruction.

Incidentally the same sort of malfunction can occur if you have made a mistake in the coding being disassembled, so that the opcode of an instruction has accidentally been changed into that for an instruction of different length. This will again throw the disassembler out of kilter, because it will be misled into regarding opcode bytes as operand bytes and vice-versa.

There is also a third way the disassembler can be led astray: by giving it the wrong memory range starting address, when you call it. Needless to say if you tell it to start in the middle of the first instruction rather than the start, it has no way of knowing. it will simply press on, translating away as best it can.

Incidentally, the fact that the disassembler can be led astray in these ways does not mean that it is faulty. There is no way in which any disassembler can tell if the numbers it is processing are instructions, or data — after all, the only difference between an instruction byte and a data byte is the way the computer is told to interpret them. Similarly where a disassembler has to deal with variable length instructions, there is no way it can infallibly identify opcode bytes and distinguish them from operand bytes — they're all just numbers.

In other words, make sure that you start the disassembler off on the right foot when you call it. And if it should

AN IMPROVED 2650 DISASSEMBLER

become misled by some data you've forgotten to tell it to bypass, or by an opcode you have accidentally changed into one for an instruction of a different length, put the blame where it really lies. After all, it's only a dumb program — you're supposed to be the intelligent one!

After it has finished disassembly of the designated memory range, the disassembler will return to PIPBUG as usual. Or, to be more accurate, it will return to PIPBUG when it finishes disassembly of the last instruction which starts in the designated range. This means that when you specify the end of the range to be disassembled, you don't have to work out the very last byte of the last instruction in the range. Just specify the address of any byte in the last instruction to be disassembled — the disassembler will automatically finish the instruction before it bows out.

This can save valuable time, because often you're working from an earlier listing for reference, and it's convenient to give the end of the range as the address of the first byte in the last instruction.

Like the assembler, the new disassembler uses a number of utility subroutines from PIPBUG. In this case it uses GNUM to fetch its input parameters, CHIN and COUT to communicate via the terminal, and CRLF to provide carriage return/line feeds.

As you can see from the sample listing in Fig. 1 (which is actually part of the disassembler itself), the basic listing produced by the disassembler is 30 characters wide. This makes it suitable for all normal terminals and printers.

Note two things about the disassembler's listing, as illustrated in Fig. 1. One is that for indexed instructions the disassembler uses the same format as the line assembler, showing the index register in the R/C field immediately after the opcode mnemonic. The other point is that for convenience the disassembler places its indexing symbols AFTER the operand address, not before it.

A third point to note is that the R/C mnemonic produced for the BDRR instruction is a condition code mnemonic (N) rather than the more usual register code mnemonic. This is a minor shortcoming of the disassembler, due to a programming compromise. It also occurs when BIRR instructions are disassembled.

Apart from these three minor differences, the listing produced by the disassembler follows the standard 2650 instruction format.

You may also have noticed from Fig. 1 that the basic listing produced by the disassembler is not all that much different from a full "source" listing — the only thing lacking is the comments. This suggests that the disassembler could be used to produce source listings of any program stored in your system's memory, merely by modifying it so that you can add comments.

In fact I have produced a supplementary routine which can be added to the basic disassembler to let you do just that. The supplementary routine is shown in Fig. 3 — as a full listing produced when it was working with the disassembler, so you can see the type of listing it lets you produce.

As you can see it is quite a short routine, which fits into memory immediately after the disassembler itself. To patch it into the disassembler, all you need to do is change the instruction beginning at address 1D97 from 1C008A into 1C1DD6.

What the routine does is cause the disassembler to pause after it has listed each disassembled instruction. You can then type in any comment you wish from the terminal keyboard.

If you end the comment by typing a carriage return, the routine will return to the disassembler via the CRLF subroutine and the next instruction will be disassembled after the usual carriage return and line feed. However if you end by typing "TAB" instead of carriage return, the routine will remain in comment mode and will provide a carriage return, line feed and 15 spaces. This lets you feed in a full line comment, of the type used to label routines, etc. The three comment lines at the top of Fig. 3 itself were added in this way.

You can provide line spaces between parts of your listing by using the TAB key, or using the LF key.

Together the disassembler and supplementary routine provide a very convenient means of making fully commented source listing. As well as using them to produce the listing shown in Fig 3, I have already used them to produce a full source listing of the disassembler itself.

For those who would like to analyse the disassembler's operation in detail, copies of the full listing are available from our Information Service for a fee of $4.00, to cover photocopying and postage.

Finally, there's one thing the disassembler won't do: print out ASCII message strings in memory, so you can see what they say. But there's an easy way to get around this — use a separate little routine which makes use of the disassembler's message printing subroutine. The routine you need is shown in Fig. 4 above. It occupies only 10 bytes, fitting in above the comment addition routine; you call it as shown.

```
                    *ROUTINE TO PROVIDE COMMENT ADDITION
                    *FACILITY FOR THE IMPROVED 2650
                    *DISASSEMBLER. J.ROWE 1/4/1979

1DD6 3F0286         BSTA,UN    Ø286    ACCEPT CHAR VIA CHIN SR
1DD9 E4ØD           COMI,RØ    ØD      TEST FOR CR
1DDB 1CØØ8A         BCTA,Z     ØØ8A    EXIT VIA CRLF IF FOUND
1DDE E4Ø9           COMI,RØ    Ø9      TEST FOR TAB (HT)
1DEØ 18Ø4           BCTR,Z     1DE6    GO SET UP IF FOUND
1DE2 BBAØ           ZBSR      *ØØ2Ø    NOT CR OR TAB: ECHO VIA COUT
1DE4 1B7Ø           BCTR,UN    1DD6    & LOOP BACK
1DE6 BBA5           ZBSR      *ØØ25    TAB: GIVE CRLF
1DE8 Ø7ØF           LODI,R3    ØF      SET R3 AS COUNTER
1DEA 3FØ361         BSTA,UN    Ø361    & USE AGAP SUBR FOR 15 SPACES
1DED 1B67           BCTR,UN    1DD6    THEN LOOP BACK FOR COMMENT

2650 DISASSEMBLER VERSION 2
```

Fig. 3 (above): An optional add-on routine which lets you add comments to the listing.

Fig. 4 (right): A further routine, called separately, which will print out ASCII message strings stored in memory.

```
                    *ROUTINE TO PRINT OUT ASCII MESSAGES
                    *STORED IN MEMORY. J.ROWE APRIL 1979
                    *USES MESSAGE PRINTING SUBR IN MY
                    *IMPROVED DISASSEMBLER, ALSO GNUM IN
                    *PIPBUG. CALL BY GIDFØ AAAA, WHERE
                    *AAAA IS START OF MESSAGE. NOTE THAT
                    *MESSAGE MUST END WITH A NULL

1DFØ 766Ø           PPSU       6Ø      SET FLAG FOR MARK,INHIBIT INT.
1DF2 3FØ2DB         BSTA,UN    Ø2DB    FETCH MESSAGE START
1DF5 3F1D3A         BSTA,UN    1D3A    & GO PRINT
1DF8 9B22           ZBRR       ØØ22    THEN RETURN TO PIPBUG
```

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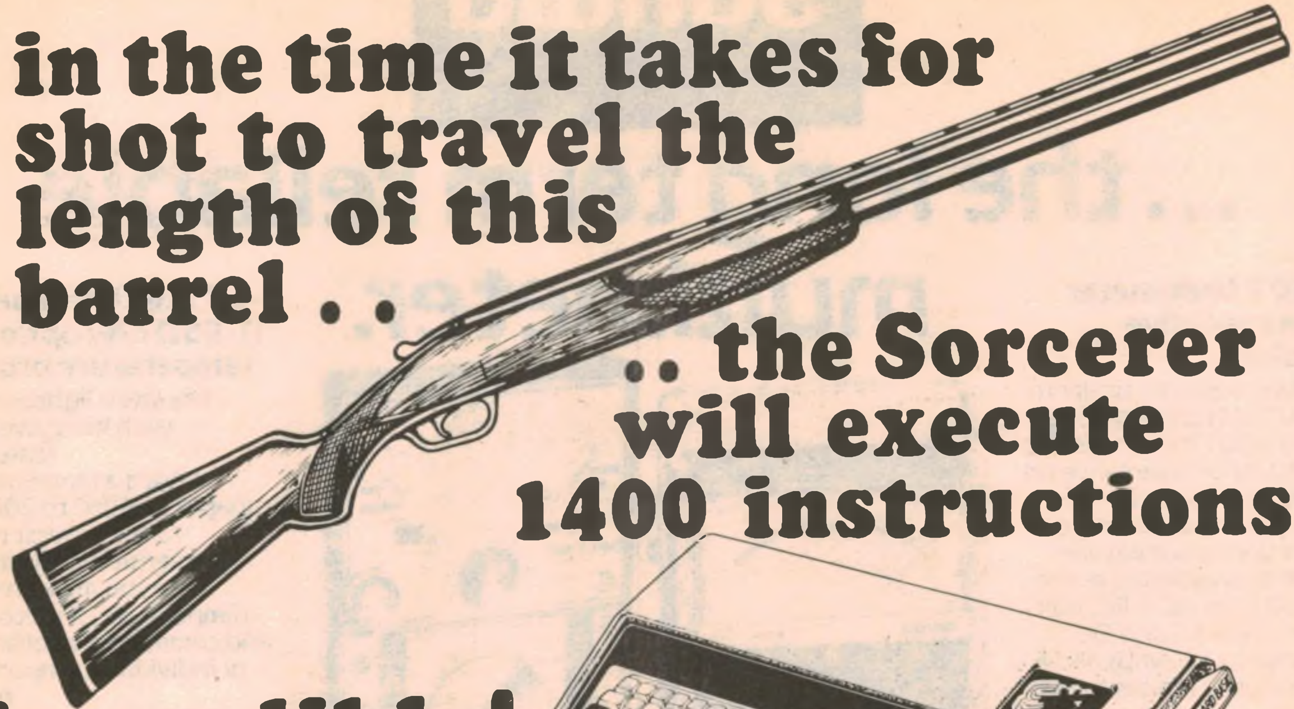
in the time it takes for shot to travel the length of this barrel . .



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4th article gives the lowdown on

Chip-8 programming for the DREAM 6800 computer

In this fourth article on the DREAM 6800 the author gives hints on CHIP-8 programming. Also featured is a substitute circuit for the 6875 clock chip using low cost TTL devices and the full size artwork for the PCB. A future article will give details of RAM expansion.

by MICHAEL J. BAUER

After a while, when the provided video games become a bit of a yawn, you will want to write your own programs. There is no language as powerful as CHIP-8 which can be learned with such ease. The function of most of the instructions can be understood from the table, but some need further explanation. First, it might be an idea to re-read the CHIP-8 summary given in the May article.

The display instruction (DXYN) is the most important. It treats the screen as a coordinate grid of dots, numbered from 0 to 63 (00-3F hex) from left to right across the screen, and from 0 to 31 (00-1F hex) from top to bottom. Two variables of your choice are used to specify the coordinates of a symbol to be displayed. The symbol may be any size up to 8 dots across by 16 dots down. Larger symbols may be shown by using more than one DXYN instruction, possibly in a loop. Various symbols are defined by making up a pattern of bytes and storing this data along with the program. As an example, let us say we want to show an "X", 7 x 7 dots in size. Thus, N is 7. The screen coordinates we will choose to be variables VA and VB, i.e. X = A and Y = B. Thus the instruction will be DAB7. But how does the interpreter know where to find our symbol pattern? A special index variable, called "I", can be set to point to anywhere in the bottom 4k of memory, using an AMMM instruction. Let us put our pattern at location 0210 onwards, thus:-

Address	Binary Data	Hex Data
0210	1000 0010	82
0211	0100 0100	44
0212	0010 1000	28
0213	0001 0000	10
0214	0010 1000	28
0215	0100 0100	44
0216	1000 0010	82

To display this pattern in the upper left hand corner of the screen, we would initialize variables VA and VB to zero, and set I = 210. Note, if N = 0, a 16 byte pattern will result. The program, with comments, is shown below:-

```
0200   6A00   VA=00              Set coordinates
0202   6B00   VB=00
0204   A210   I=210              Set pointer
0206   DAB7   SHOW 7@VA,VB       Show 7-byte pattern
0208   F000   STOP               Jump to monitor
020A
020C
020E
0210   8244   DATA               Pattern for "X"
0212   2810
0214   2844
0216   8200
```

Note that the first CHIP-8 instruction must be at 0200. The program is executed by a GO from C000, which is the interpreter's starting address. Try setting VA and VB to different starting values, then re-run the program. Note that these values specify the position of the upper LH corner of the symbol.

An important feature of the SHOW instruction is that if a symbol is displayed and it overlaps another symbol already there, then the overlapping spots are erased and variable VF (the "flag" variable) is set to 01. If no overlap, VF = 00. This feature can be used to erase a symbol, by showing it again at the same coordinates, without erasing the whole screen (which can be done with a 00E0). Of course, you have to keep track of the positions of each different symbol used in this way. Variable VF can be used to see if two objects collided, in an animated game. An object can be made to move about on the screen by erasing it and re-showing it in a new position each time.

This program illustrates:-

```
0200   6A00   VA=00
0202   6B00   VB=00
0204   A210   I=210
0206   DAB7   SHOW 7@VA,VB
0208   DAB7   SHOW 7@VA,VB
020A   7A01   VA=VA+01
020C   7B02   VB=VB+02
020E   1206   GOTO 206
0210   8244   DATA
0212   2810
0214   2844
0216   8200
```

The speed and direction of motion can be manipulated with the instructions at 20A and 20C by changing the values which are added. Note that adding FF is the same as subtracting 01; (refer to a text on "two's complement" arithmetic). The motion can be slowed down by putting a time delay inside the loop.

The random byte generator in CHIPOS is unique, and achieves longer sequences and higher randomisation than conventional software pseudo-random sequencers by utilising the fact the program bytes are "kind-of" random. In a VX=RND.KK instruction (CXKK), a variable is set to a random value which has been masked by (i.e. ANDed with) a constant (KK). Thus, random numbers covering a specified range, and falling into precise intervals, can be selected. For example, a C01E instruction will give only even numbers in the range 0 to 30 (00-1E hex).

CHIPOS has built-in patterns for the symbols 0 to 9 and A to F, and CHIP-8 provides an instruction to allow you to display the contents of any variable as a hex digit. Only the least significant 4

bits are relevant. For example, to show the hex value of V6, we would use an F629 followed by a DXY5, where X and Y are again arbitrary. The F629 sets up I to point to the symbol corresponding to the value of V6 (LSD).

Another useful instruction, FX33, lets you find the 3-digit decimal equivalent of any variable; e.g: F433 would store 3 bytes in memory, at the location specified in I. To display this 3-digit number, you will need to be familiar with another pair of instructions: FX55 and FX65.

FX55 takes the values of variables V0 up to VX (incl.) and stores them in successive memory locations, indexed by I. FX65 does the reverse, i.e. re-loads the variables from memory. These powerful instructions not only extend the number of available variables, but also let you perform array processing. Note that the pointer (I) auto-increments with these two instructions, i.e. I is advanced by the number of variables stored or loaded (X+1), provided that a page boundary is not crossed. (A "page" is 256 bytes.) Also note that if X=0, only one variable (VO) is affected.

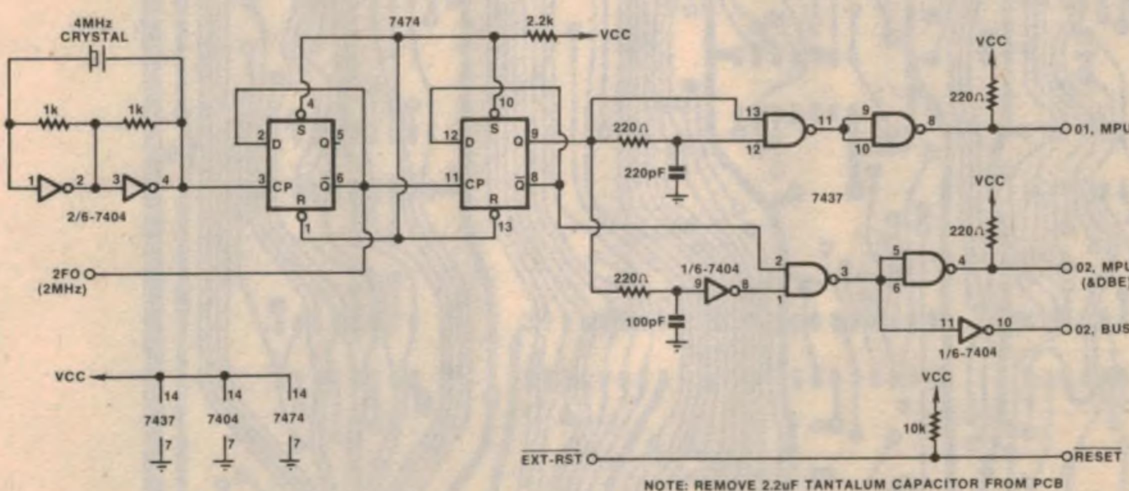
We can therefore use F256 to load variables V0, V1 and V2 from memory at I. If we had previously used an F433 to store the 3-digit decimal equivalent of V4 in memory at I, then V0, V1 and V2 would now contain the "hundreds", "tens", and "units" (resp.) of the value of V4. These can be displayed with the FX29 and DXYN instructions, as explained. While this may be confusing at first, it makes for a very versatile language, as you will come to appreciate.

A small part of a program, called a subroutine, can be accessed several times from different parts of a larger program. Further, a subroutine can "call" other subroutines (known as subroutine nesting). Each subroutine must end with a RETURN statement (00EE) so that, upon completion, control will return to the instruction following the particular "DO" statement (2MMM) that called it.

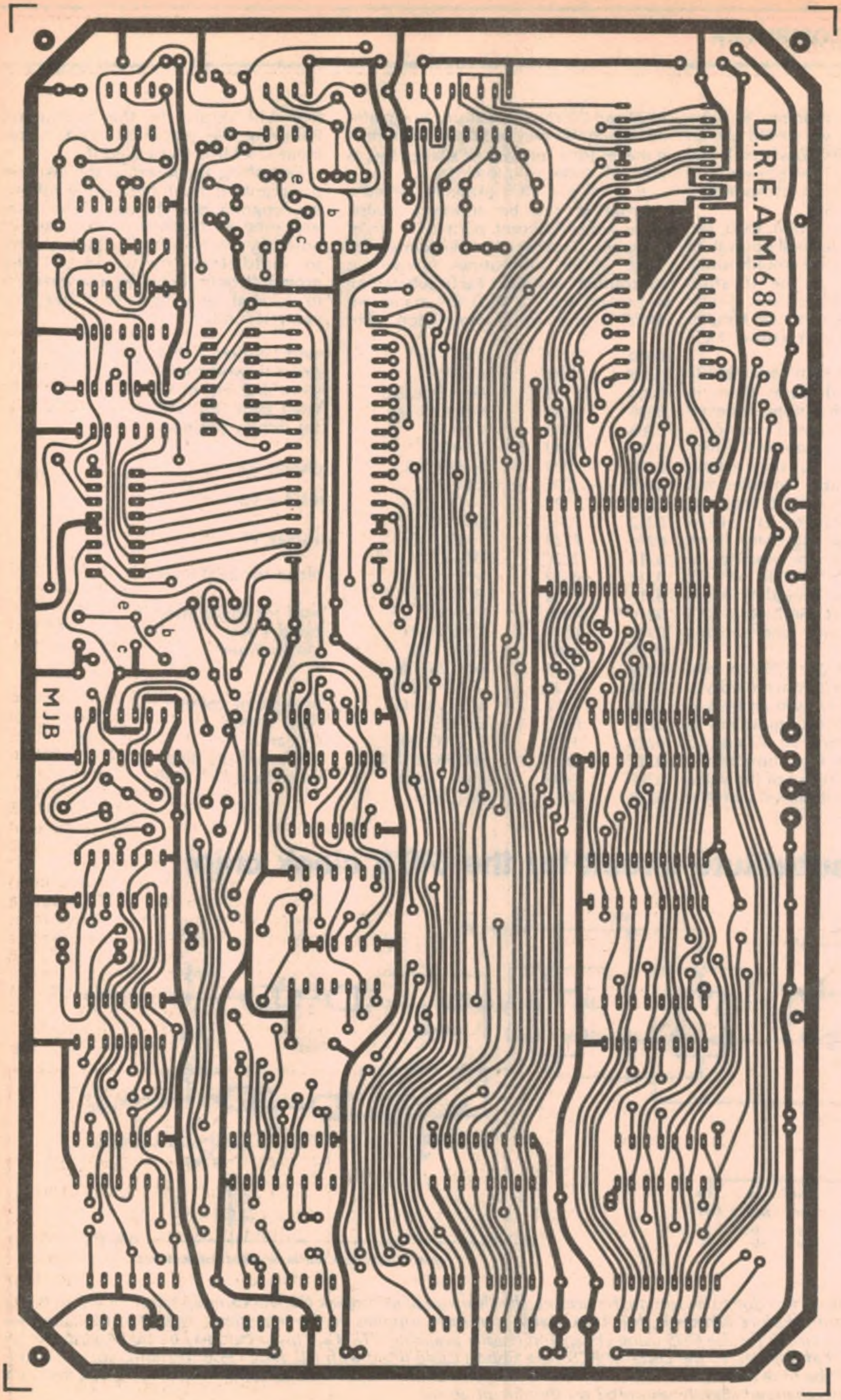
Everything discussed in the last few paragraphs is illustrated in the following program, plus the use of the timer and tone instructions, so you can see how easy it is. Have a close look, and try to understand its workings. The program counts down V3, converting it to decimal, showing it, and bleeping, every second.

0200	63FA	V3=FA	start counter at 250
0202	A240	I=240	point to workspace
0204	F333	MI=DEQ,V3	store dec. eq. of V3
0206	F265	VO:V2=MI	Load same into V0:V2
0208	6418	V4=18	set display position
021A	6510	V5=10	
021C	F029	I=DSP,V0	display V2
021E	222C	DO 22C	
0210	F129	I=DSP,V1	display V0
0212	222C	DO 22C	
0214	F229	I=DSP,V2	display V1
0216	222C	DO 22C	
0218	6602	V6=02	bleep for 2x20 msec
021A	F618	TONE=V6	
021C	6630	V6=30	wait for 48x20 msec
021E	F615	TIME=V6	(total 1 sec)
0220	F607	V6=TIME	check timer
0222	3600	SKF V6=00	
0224	1220	GO TO 220	
0226	73FF	V3=V3+FF	decrement counter
0228	00E0	ERASE	clear screen
022A	1202	GO TO 202	repeat . . .
022C	D455	SHOW 5@V4,V5	subr. to show digit
022E	7404	V4=V4+04	move "cursor" right
0230	00EE	RETURN	

Here is a substitute circuit for the 6875 clock chip:



Just before the July issue was due to be run on the presses, the shortage of 6875 clock chips became apparent. It seems that it could be several months before Motorola, Inc, USA is able to restore supplies. In the meantime, designer M.J. Bauer has produced a substitute circuit for the 6875 using cheap and readily available TTL ICs. This circuit may be built up on a small section of Veroboard and linked to the DREAM PCB via a ribbon cable fitted with DIL plug (16-pin) and IC socket, in the 6875 position. When the time comes, the TTL circuit can be discarded and the 6875 plugged in, instead. Note that the reset circuitry must also be changed slightly, as noted on the circuit above.



Here is the full size artwork for the printed circuit board.

While the above program serves to illustrate some of the trickier CHIP-8 statements, it is not a good example of the power and efficiency of the language. To see that, one has to analyse a more complex, graphics oriented program, such as an animated video game. It is good experience to "dis-assemble" one or more of the games provided, to see how the programmer tackled the problem. You should therefore deduce: which numbers are instructions and which are data; what each variable is used for; and what is stored in various memory workspaces; etc. (Kaleidoscope and TV-Typewriter not recommended for starters.) Flowcharting is also a handy programming tool that will increase your expertise.

I have presented only a very sketchy description of how to write programs. A lot of practical experience is the only way to learn and become proficient. Test the operation of each of the instructions in a short routine, so that its operation becomes clear. Before attempting any complex video games, try some of these simpler exercises:-

1. A program that waits for a key depression, then displays the corresponding hex digit on the screen. (Looping indefinitely.)
2. Same as (1), but rejects keys A to F by returning to monitor.
3. Show an 8 x 8 symbol of your choice on the screen and make it move left when key 4 is held down and right when key 6 is held (using EX9E or EXA1).
4. Make the above 8 x 8 symbol move randomly about the screen.
5. Program the game of NIM. Show 21 objects on the screen. Two players take turns to remove 1, 2 or 3 objects. Player to take last object(s) wins.
6. Imagine a 4 x 4 square game board. The keypad is also a 4 x 4 matrix. Program accepts a hex key, then places a symbol in corresponding position on screen.
7. As above, but alternating between two different symbols.
8. Invent a two-player game based on the above principle, and program your computer to win against a human opponent.

Once you can do the above, you're ready for Lunar Lander,LIFE, Blackjack, and other favourites. Add a 2k RAM board and you can try for CHESS or STAR-TREK.

APPENDIX: HEXADECIMAL

There's nothing complicated about it, but it might help if you had 8 fingers on each hand. Then you could count from 0 to 15 (instead of 0 to 9) before having to use carry. HEX is convenient because each digit can be represented by exactly 4 binary digits (bits), without having any missing codes or extraneous codes:-

Decimal	Binary	HEX
0	0000	0
1	0001	1
2	0010	2
3	0011	3
4	0100	4
5	0101	5
6	0110	6
7	0111	7
8	1000	8
9	1001	9
10	1010	A
11	1011	B
12	1100	C
13	1101	D
14	1110	E
15	1111	F

The symbols A to F are used to denote the numerals 10 to 15. Furthermore, 4 divides into 8 exactly; so you can represent an 8-bit binary number with 2 hex digits, without having any bits left over; unlike the OCTAL (base 8) system, which has had many programmers pulling out their hair! Thus we can easily convert between binary and hex, simply by grouping bits into fours: e.g.:-

What is 26F0 in binary?

```
           2     6     F     0
Answer = 0010  0110  1111  0000
```

(from above table)

What is 01111100 in hex?

```
         0111 1100
Answer =   7    E
```

As well, 16=4x4, and 4+4=8, and PIAs have 8-bit ports, which makes 16-key keypads ideally suited. So HEX is very convenient all round, and easy to master once you memorize the above table!

EDITOR'S NOTE: Reaction to the DREAM 6800 articles has been unprecedented and it seems that a very large number of readers intend building this circuit. Unfortunately, there have been component shortages, including the 6875 and the 2708 EPROM. But it now seems (at time of writing, June 26) that most of these problems are close to solution.

We are informed that programmed 2708 EPROMs containing CHIPOS are now available from Silicon Valley stores and from All Electronic Components (formerly E.D. & E. Sales Pty Ltd), 118 Lonsdale Street, Melbourne, Victoria. As well, complete kits for the DREAM 6800 are available from J.R. Components, PO Box 128, Eastwood, NSW 2122.

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4009	0.70	4027	0.70	4071	0.35
4010	0.70	4028	0.95	4072	0.35
4011	0.25	4029	1.20	4073	0.35
4012	0.25	4030	0.45	4075	0.35
4013	0.55	4035	1.50	4081	0.35
4014	1.20	4040	1.20	4082	0.35
4015	1.15	4042	1.10	4510	1.30
4016	0.50	4043	1.00	4511	1.30
4017	1.20	4044	1.00	4516	1.30
4018	1.20	4046	1.50	4518	1.30
4019	0.45	4049	0.50	4520	1.30

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7404	0.25	7448	0.90	74109	0.55
7405	0.25	7450	0.25	74121	0.50
7406	0.40	7451	0.25	74122	0.60
7407	0.40	7453	0.25	74123	0.60
7408	0.25	7454	0.25	74125	0.70
7409	0.25	7460	0.25	74126	0.70
7410	0.20	7470	0.45	74132	1.00
7411	0.28	7472	0.45	74141	1.25
7412	0.28	7473	0.45	74145	1.10
7413	0.40	7474	0.45	74151	0.90
7414	0.60	7475	0.60	74153	0.90
7416	0.50	7476	0.40	74154	1.30
7417	0.50	7480	0.80	74157	0.85
7420	0.28	7482	1.00	74160	1.10
7421	0.30	7483	1.00	74164	1.30
7423	0.35	7485	1.30	74165	1.30
7425	0.35	7486	0.45	74174	1.30
7426	0.35	7489	2.00	74176	1.10
7427	0.35	7490	0.40	74177	1.10
7430	0.25	7491	0.90	74184	2.20
7432	0.35	7492	0.55	74185	2.20
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NE556	0.80	733CA	1.15	7824CU	0.90
NE561	3.50	741CV	0.35		
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Adapter PCB for 300-baud PIPBUG mod

Here is an item which should be of special interest to those with 2650-based microcomputer systems using the PIPBUG monitor. It is a small adapter board which lets PIPBUG operate at either 110 or 300 baud, without the need to cut or patch the main CPU board.

by ANTHONY HAGEN

11 Stewart Street, Hawthorne Qld 4171.

Like many other readers I built the 2650 Mini Computer of May 1978. After using it for a while, I felt the need to have PIPBUG run at 300 baud rather than 110 baud, in order to dump and load more rapidly. However I hadn't worked out how to do this before Mr R. W. Brown's solution was published in the February 1979 issue, in the "Circuit and Design Ideas" column. Mr Brown's idea was such a good one that I resolved to put it into practice, but I didn't like the idea of cutting the tracks on the main CPU board.

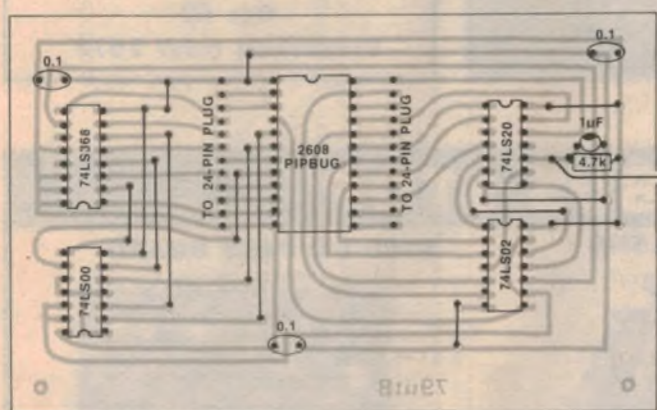
To avoid having to do this, I designed a small adapter PCB which uses the same basic circuit as Mr Brown's, but with a few pin connections changed. The idea is that the adapter PCB connects via a cable and 24-pin DIL plug to the main PCB, plugging into the original socket used for the PIPBUG ROM; the ROM then plugs into a similar socket on the adapter PCB.

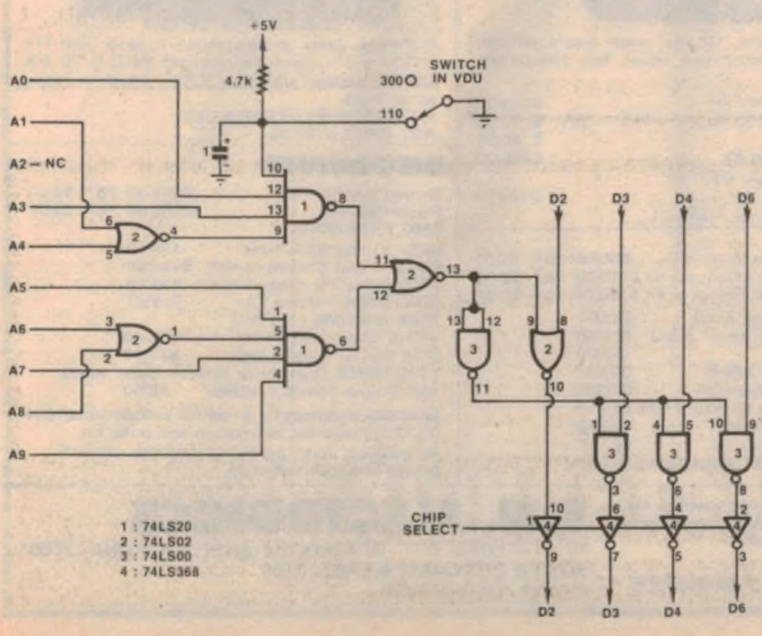
Details of the adapter PCB are shown below, along with the slightly modified circuit. I mounted the PCB between the main PCB and the end of the case, on two small brackets. Apart from the 24-way cable back to the original PIPBUG ROM socket, the new PCB has only one other connection: a wire to a 110/300 baud control switch.

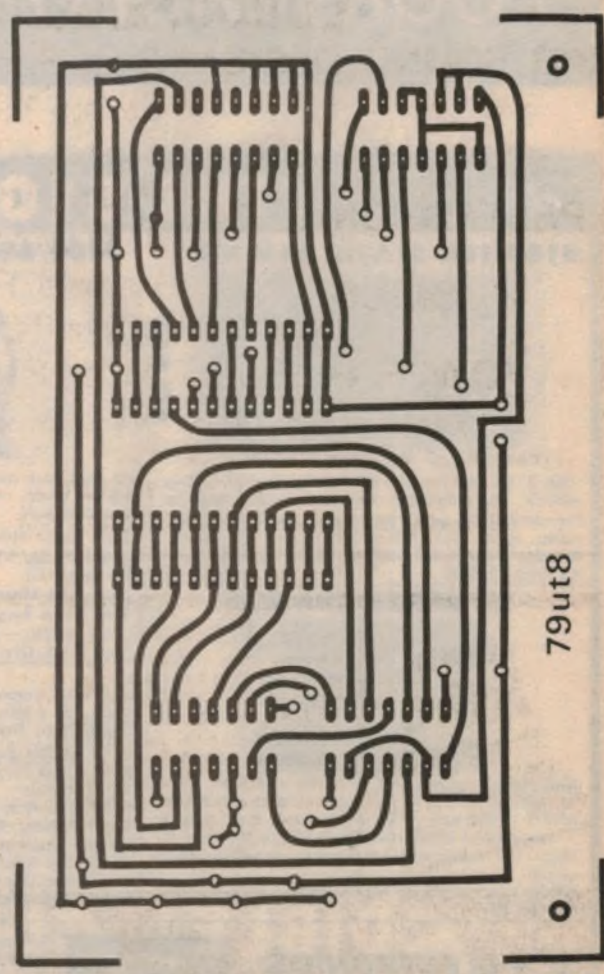
For convenience I extended this control wire to a spare set of contacts on the baud selector switch of my Low Cost VDU, by using a spare pin of the DIN connectors.

The earthy side of the 20mA serial output circuit serves as the return. This makes the VDU switch control both the VDU and the CPU baud rates together.

My adapter worked immediately, and surpassed all expectations. I hope other readers will be able to use my adapter layout with equal benefit.







Here are full details of the adapter board: the circuit, the full-size PCB pattern and the board wiring diagram.

Cassette Interface runs Kansas City, 1200 baud

Microcomputer users looking for a flexible, high performance cassette interface should find the E & M Electronics CI-1 of special interest. It will operate at the "Kansas City Standard" frequencies for compatibility with other systems, but also allows storage and retrieval of data at up to 1200 baud.

by JAMIESON ROWE

The easiest way of storing and retrieving both data and programs with small microcomputer systems is to use magnetic tape, usually in compact cassette form. Ordinary audio cassette recorders can be used for the job, providing a suitable interface is used to convert between the computer's logic levels and the audio frequencies handled by the recorder.

To date most cassette tape interfaces used with hobby computers have used the frequency-shift keying (FSK) technique, and in particular the "Kansas City Standard" method whereby a digital 1 is recorded as a tone of 2400Hz or 4800Hz and a digital 0 as a tone of 1200Hz or 2400Hz. The higher frequency in each case is for data at 300 baud, while the lower frequencies are for data at 110 baud.

While capable of quite reliable operation at these lower data transfer rates, the Kansas City Standard is not really suitable for higher rates. The problem is that as soon as your computer grows beyond a modest size, and you develop some useful programs, a data rate of 300 baud becomes irritatingly slow. Programs and data seem to take ages to get into and out of memory, and you long to be able to dump and load at a higher rate — say 1200 baud, which is available on some of the new packaged personal computers.

Unfortunately until now, if you have used an interface designed to work at 1200 baud or some other high data rate, you have tended to lose the compatibility of the Kansas City Standard. This can create problems, because hobbyists often want to exchange data and programs with each other.

The CI-1 cassette interface from E & M Electronics has been designed to get around these problems. It is a dual-mode interface, able to work in either the Kansas City format or in a high-speed mode capable of handling data at up to 1200 baud. At his rate the highest audio frequency recorded on the tape is 8kHz, which should be within the bandwidth of most cassette recorders.

So using the CI-1 allows you to dump and load most of the time at up to 1200 baud for faster system operation, while still allowing you to generate and handle material conforming to the Kansas City Standard, when required.

The CI-1 is based on a phase-locked loop (PLL) encoding and decoding system, to provide tolerance to tape recorder speed fluctuations. The PLL and filter circuitry time constants are switched to change between the Kansas City and high speed modes of operation.

To make the interface compatible with just about any system, its computer and terminal ports can be wired for either 20mA current loop or TTL logic level interfacing.

Other features of the interface include a "data present" LED, to make it easier to find the start of data records, and CMOS switching to simplify the mode wiring. The interface runs from a single 5V supply, drawing only 90ma maximum with current-loop interfacing (50ma with TTL interfacing).

The CI-1 interface is available as both an assembled and tested unit, ready for operation, and as a do-it-yourself kit. This is a little unusual, because PLL interfaces are usually a little critical when it comes to some of the key components. To get around any possible problems, E & M Electronics select and match the critical components for each kit, and supply them as a carefully identified set. They also offer a back-up service, in case the kit builder should get into trouble.

Ed Monsour, the engineer behind E & M Electronics, sent me a sample CI-1 kit with the idea that I could find out at first hand how it goes together and performs.

Although the instructions supplied with the kit are a little brief, they are quite clear and I found no real difficulty in putting it together. The only trouble was a very minor one: connections to the PCB are via pins and push-on connectors, and PCB drilling tolerances made the connectors a little hard to push on properly. But they responded with a little care and perseverance.

My only other minor gripe is that the switches supplied with the kit have very short toggle levers. Presumably this is to prevent inadvertent operation, but some users like myself may prefer to have a longer toggle at least on the record/play switch. Still, this is easily fixed.

After following the setting-up procedure given in the instructions, the completed CI-1 worked very well. In Kansas City mode it made recordings which were fully compatible with my existing interface, and vice-versa. And in the high-speed mode it performed as series of dumps and reloads at 1200 baud without an error.

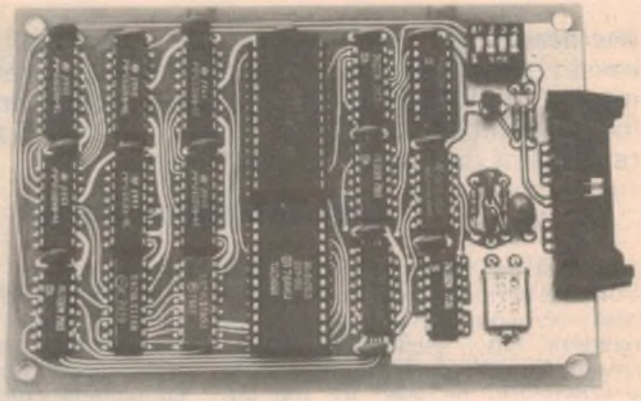
The CI-1 interface as assembled from a kit. As supplied it doesn't include a case or power supply, just the basic PCB assembly.

In short, then, I found the CI-1 interface an excellent performer, and can recommend it to anyone seeking an interface which offers high-speed operation with a compatibility option.

The quoted prices of $69.00 for the assembled unit and $39.00 for the kit (both plus 15% sales tax if applicable) also seem very reasonable.

Further information on the CI-1 cassette interface is available from E & M Electronics Pty Ltd, 136 Marrickville Road, Marrickville, NSW 2204. Telephone (02) 51 5880.

Video interface uses custom LSI chip, has many functions



The VIB-1000 video interface, from Embryonic Systems.

A compact, low cost video interface module based on a custom LSI video processor chip is available from Embryonic Systems. Made by the Nucleonic Products Company of Canoga Park, California, the VIB-1000 interface comes on a single PCB measuring just 120 x 85mm, and costs only $129.95 fully assembled and tested.

Despite its small size and low price, the VIB-1000 is fully self-contained and offers impressive features. It responds to a large group of cursor and format command characters: ERASE PAGE & CURSOR HOME, CURSOR HOME, ERASE TO END OF LINE & CURSOR RETURN, CURSOR RETURN, CURSOR LEFT, CURSOR RIGHT, CURSOR UP, CURSOR DOWN and ERASE LINE.

When the cursor reaches the bottom line of the display and a LINE FEED is received, the entire display is shifted up one line (auto scrolling). A separate DISPLAY ROLL function is also available.

The VIB-1000 provides a display of 16 lines by 64 characters. All synch and other timing is crystal derived. Power requirements are 5V DC at approximately 350mA. Output is composite video, while input is TTL compatible parallel format.

Further information on the NPC VIB-1000 video interface is available from Embryonic Systems Pty Ltd, 1 Ramsden Street, Clifton Hill, Victoria 3068.

Tape controller

A digital cassette tape transport with integral LSI controller is available from the Data Logging and Recorder division of Jacoby Mitchell. Made by the Teac Corporation in Japan, the MT-2 digital cassette memory system is very compact: 120 x 105 x 91mm. Yet it offers 32 bits/mm recording density (800bpi), a nominal data transfer rate of 12k bits/second and a recoverable error rate of less than 10^{-8} bits.

The MT-2 uses a direct reel drive system, with the DC drive motor electronically controlled to give constant tape speed. Feedback is via a sensing roller and optical transducer. Normal tape speed is 15ips, with 45ips used for record searching. Twin motors are used for bidirectional operation.

Phase encoding is used, and the format of records conforms to ISO. ANSI, JIS and ECMA standards for compatibility.

The LSI controller provided in the MT-2 responds to straight forward commands, and provides all necessary status flags. The interfacing is also straight forward, and a minimum of hardware is required for connection to 8080, 6800 or other microcomputer systems. A DMA data transfer technique can also be used if desired.

Two versions of the MT-2 are available: a version with a single-gap read/write head (option 02) and a version using a dual-gap head (option 04) which allows read after write for rapid verification.

Power requirements of the MT-2 are 12V DC at 1A and 5V

DC at 700mA. Prices are $459 for the 02 version and $504 for the 04 version.

Also available from the manufacturer is a mini floppy disc transport, type FD-50A, which is fully compatible with the Shugart SA-400. Price for this is $347.

Further details on both the MT-2 and the FD-50A from the Data Logging and Recorder Division, Jacoby Mitchell Company, 2 The Crescent, Kingsgrove, NSW 2208.

Micro-based keyboard

Honeywell Micro Switch has announced the release of a new full function keyboard which combines solid state Hall Effect key modules with scanning and encoding by a single-chip microcomputer. The 103SD24-1 keyboard provides solid state reliability with increased functions to meet the needs of intelligent terminals and distributed processing applications.

The keyboard is encoded for 8-bit USASCII in 4 modes: up-shifted, shifted, control and upper case alpha. Both serial and parallel data outputs are provided, with 8-deep FIFO character storage. Fourteen user-legend keys are provided for application programming. Also incorporated are a timed auto repeat key and an audio output for feedback purposes.

Honeywell is able to offer various programming options by using an EPROM instead of the standard masked ROM.

Further information on the new 103SD24-1 keyboard is available from Honeywell Micro Switch, 463-471 Bourke Street, Waterloo NSW 2017.

Clubs update

Currently we know of the following computer hobby clubs and groups. Details of others will be published if we are advised of their formation or existence.

CANBERRA. The Microprocessor Special Interest Group (MICSIG), which although affiliated with the Canberra branch of the Australian Computer Society also welcomes non-ACS members, both hobbyist and professional. Meetings are held at 7.30pm on the second Tuesday of the month in Building 9 at the Canberra College of Advanced Education. Further information from the Registrar, MICSIG, c/- PO Box 446, Canberra City, ACT 2601.

(Continued over page)

Winner of the Dick Smith "Win A Computer" competition at the recent Home Computer Show in Sydney was Kevin Reville of Frenchs Forest, shown here receiving his Exidy Sorcerer computer from Dick Smith. Mr Reville is a computer consultant and part-time technical college lecturer in data processing.

Microcomputer News & Products

SYDNEY. The Microcomputer Enthusiasts Group (MEGs). Meetings are held at 8pm on the first and third Monday of each month at the WIA centre, 14 Atcheson Street, Crows Nest. Mail address PO Box 3, St Leonards 2065.
IREE SYDNEY MICROPROCESSOR GROUP. Meets monthly. Details available from Dr Barry Madden, School of Chemical Technology, University of NSW, PO Box 1, Kensington, NSW 2033.
MELBOURNE. The Microcomputer Club of Melbourne (MICOM). Meetings are held at 2pm on the third Saturday of each month at the Model Railways Hall, Glen Iris (opposite railway station). Contact is Roger Edgecome on (03) 836 1077 (bus hours).
BRISBANE. The Microcomputer Interest Group. Meetings are held at 7.30pm on the second Friday of each month at the Windsor State School, Harris St, Windsor. Contact is Norman Wilson, PO Box 81, Albion, Qld 4010.
PERTH. The Western Australian Computer Enthusiasts' Group (WACEG). Meets on the last Monday of the month at 7.30pm, at Taimac Video Corporation, 1st floor, Cnr Newcastle and Williams Sts, Perth WA. Further information from Bob Langlois, c/- Memorex Pty Ltd, 49 Hay St, Subiaco WA.
SOUTH AUSTRALIA. The South Australian Microprocessor Group. Meetings are held on the third Friday of the month at Thebarton High School, Ashley St, Thebarton. Further details from Bob Stunell, PO Box 113, Plympton SA 5038.
HOBART. The Tasmanian Amateur Computer Society (TACS). Meetings are held at 7.30pm on the first and third Tuesdays of the month in the Computer Studies area of the Rosny Matriculation College, Hobart. Further details from the secretary, Clive Myers, on Hobart 65 2252.

(Continued next month)

In Brief:

Store in Crows Nest

A retail store specialising in microcomputer based products has been opened in the Crows Nest business area of northern Sydney. Called Microware, the store will market Texas Instruments learning aids and programming tools, Commodore PET microcomputers and the PDI range of educational and applications software for the PET. It will also be offering a mail order service for both country and city clients.

The store is at Suite 104, 109 Alexander Street, Crows Nest. Its mail address is Microware, PO Box 107, Cammeray, NSW 2062.

Tandy Computer Store

Tandy Electronics has opened a Computer Centre at 721 Glenhuntly Road, Caulfield South, Victoria. Aim of the centre is to co-ordinate TRS-80 sales, provide related materials such as books, software and calculators, and provide training and after-sales customer assistance. The store has started running short introductory courses on Level-1 Basic, running over three consecutive evenings or days, and costing $29.95 per person. Bookings for the courses may be made at either the centre itself or at any Tandy store.

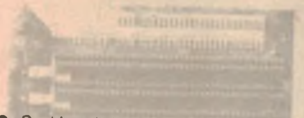
Error in price

In the review of the Texas Instruments TM990/189 single-board microcomputer in the July issue, the price given was incorrect. The correct price is $300 plus tax, where appropriate. Radio Despatch Service are also able to supply the unit with the TI publication "9900 Family Systems Design and Data Book", for $312 plus tax. They also have the same book available separately for $15.76. Some 50mm thick, the book contains a wealth of information on system operation and design using the 9900 series of processors.

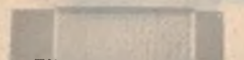
6800 DESIGNER BOARDS MODULES PROTO BOARDS

Ideal for expanding D2 kits:

STEWART ELECTRONICS
9 SLOT BACKPLANE FOR M6800



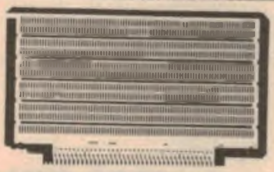
- Double sided board
- Active or passive termination
- Provision for 10 bypass caps
- Exorciser and D2 compatible
- Bare PCB with instruction sheet $ 39.50
- Completely Assembled $110.50



EXTENDER CARD

6800 — D2 — Exorciser Compatible 43 x 43 way double sided fibre glass board Hard gold plated contacts Gold plated socket $26.50

Stewart Motorola D2 Exorciser Compatible Card Cage with provision for shielded power supply See E.A. Feb 1979 for full details shown with our 9 slot mother board fitted Cage complete with 18 card guides $39.50



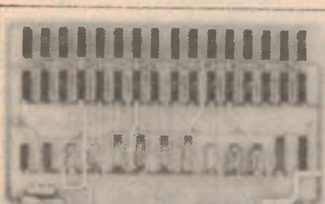
M6800 PROTOTYPING BOARD

Suitable for wirewrap or point to point wiring Drilled to accept IC's with 0.3" 0.4" or 0.6" spacing Any mix
43 x 43 way 0.156" spacing gold plated edge connector
Motorola EXORciser and D2 compatible $25.50

LOW COST VDU

VIDEO DISPLAY BOARD
D2—6800 COMPATIBLE

- Electronics Australia Aug 1978
- 16 lines 32 characters
- Memory mapped — software controlled
- Complete Kit $56.50
- PCB plated through holes $22.50



6800 16K STATIC RAM

- Uses 2114 1K x 4 STATIC RAMS
- Only 1.2 @ 5 V typical for 15K
- Motorola Exorciser Bus as on D2
- 8K blocks switch addressable
- PCB plated through with solder resist
  PCB + support ICs Kit $ 97.20*
  8K (450 nS) ass & tested $257.20*
  16K (450 nS) ass & tested $392.40*
  2114 (450 nS) 5.95

MEM2 16K S100 STATIC MEMORY BOARD

- Uses 2114 RAMS
- Wait state generation
- Addressed on 4K boundaries
- Complete documentation
- Silk screen parts layout

Bare board W/ documentation $39.50
2114 450 nS $ 5.95
Manual only (refundable with board purchase) $ 5.00
Complete Kit (less 2114s) $95.00

EP 16K EPROM BOARD

- Accepts up to 16 2708 or 2716
- Addressable to any 16K boundary
- Only Eproms installed need be enabled Unused locations may be allocated for RAM
- Selectable wait states 0, 1, 2, 3, 4
- All S100 lines fully buffered

PCB BOARD with manual $39.50
Manual only (refundable when PCB purchased) $5.00

Z80 CENTRAL PROCESSING UNIT

Software:
The Z 80 CPU will accept most existing 8080 software without modification including Assemblers Debuggers Disk Operating Systems, Basic and Fortran

Support:
The Z-80 CPU is fully S 100 compatible and supported by a full range of peripherals from both Ithaca Audio and other vendors

Features:

- On board 2708 EPROM
- Power-on-jump to any 4K boundary above 32K RAM, ROM, or the on board 2708
- Front panel-less operation allowed by on-board run-stop flip-flop and optional generation of MEMORY WRITE
- Selectable wait states on the following cycles M1 cycle
  Memory Request cycle On-board ROM cycle Input cycle Output cycle
- Selectable 8080 or Z-80 I/O addressing modes
- DMA Grant tri-states all signals from processor board
- 8224 clock generator provides 8080 like 1 and 2 for the S-100 Bus

PCB with manual $44.50
Manual only (refundable when board purchased) $5.00
Kit complete with manual 4MHz $125.00
Built and tested 2MHz board $175.00

Z80 CPU IC $18.50
Z80 Technical Manual $8.50 tax exempt
Z80 Programming Manual 288 pages One full page on every instruction plus much other data $12.50 tax exempt Plus $3 postage

All items plus 15% sales tax unless otherwise marked prices subject to change without notice
All orders plus packing and freight $2 small items $5 large and heavy parts

wirewrap

WIRE WRAP WIRE — 30 AWG KYNAR SPECIFY COLOUR —

White-Yellow-Red-Green-Orange-Blue-Black 1000ft $21.60
50ft Spool $2.95

WIRE DISPENSER — WD-30

- 50 ft roll 30 AWG KYNAR wire wrap wire
- Cuts wire to desired length
- Strips 1" of insulation $4.80 ea.

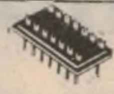
HOBBY-WRAP TOOL-BW-630

(Batteries not included)

- Battery Operated (size C)
- Weighs ONLY 11oz
- Wraps 30 AWG Wire onto Standard DIP Sockets (.025inch) Complete with built in bit and sleeve $47.75

Tax exempt

DIP PLUGS



Ideal for use with flat ribbon cable or to mount components on

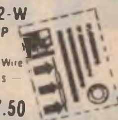
14 pin $0.56
24 pin $0.94
16 pin $0.58

WIRE-WRAP KIT — WK-2-W

WRAP • STRIP • UNWRAP

- Tool for 30 AWG Wire
- Roll of 50 Ft White or Blue 30 AWG Wire
- 50 pcs each 1" 2" 3" & 4" lengths — pre-stripped wire

$17.50



HOBBY WRAP TOOL

Wire wrapping, stripping, unwrapping tool for AWG 30 on 025 (0.63mm) Square Post

Modified Wrap	WSU-30M	$8.95

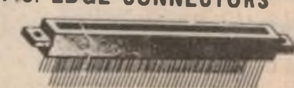
Tax exempt

DIP SOCKETS

SOLDER Wire Wrap

	SOLDER	Wire Wrap
8 PIN	25	42
14 PIN	35	66
16 PIN	37	74
18 PIN	32	90
20 PIN	37	1.20
22 PIN	43	1.20
24 PIN	48	1.30
28 PIN	56	1.82
40 PIN	63	1.96
60 PIN	1.35	

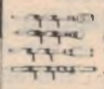
P.C. EDGE CONNECTORS



S100 gold plated wirewrap $5.50
S100 gold plated solder tail $4.90
D2 Motorola bus
43/86 .156 gold solder tail $7.34
43/86 .156 w/wrap $7.95

We can supply all your edge connector requirements from 2 to 85 pin in both .156 and .1 spacing Please send for price sheet

Gold Plated
WIRE WRAP PINS
Per Hundred



WWT 1 Slotted Head $5
WWT 2 Single Sided $5
WWT 3 Socket Head $15
WWT 4 Double Sided $5

Hexadecimal Keypad

$17.50/each

19-key pad includes 1-10 keys ABCDEF and 2 optional keys and a shift key

Ideal For Dream Project

MICROPROCESSOR CHIPS

	$		$
8085	24.00	8282	8.90
8212	4.80	8286	8.90
8214	8.55	8287	8.90
8216	3.95	6800	9.93
8224	7.10	6802	14.50
8226	3.95	6810	5.50
8228	9.10	6820	5.50
9238	9.10	6821	6.50
8251	10.75	6828	9.60
8253	26.40	6840	15.00
8253-5	27.70	6850	7.50
8255A	8.60		
8257-5	9.10	2102	0.95
8259A-8	17.00	2102-4	1.65
8275	51.20	2114	5.95
8279-5	18.50	Z80A	18.50

POWER TRANSFORMERS

SPECIALLY DESIGNED FOR MICROCOMPUTERS

- See Feb 1979 EA for full details
- Good regulation Electrostatic shield
- SE 805
  8V @ 5A 2x15V @ 1A $16.50
- SE 810
  8V @ 10A 2x15V @ 1A $19.50
- SE 820
  8V @ 20A 15V @ 1A
  15V @ 3A $29.50

10 TURN POTENTIOMETERS

Stock resistance values

10, 25, 100, 500
1K, 2K, 5K, 10K,
20K, 50K, 1000K

Spectrol model 534 ¼" shaft
Price 1—9 $6.75
10 + values may be mixed $5.75

DREAM

ELECTRONIC AUSTRALIA MICROCOMPUTER PROJECT

Kit for main board (including programme 2708)

Please write for price.

PCB (fibre glass) only $14.50
2708 programmed $15.50
Key Pad 19 keys $17.50
PCB for power supply $4.50

STEWART ELECTRONICS

33 SUNHILL ROAD, MT WAVERLEY 3149
Phone (03) 277 0622
Bank Card Accepted.
Telex AA36908
Mon.-Fri. 9am-6pm
Sat. 9am-12noon

PRACTICAL ELECTRONICS

Wire wrapping: tools and techniques

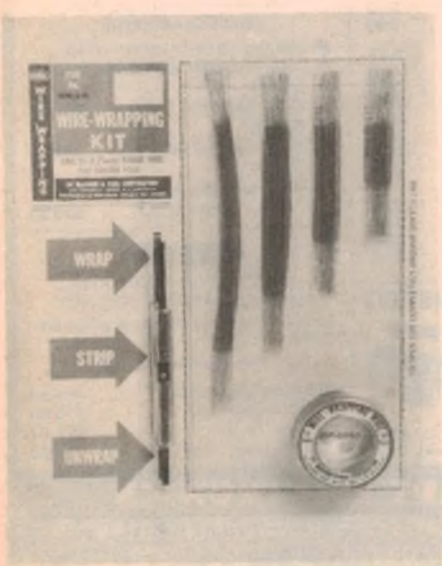
Although popular in industry, wire-wrapping is a technique that is little used at hobby level. The recent introduction of a range of low-cost hobby tools may change that situation, however. Here we take a look at the wire wrapping technique, and explain how some of the tools are used.

by GREG SWAIN

In an earlier chapter, we dealt with the practical aspects of soldering. Soldering can make or break any electronic project, so it is important to master the technique at an early stage. It's not difficult; all it requires is a little practice.

As we've seen, soldering is used for permanently connecting the various components into circuit, and for making wiring terminations. The components are, more often than not, mounted on a printed circuit board. But there is an alternative to soldering. It's called "wire wrapping".

So what's wire wrapping? In a nutshell, it's a process whereby a solid conductor wire is wound tightly (or wrapped) around the sharp corners of a rigid metal terminal to form an electrical connection. No soldering is needed! The accompanying photographs illustrate the basic idea.



Left: a low-cost wire wrapping kit for the hobbyist. The simple hand tool can be used for both wrapping and unwrapping. View at right shows the tool in action.

Development

Wire wrapping is not new. It was developed in the early 1950s by Bell Telephone Laboratories in conjunction with Gardner Denver, Michigan, for making reliable connections in high contact density telephone equipment. In particular, Bell developed the method to overcome the mechanical and thermal difficulties of making soldered connections in such equipment. The technique was seriously adopted in the mid 1950s, and is now used extensively by the telephone industry.

During the 1960s the technique was adopted by the electronics industry, and today it is a standard technique for making terminal connections in high density electronic equipment. This particularly applies to the computer and telecommunication industries, where a large number of interconnections often have to be made.

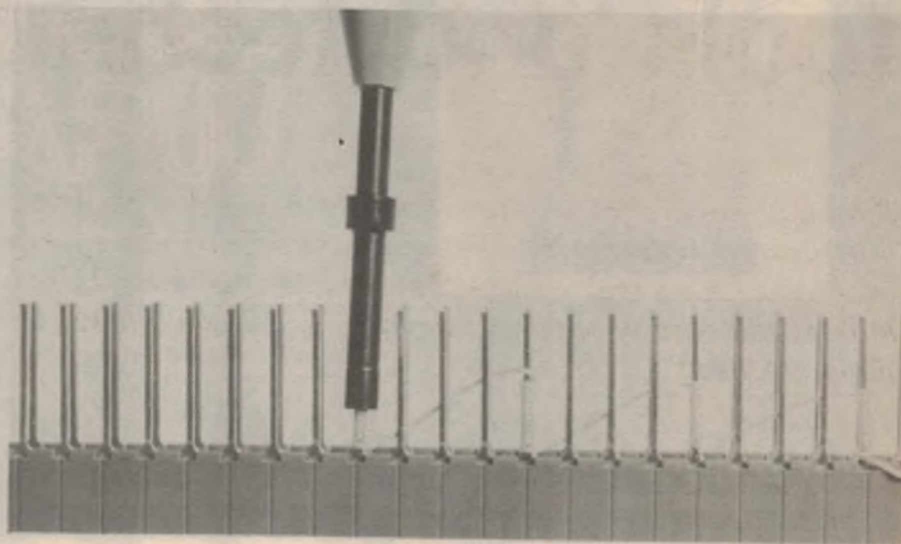
In addition to allowing high density terminal connections, wire wrapping has a few other advantages over soldering. These include the elimination of fumes, solder splash, flux residue, and lead clippings. The possibility of heat damage to sensitive components is also eliminated.

Before going further, though, let's get a couple of things straight. Wire wrapping is a technique which, thus far, has penetrated very little into the hobby market. So if you're just getting into electronics don't rush out and buy wire wrapping tools. You may possibly never use them.

The hobbyist should, however, at least be aware of the technique. It is gaining in popularity, and may be catching up with those hobbyists who design their own logic circuits and computer boards. And with the availability of low-cost wire wrapping tools the technique can also be used for circuit prototyping.

With wire wrapping you don't need artwork for PC boards. You can buy commercial IC circuit boards which carry an array of wire wrapping terminal pins. The ICs are simply plugged into one side of the board, and the pin connections made by running leads between the various terminals on the reverse side. In addition, you can buy IC sockets, edge connectors, and LED displays with wire wrapping terminals, assorted wrapping posts (which can be soldered to a circuit board), and a range of accessories to make the wire wrapping process fast and efficient.

Above & below: the "Just Wrap" from OK Machine & Tool Corporation. The tool wraps insulated wire onto the terminal; terminal corners bite through insulation for electrical contact.



Wire wrapping tools

Essential to the wire wrapping process is the wire wrapping tool itself. This contains a bit which, when fed with wire, is placed over the terminal to be wrapped, and rotated to obtain the desired wrap.

There are basically four different types of wire wrapping tools available. They are the pneumatic or air type, the mains operated type, the battery operated type, and the manually operated type. Within these broad groupings are many styles and classifications. For example, the manual tools are operated either by squeezing a trigger, or by manually twisting the entire tool with the hand.

If you look closely at the bit, you will notice three major features:

- First, a large central hole. This hole allows the bit to be slipped over the terminal, and marks the point around which the bit rotates;
- Second is a slot in the top of the bit, beginning at the front (or face) and extending rearward. This slot accepts the wire to be wrapped around the terminal;
- Third is the special contour (cutout) on the face of the bit. This contour applies tension to the wire during the wrap, to ensure that the wire is wrapped tightly around the terminal.

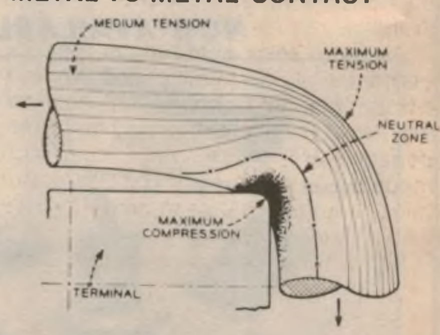
In tools designed for professional use, the bit is housed in a metal tube called a sleeve. This serves to retain the bit in the collet (socket) of the wrapping tool, and prevents the wire from falling out of the slot or spinning loosely during the wrapping process. Since the sleeve does not rotate, it also protects the user from the spinning bit.

Both the bit and it's mating sleeve are precision items, and for this reason are quite expensive. A typical bit and sleeve are shown in one of the accompanying photographs.

Hobby tools

To overcome the problem of expense, a range of low-cost tools has been developed specially for the hobbyist and for prototyping. In these, the bit and the sleeve are combined to form one piece. They don't do quite as good

METAL-TO-METAL CONTACT



By bending the wire around the sharp corner of the terminal, the oxide layer is crushed or sheared, and a clean metal-to-metal contact is obtained.

Wire wrapping step-by-step:

Step 1
WIRE INSERTION AND ANCHORING

Step 2
TERMINAL INSERTION

Step 3
WRAPPING

Step 4
FINISHED CONNECTION

The two types of wrap used. Regular wrap (left) wraps bare wire only; modified wrap (right) coils 1½ turns of insulated wire around the terminal to add mechanical stability. (Courtesy OK Machine & Tool Corp.)

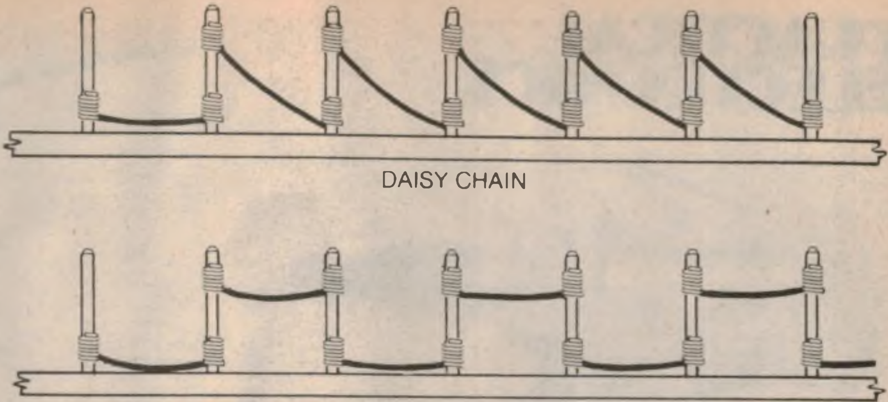
a job as the professional tools, but are still quite adequate for hobby work.

Costs are further reduced by making hobby tools either battery or hand operated. The more expensive pneumatic and electric tools are generally fitted with precision bits and sleeves, and are reserved for production work.

The best-known companies in the wire wrapping business are Gardner Denver (Michigan), Vector Electronic Company (California), and Cambridge Thermionic Corporation (Massachusetts). These are all American companies, and mainly manufacture upmarket equipment for industry.

Another company involved in wire wrapping in a big way is OK Machine & Tool Corporation, New York, which not only makes professional equipment but low cost hobby tools as well. Professional tools are generally sold under the "Speed Wrap" label, while trypical hobby tools retail under such names as "Hobby-Wrap" and "Just Wrap".

Also available is a "Wire-Wrapping Kit", which includes a simple hand wrapping tool, various lengths of pre-stripped solid conductor wire, and a spare reel of wire. The wrapping tool, by the way, also includes an unwrapping bit.



Wire wrapping styles: daisy chain (top) and level ordered (bottom). (OK Machine & Tool Corp.)

Making the connection

The wire wrapping process is actually quite simple, although it may take a little practice to get it quite right. First, the end of the wire (single conductor wire only, not stranded) is stripped of insulation to allow several turns of bare wire (generally at least 6) around the terminal. The bared wire is then inserted into the smaller hole (or slot) in the tool bit, and anchored either in a notch in the sleeve or by simply holding with the hand — it all depends on the tool you're using.

This last step is to prevent the wire from spinning when the bit starts to turn.

Next, the wrapping tool is placed over the terminal to be wrapped, with the terminal going into the large central bit hole. The final step, the wrap, is then accomplished either by squeezing the tool's trigger or by twisting manually.

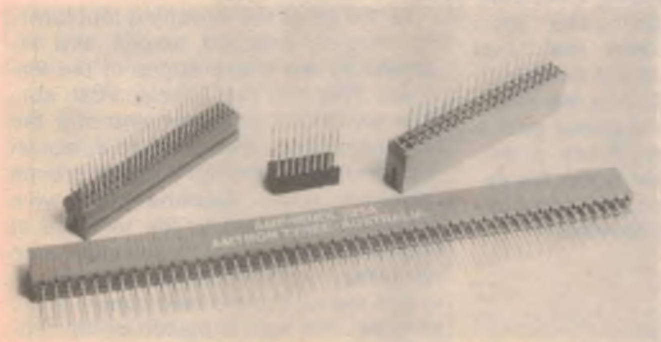
The end result will be a uniform, closed, non-overlapping helix of wire wrapped tightly around the terminal.

Types of wrap

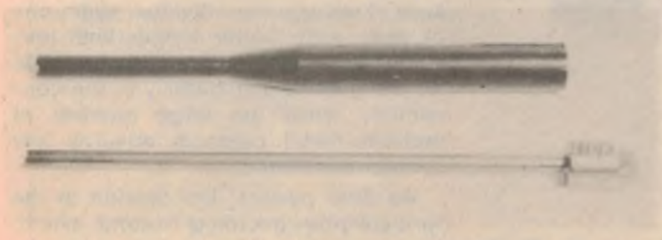
A wire wrapped connection can be either "regular" or "modified", depending on the user's needs and the wrapping bit used. The regular wire-wrapped connection is the one we have been discussing so far; it consists of wrapping uninsulated wire only around the terminal. A modified wrap, on the other hand, coils approximately 1½ turns of insulated wire around the terminal in addition to the bare wire.

The idea behind the modified wrap is that the insulation serves as a shock absorber. This increases the ability of the connection to withstand vibration and flexing stresses on the wire.

To produce a modified wrap, you

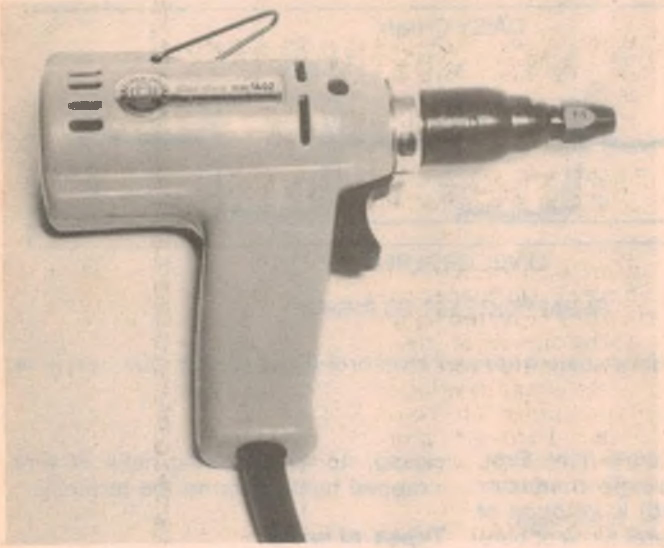


IC sockets, edge connectors and a range of other accessories are available with wire wrapping terminals.



A precision bit (bottom) together with it's matching sleeve. Different wire gauges require different bits and sleeves.

A manual wire-wrapping tool for professional use. This is the G200/R3278 "Speed Wrap" tool from OK Machine & Tool Corp.



Model 14G2 mains-powered "Wire Wrap" tool from Gardner Denver.

The "Hobby-Wrap" from OK Machine & Tool Corp. is battery powered and produces a modified wrap.

simply need to use a modified bit. In this, the wire slot is enlarged at the front to permit insulated wire to enter. The length of this enlargement is such that just enough insulated wire is admitted to wrap approximately 1½ turns.

A regular bit, on the other hand, is just large enough to accept the bare wire. In both cases, you just push the wire into the end of the tool as far as it will go, and then proceed with the actual wrap.

Another type of modified wrap is produced by the "Just Wrap" tool. This differs from other types of wire wrapping tools in that insulated wire is fed directly to the bit from a spool mounted at one end of the tool. In use, the "Just Wrap" wraps the insulated wire directly onto the terminal, the idea being that the sharp edges of the terminal cut through the insulation and into the wire.

The advantage of this arrangement is that it permits a wiring technique whereby the wire can be wrapped on successive terminals without having to break the wire. What's more, "Just Wrap" completely eliminates the need for wire stripping and wire insertion into the bit for each wrap.

It's an idea that works extremely well in practice. The "Just Wrap" tool is fast, easy to use, and would be an ideal tool for the hobbyist who's just starting in wire wrapping.

Yet another variation is used by the "Slit-N-Wrap" wire wrapping tools from Vector Electronic Company Inc., California, USA. As with the "Just Wrap," insulated wire is fed directly to the bit from a spool. During the wrapping process, the wire is pulled past a sharp cutter which produces a thin longitudinal slit in the insulation, the exposed wire subsequently making contact with the wrapping terminal.

"Slit-N-Wrap" from Vector Electronic Company is spool fed and automatically slits wire insulation during wrapping process.

Reliability

Connection reliability is extremely important if an electronic circuit is to continue functioning correctly. So how reliable is wire wrapping?

The answer to this question is that properly formed wire wrapped connections are extremely reliable, and compare very favourably with soldered connections both in terms of mechanical strength and electrical resistance. To understand why this is so, we need to look more closely at what actually takes place during the wrapping process.

As the bit of the wrapping tool turns, the wire is dragged across and indented by the sharp edges of the terminal. This has two effects. First, surface oxides on both the wire and the terminal are sheared away to establish a clean metal-to-metal contact at each terminal edge. Second, the wire becomes anchored to the terminal at each indentation point, and can slide no further. As a result, as the bit turns to pull the wire to the next corner of the terminal, the wire is placed under tension.

The process is repeated at each corner, so that the completed wrap consists of successive individual segments of wire, each under longitudinal tension. This tension is initially responsible for the mechanical stability of the connection, while the large number of metal-to-metal contacts ensures low contact resistance.

As time passes, the tension in the wire coil does decrease to some extent. However, this effect is countered by another, less obvious phenomenon.

Because the wire and the terminal edges are in such intimate contact, and because they are pressed tightly together, diffusion actually takes place between the two metals. In other words, the terminal and conductor metals actually bond together to form a cold weld.

This bonding process more than offsets the progress of stress relaxation in the wire coil. Indeed, experiments have shown that the force required to undo a wire-wrapped connection actually increases with time.

Another reason for the electrical reliability of wire wrapping is the fact that the high compression contact areas are "gas tight", and are not subject to corrosion or contamination.

Unwrapping

One of the main advantages of wire wrapping is the ease with which a wire may be removed from a terminal to make a wiring modification. This process is called "unwrapping" and consists of exactly that: uncoiling the wire helix from the terminal.

If you're working at hobby level and don't need to make too many unwraps, you can simply unwrap by hand. You have to be very careful not to damage the wrapping terminal with this method though. The terminals are only made of relatively light gauge materials, and are easily bent or broken.

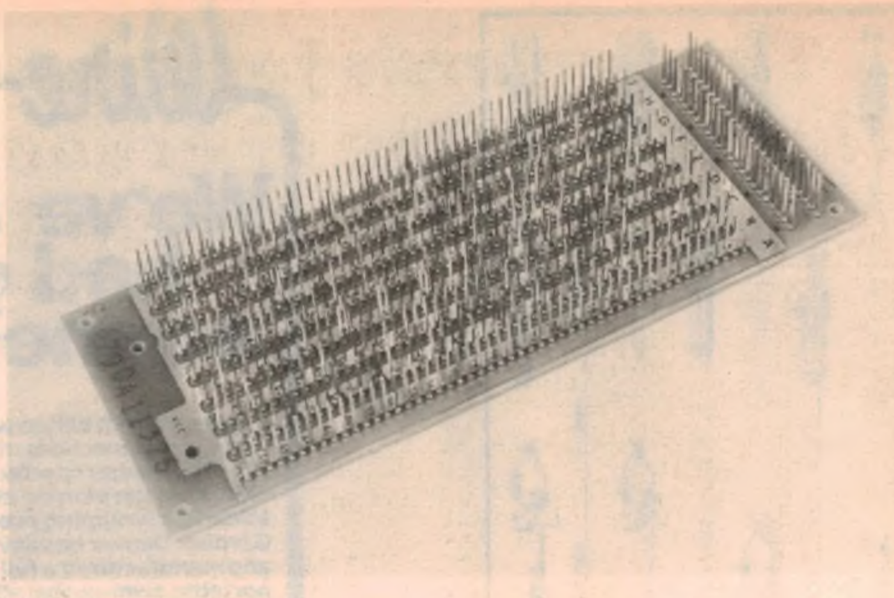
A far better idea is to use a special unwrapping tool. This tool is similar to a corkscrew and is simply placed over the terminal and rotated in the opposite direction to the wrap.

As the bit is rotated, it "screws" down the inside of the wire helix, separating it out from the terminal. Removing the tool will now lift the expanded wire clear of the terminal.

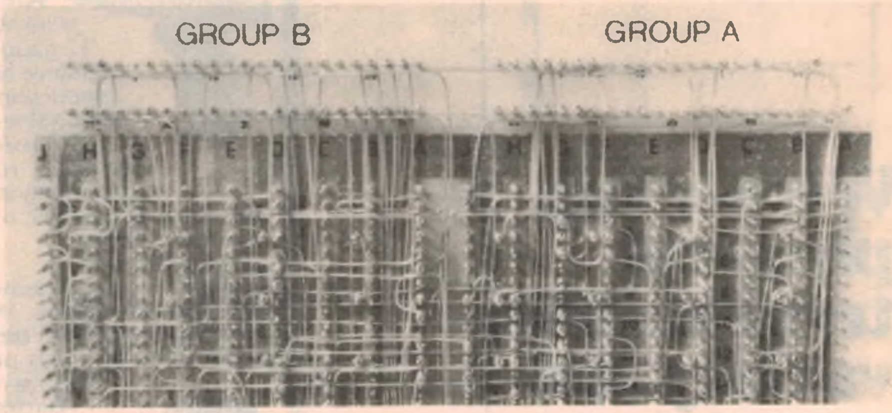
Within practical limits, unwrapping does not damage the terminal, and it may be used to make other connections. Of course, repeated wrapping and unwrapping will eventually blunt the sharp edges of the terminal and it won't bite into the wire properly.

In practice, it's best not to make more than four re-wraps of a terminal if long-term reliability is important. But for prototyping, there's no reason why a terminal cannot be re-used many times over.

Just one more point on wire unwrapping. Because the wire is indented and bent severely during wrapping, unwrapped wire cannot be straightened out and re-wrapped. It must be discarded.



An IC circuit board with wire-wrapping terminal array as sold by Ampec Engineering Company. The ICs plug directly into the reverse side of the board.



This demonstration board was produced by an automatic wrapping machine.

Wire & wire size

As mentioned earlier, solid (or single conductor) wire must be used for wire wrapping. Tin-plated copper wire is preferred for most applications, although bare copper wire and silver-plated copper wire is also available.

It is important to always use the correct size of wire. Different sizes of wire generally require different bits, sleeves and wrapping terminals if the correct results are to be obtained.

The most popular size of wire for electronic work is 30AWG (0.25mm) wire, although 28AWG (0.32mm) and 26AWG (0.40mm) are also commonly used. All of the hobby tools featured here use 30AWG wire and mate with 0.63mm square terminals.

So that's wire wrapping. As you can see, it's got quite a few advantages over soldering for certain applications. You may not have come across it as yet in general hobby work — unless you happen to be a computer freak — but if you ever do, you'll at least be prepared.

FOOTNOTE: Wire wrapping equipment is manufactured by a number of companies in the USA. Some of these companies and their Australian distributors are:

- Gardner-Denver, Michigan, USA; distributed by Sulco Pty Ltd, 469 Pacific Highway, Artarmon, NSW 2064.
- Vector Electronic Company, California, USA; distributed by Assembled Products, Box Road, Cross Roads, NSW 2170.
- OK Machine & Tool Corporation, New York, USA; distributed by Ampec Engineering Co. Pty Ltd, 1 Wellington St, Rozelle, NSW 2039.
- Cambridge Thermionic Corporation, Massachusetts, USA; distributed by Electronic Development Sales Pty Ltd, 92 Chandos St, St Leonards, NSW 2069.

Equipment featured in this chapter courtesy Ampec Engineering Co. Pty Ltd, Sulco Pty Ltd, and Radio Despatch Service, 869 George St, Sydney, NSW 2000.

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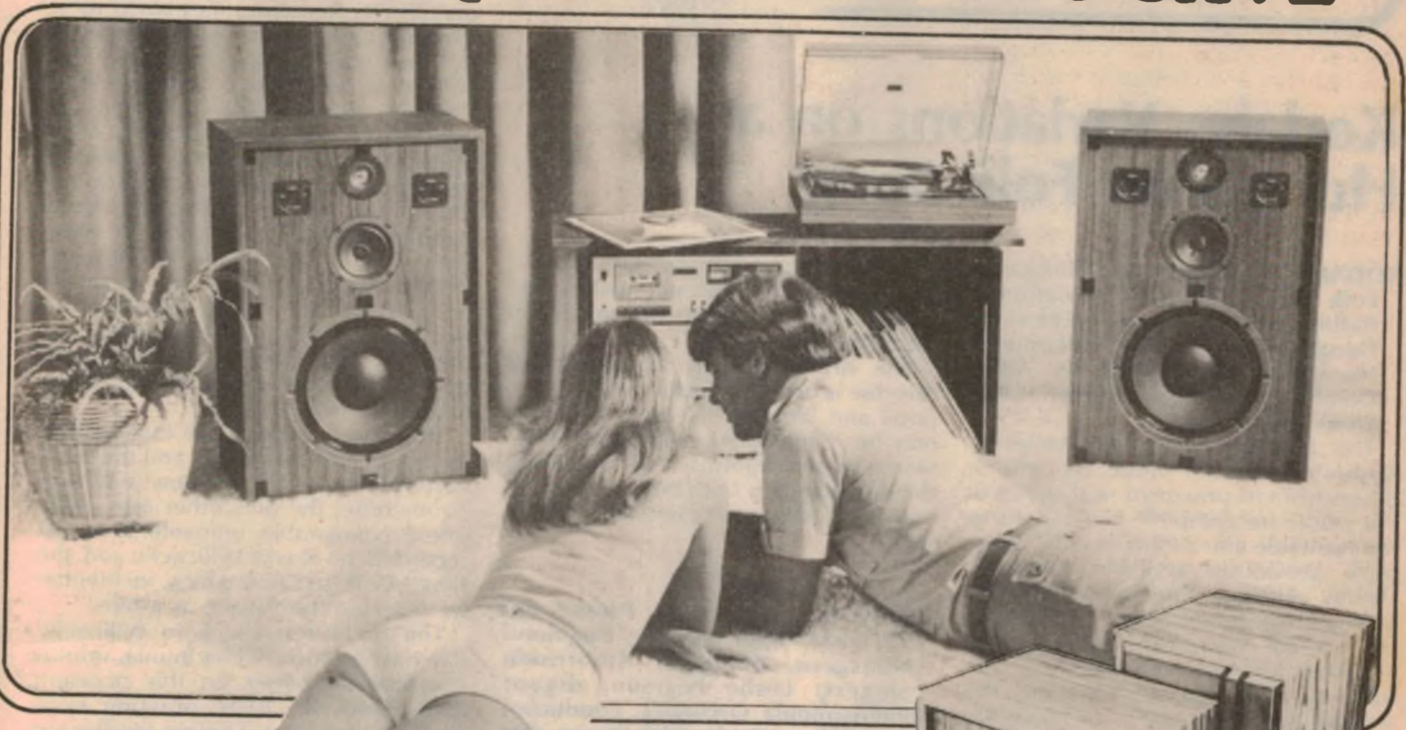

Photograph shows speakers without front grilles.

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Classical Recordings

Reviewed by Paul Frolich

Kodaly: Variations on a Hungarian Folk Song

KODALY: Variations on a Hungarian Folk Song (Peacock Variations); Ballet Music; Summer Evening; Hungarian Rondo. The Philharmonia Hungarica conducted by Antal Dorati. Decca/World Record Club. Stereo disc R.04248.

This further issue in the series of Kodaly's orchestral music (Volume 3) differs from its precursor in that two of the works are complete newcomers to the turntable and a third has only been once previously available, under a slightly different title. Also, this disc appears to have been differently engineered. Most of the music on it is at rather low volume. Indeed, at the opening of the Peacock Variations, the volume is so very low as to make the opening bars almost inaudible.

There was quite a splendid recording of the Variations conducted by Kertesz, issued about 1971; this one by Dorati appears to be the only other available one and (apart from the problem mentioned) it is even livelier and, I think, more interesting, than Kertesz'. The music, written in 1939, is one of the composer's greatest accomplishments and brilliantly demonstrates his use of, and thinking about, folk material.

The final piece on the disc, the "Hungarian Rondo", which I'd never heard before, dates from 1917 and proves to be an earlier essay on similar lines; it is a lovely work, full of little dances, delicate and exuberantly folksy in turn and deserving of frequent hearing.

The item called "Ballet Music" was, according to the sleeve note, part of the original stage version of the opera "Hary Janos" in 1926, but "very soon it embarked on a life of its own". I presume this refers to concert practice in Hungary. I have not previously heard this music programmed on its own; it lasts a mere 5½ minutes and quotes freely from the operatic score!

"Summer Evening" was, when recorded under Kodaly's baton some years before his death, called "Summer Night". First written in 1906, it was revised by Kodaly in 1930 in accordance with a request made by Toscanini. It is an extremely beautiful work and lacks any strong Hungarian flavour; its scoring omlts brass and percussion and relies on rich melodiousness, much of it from the woodwinds.

The orchestral playing throughout this disc is of a high order. Mr Dorati, a pupil and life-long friend of Kodaly's, may be relied upon to interpret these works to perfection. I must emphasise that he maintains both beauty of sound and a high degree of excitement all the way.

☆ ☆ ☆

FAURE: Requiem, op. 48; Pavane, op. 50. Lucia Popp, soprano; Siegmund Nimsgern, baritone; Ambrosian Singers; Leslie Pearson, organ; Philharmonia Orchestra, conducted by Andrew Davis. CBS Stereo disc SBR 235966.

The Requiem by Gabriel Faure, written in 1888, is unique among works bearing this title in that it is genuinely suited to being performed in church. Others, including even Mozart's, are quite comfortable in the concert hall, but Faure's work is of such utter conviction and so profoundly moving that it cannot easily be fitted into the festive atmosphere of a concert. The innocently religious feelings, which probably motivated the composer shortly after his father's death, are here being realised in All Saints Church, at Tooting Graveney, London.

Though solo voices play a very small part in this Requiem, they need to be carefully chosen to avoid any flavour of the theatrical. Some conductors — as, almost 20 years ago, Fremaux in a Monte Carlo recording — prefer a boy-soprano for the above reasons. Lucia Popp, though a celebrated coloratura, has the ability to produce a pure and clean sound and her "Pie Jesu" is quite heart-rending. Mr Nimsgern, a singer new to me, is equally well chosen and, in this score at any rate, is to be preferred to both Fischer-Dieskau and to Souzay, both of whom were too dramatic. The singing of the choir is quite outstandingly good and admirable in its restraint.

The work has been well looked after by the record companies, and there are currently six other versions available. To my taste, the only other one which offers comparable enjoyment is that recorded by David Willcocks and the King's College Choir which, incidentally, also uses the Pavane as a filler.

The orchestra, which in Willcocks' day was the New Philharmonia, sounds considerably better on this occasion and I find Mr Davis' phrasing even more to my liking. Though the Pavane is not very important, and this original version of it not much superior to the commonly heard orchestral one, it also is very well performed and adds to good listening.

The technical quality of this disc is all one could wish for.

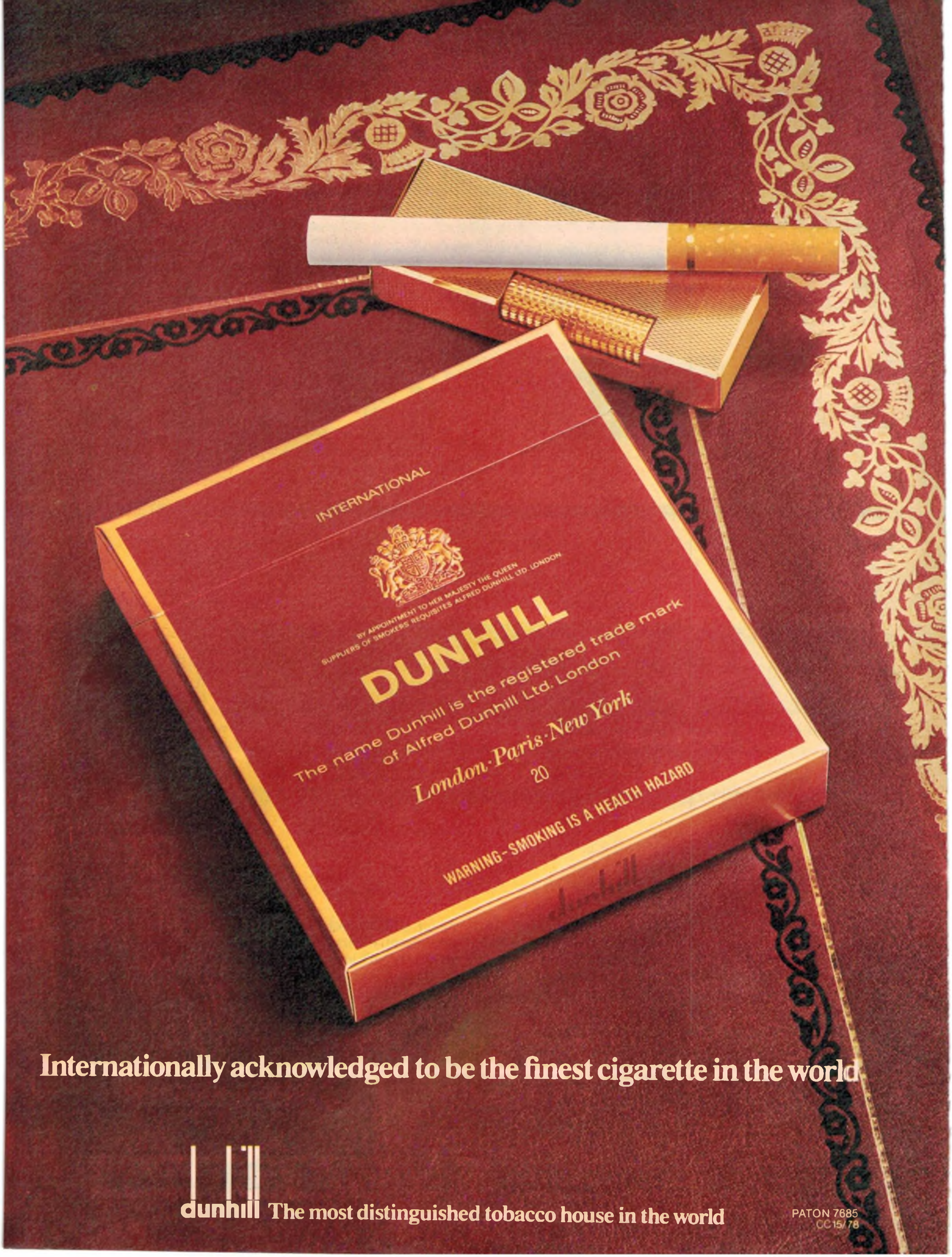
Stranvinsky: austere, interesting

STRAVINSKY: Les Noces. Soloists, English Bach Festival Chorus, 4 pianists and English Bach Festival Percussion Ensemble. Mass for Mixed Choir and Double Wind Quintet. Trinity Boys' Choir, English Bach Festival Chorus and members of the English Bach Festival Orchestra; both directed by Leonard Bernstein. Deutsche Grammophone Stereo disc 2530 880.

"Les Noces", completed in 1923, had the sub-title "Russian choreographic scenes with singing and music". It is a ritual cantata, scored for a mixed choir, a quartet of solo singers, percussion and four pianos which, also, are used percussively. Although on most of its rare appearances, the work is mainly known as a concert piece, it was dedicated to Diaghilev and is occasionally danced — most recently by the Royal Ballet Company.

The music is extremely austere and my fail to give pleasure to many listeners. It is, however, extremely interesting and needs to be known to anyone concerned with the music of our time. It is, beyond doubt, one of Stravinsky's most startling creations and has been repeatedly recorded — most successfully perhaps in the version conducted by the composer, issued by CBS in 1963. The score includes many allusions to Russian modal church tunes and the sound of bells pervades all, symbolic of the old folk customs of a village wedding.

The Mass was completed in 1948 and was definitely intended for liturgic use; it is set to the traditional Latin text of the Missa Brevis. Much of the text is in rhythmic chant, ensuring utmost clarity for the words and only the most basic use of polyphony. It is by no means easily approachable music and requires the most careful listening before its deeply religious content may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be properly appreciated.

Although this work has been repeatedly performed in the concert hall, it really comes off better in the privacy afforded by a recording and would, no doubt, impress even more in a proper church performance.

Both the compositions on this disc are sparse and very openly scored, beautifully sung and, as far as I can tell, very well played by the few instrumentalists involved. In instances such as these, it is difficult indeed to judge the conductor's or director's contribution — presumably, his guidance is of great value, at least to the technicians. As far as the disc is concerned, it offers flawless sound with a suitable amount of reverberation.

☆ ☆ ☆

BEETHOVEN — Symphony No. 7 in A major, op.92; Fidelio Overture. Cleveland Orchestra conducted by Lorin Maazel. CBS Stereo Disc SBR 235965.

The current Schwann catalog lists twenty-one stereo recordings of this work, not including this latest one which managed to get released in England late last year, nor, of course, including several older, famous and illustrious readings, now deleted. Inevitably, the question arises: Why? There cannot be a genuine market demand for ever more "interpretations" of such works, nor is it true that all fine music has, by now, been recorded at least once.

Probably there is no other reason than that every conductor who is proud of "his" orchestra wants to exhibit their, and his own, prowess in all sections of the repertoire. If indeed this is the reason, Maazel has, I suppose, made his point. The disc, which is quite excellently made, suggests that the early (and, from local reports, major) differences between the Cleveland Orchestra and their director have been settled and that they do, now, work as a contented team.

At the same time, my ears suggest that the Cleveland players, though very good indeed, have not as yet fought back to the magnificent standard they had attained under Szell. The orchestral sound is very agreeable, but there is some awkwardness in the upper strings which still lack their erstwhile golden sheen.

To a conservative listener, happy with the tempi and phrasings of such masters as Kleiber, Klemperer and Hans Schmidt-Isserstedt, some of Maazel's ideas seem decidedly odd. The opening tempo is definitely on the fast side and the drive imparted to it is quite exciting. The same can be said for much of the finale, though the coda sounds rushed and a little thin.

What I did not care for at all were some of the accents in the 2nd and 3rd movements. The Allegretto is a bit heavy and lacking in the depth which Beethoven's contemporaries were so moved by. The Presto has some of the relentless accents one might expect from a barrel-organ.

This is, no doubt, a good performance and the quality of the recorded sound quite excellent; however, in so crowded a field of first-rate recordings, it no more than passes. A curious feature of the disc's presentation is the very elaborate album, with notes in three languages. The three sets of notes have nothing at all in common, which is rather odd and must add enormously to production costs; moreover, the English notes also differ from the others in that they bristle with typographical errors — perhaps it would be uneconomical to read proofs!

Mozart: Serenades No. 4 & No. 5

MOZART: Serenades No. 4 K.203 and No. 5 K.204; Marches K.237 and K.215. Pinchas Zukerman, violin; Neil Black, oboe; English Chamber Orchestra, conducted by Pinchas Zukerman. 2 CBS Stereo discs S2BR 220350.

These two discs, very attractively presented in a twin-sleeve, are marketed under the title "Zukerman Plays and Conducts Mozart"; this does seem rather a pity and very much in keeping with the excessive adulation being accorded to this fine violinist wherever he appears. It is the more regrettable in that Mr Zukerman really does not need this type of advertising; both as a fiddler and as a musician, he commands quite remarkable talent and his achievements can, I feel, be quite safely relied upon to get him all the acclaim he deserves.

The Serenade No. 4 (in D major, as are all the works on this set) has been recorded on many occasions. The version I've liked best has been Willy Boskovsky's and I think it remains, on purely musical grounds, the preferable one. I find no fault with Mr Zukerman's playing or conducting, but he does approach Mozart with great romanticism and treats the Serenades as confections to a greater extent than did either Boskovsky or Menuhin, whose reading is, otherwise, nowhere as good or interesting.

The Serenade No. 5 (also known as K.213a) is not nearly as popular and I had not encountered it on disc before. It is played much in the same manner as its companion — beautifully, lushly and with great attention to its richness of ideas.

The two Marches, which may not be as well known, properly belong to the Serenades. Traditionally, a march preceded and followed on a serenade when it was presented out-of-doors. The playing of the ECO is, as almost always, immaculate and they respond as generously to Zukerman as they ever have to their other conductors. The quality of the recorded sound is quite excellent as are the stereo effects. This set may be warmly recommended.

☆ ☆ ☆

WEBER: Quintet in B flat, op. 34 Grand Duo Concertant, op. 48; Seven Variations in B flat on a theme from Silvana, op. 33. Murray Khouri, clarinet, with the Sydney String Quartet and with David Bollard, piano. RCA Red Seal Stereo disc VRL 1-0162.

For several decades now, Australian concert-goers have been remarkably fortunate to have the outstanding clarinetists who made their home here — these in addition to native Australians, whose work has been only fractionally of lesser excellence. Murray Khouri, since his arrival five years ago (initially to join the teaching staff of the Canberra School of Music), was quick to find friends and admirers here. By now, his name is widely known throughout the country and his talents, musical as well as organisational, are recognised.

This RCA disc, which was actually released some time back, is of ABC studio tapes and contains a large proportion of Carl Maria von Weber's justly celebrated clarinet music. The quintet is almost as popular as are those by Brahms and Mozart and it has been frequently recorded.

The recording is very good and the playing quite remarkably so; to my ear, the balance favours the clarinet too much and I regret that some of the SSQ's fine string effects remain hidden. All the same, such blemishes as they may be are minor ones and this recording is as good as any other currently available version of the work. It remains one of the most spectacular pieces in the wind repertoire.

The works for clarinet and piano, on side 2 of the disc, are from the same period — roughly 1811 to 1815 — and among the best examples of early German romanticism. David Bollard, who partners Mr Khouri quite brilliantly, must be a remarkable pianist indeed. Originally a New Zealander (as is Khouri), he is stationed in Perth. Music-lovers know how ample the supply of pianists is; therefore, for a Perth musician to be known by name in the East is, in itself, an achievement. Mr Bollard is known by name and by performance!

The result is a very satisfactory disc which, I hope, will be widely heard.

Lighter Side

Reviews of other recordings

Chopin: digital in all respects
Ravel: rhythm and jazz — direct cut

MALCOLM FRAGER PLAYS CHOPIN. Stereo, digital recording. Telarc DG-10040. (From P.C. Stereo, PO Box 272, Mt Gravatt, Qld 4122).

I wondered why Alan Little of PC Stereo seemed particularly keen for me to listen to this particular recording. Having just done so, I know why.

From the first few bars it is evident that it is going to be technically outstanding. The big Bosendorfer Imperial Concert Grand sounds full and rich, with massive bass and yet with a top end that, at the one time, is clean and incisive without there being the slightest suggestion of hardness.

This is a tribute to the instrument, but it is also a tribute to the entire recording chain: three carefully placed omnidirectional microphones to capture both attack and ambience; mixing without subsequent "fiddling" during the performance; a Soundstream digital master tape recorder; then on to disc at half-speed, with quartz locking right through to eliminate any trace of wow and flutter.

I can believe the specifications; wow, unmeasurable; total distortion off the tape, less than .004%; dynamic range and signal/noise ratio off the tape, 90dB.

Add to this a precise fit to the disc dynamics and variable spacing which puts something like 20 minutes per side towards the outside of the disc and you'll know why I regard digital mastering as the way to do it.

And it shows in the uninhibited performance.

Once you've stopped reacting to the technology, you'll start listening to the playing of Malcolm Frager, introduced as the most widely travelled pianist of his generation. Listening to the detail, one might also wonder whether he is also equipped with more than the usual number of hands and fingers!

The program, all Chopin: Polonaise in A Flat Major, "Heroic" — Andante Spianato and Grand Polonaise in E Flat Major — Variations Brilliants on a

Theme from Ludovic — Mazurkas, Op. 6 — Contredanse in G Flat Major — Tarantelle in A Flat Major, Op. 43.

Let me assure those who may be uncertain about some of the items, they are all highly listenable, and well suited for hifi demonstration, if you're on the lookout for such material.

Highly recommended. (W.N.W.)

☆ ☆ ☆

THE L.A.4. PAVANE POUR UNE INFANTE DEFUNTE. Direct cut stereo, East Wind EW-10003. (From M.R. Acoustics, PO Box 165, Annerley, Qld 4103.

Recorded in October 1976, in the Warner Bros Recording Studio, California, the master was plated and processed by the Nippon Victor Company, in Tokyo. In fact, this particular pressing comes in a Japanese double-fold jacket, with printing in both Japanese and English.

The musicians need no introduction: Bud Shank, alto sax and flute; Laurindo Almeida, guitar; Ray Brown, bass; Shelly Manne, drums and bells. For the occasion, the studio was subdivided into four distinct areas, with a dozen or so hand-picked microphones feeding the sound into a 24-channel mixer and equaliser, before passing it on to twin Neumann VMS-70 cutting lathes.

The program, lasting just over 33 minutes, contains a mix of rhythm and jazz, intimate in sound and contributed just by the quartet: Pavane Pour Une Infante Defunte (Ravel, arr. Almeida) — Autumn Leaves (Kosma & Prevert) — C'est What (Shank) — Corcovado (Jobim) — Wave (Jobim) — Reveil (Almeida) — Samba De Orfeu (Bonfa & Salvet).

The album opens with a faraway tinkle of tiny bells, unaffected by system noise. If you listen closely, however, you will pick what is probably the ambient of the studio itself and of the players within it.

But the music emerges startingly exposed — perhaps uncomfortably so for the performers. Every finger noise, every squeaky or rough note stands out in snarp relief, with no backing or audience noise or echo to gloss it over. Bud Shank and Laurindo Almeida on sax, flute and guitar, are revealed as or-

dinary humans, with human imperfections.

This isn't a criticism; rather a comment, emphasising the extreme intimacy of a direct recording like this, as contrasted with the more usual, much taped, much edited commercial release. One thing is certain: this recording will bring you into closer contact with a jazz quartet than you are likely to get in the normal way of things.

A good one. (W.N.W.)

Devotional Records

THANKS. Gary & Carol. Original Scripture Songs. Son Songs stereo 280 775. (From S. John Bacon Pty Ltd, 13 Windsor Ave, Mt Waverley, Vic 3149).

These days, when one picks an album of new Gospel songs, one expects automatically to be greeted by a rock beat and a bevy of guitars. It is with a welcome sense of change that I record that this album has been created by a conventionally dressed young couple using conventional vocal harmony and a mainly string orchestral backing.

With one exception, the songs are original compositions by Gary Johnson, based largely on Gospel texts and with lyrics set out in full on the jacket: With My Whole Heart I Give Thanks — Go In Joy — Thou Art There — Am I A Soldier Of The Cross — God Is Good In All His Ways — All God's People Sing Allelu — In Jesus' Name — Make A Joyful Noise To God — Bless The Lord — He Gives Us All Things — The Lord Is My Shepherd — The Lord Bless You.

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.), Greg Swain (G.S.), and Danny Hooper (D.H.).

LIGHTER SIDE — Continued

If you want a change from rock Gospel, you enjoy this one, complete with its changes of mood and pace. In fact, "All God's People Sing Allelu" is one of the brightest, most catchy Gospel songs that I've heard in many a long day. Well worth a hearing. (W.N.W.).

☆ ☆ ☆

THE BILL GAITHER TRIO. The very best of the Very Best. Stereo, Word WSB-8804. (From Word Records Australia, 18-26 Canterbury Rd, Heathmont, Vic 3135.)

For the record, the Bill Gaither trio comprises Bill and Gloria Gaither and Gary McSpadden. On this album, they have the assistance of five other singers, the Bob Rist Children's Choir and a wide array of musicians from the Nashville scene — all named in the credits.

Virtually all the numbers on the album are originals by members of the Trio and you won't have any difficulty in following them, because the lyrics are printed in full on the inner jacket: I Am Loved — He Touched Me — God Gave The Song — Plenty Of Room In The Family — The Family Of God — The King Is Coming — There's Something About That Name — I Am A Promise — I Will Serve Thee — Jesus Is Lord Of All — Joy Comes In The Morning — The Church Triumphant.

Musically, the program shows commendable variation, from recitative, through slow numbers to touches of swing and rock: modern, without being way out, and presented with the skill that you would expect of such musicians.

On the other hand, the lyrics abound in phraseology and imagery that betray a steady diet of traditional sermons, probably since the Gaither childhood. As such the lyrics will probably have their greatest appeal to that kind of audience. (W.N.W.)

Instrumental, Vocal and Humour

WHEN EVENING'S TWILIGHT. Massed Welsh Male Choirs. World Record Club R 04213.

Welsh male Choirs must surely be one of the most delightful expressions of the human voice en masse and this record made in Birmingham Town Hall surely shows why. The five choirs involved are: Canoldir Male Choir, Cwmbach Male Choir, Dunvant Male Choir, Fernadale Male Choir, Ynysowen Male Choir, all under the direction of Rae Jenkins.

The tracks are: God Save The Queen — The Pilgrim's Chorus — Morte Christe — Gwahoddiad — Where You There — Animals Are Coming — When Evening's Twilight — By Babylons Wave — The Soldiers Chorus — Speed Your Journey — The Silver Birch — My Love Is Like A Red Red Rose — Ar Hyd Y Nos — Nidaros — Hen Wlad Fy Nhadau.

The quality is really good; a record to enjoy. (NJM).

☆ ☆ ☆

THE GOLDEN AGE OF AMERICAN RADIO, Starring Bing Crosby. United Artists L36809. Festival release.

Bing Crosby has a warm spot in the memories of lots of people, for the easy, comfortable style of singing that made him a household word for many years. On this disc there are twenty six tracks a lot of them with Bing acting as host, others singing together with such stars as: The Andrews Sisters — Judy Garland — Connie Boswell — George Burns — Dick Powell — Rosemary Clooney — Jimmy Durante — Peggy Lee — Bob Hope — Maurice Chevalier — Nat King Cole.

The recording engineers were kind enough not to attempt any "stereo" treatment and the record is of uniformly good mono quality, considering that some of the originals date back to 1948.

The sleeve notes contain an extensive biography of Bing, together with a picture album of the other stars introduced on the record. (NJM).

(Continued on page 111)

CHILDREN: DOING THEIR OWN THING

SUZUKI TALENT EDUCATION ASSOC. OF AUST. First Australian Visit. Sydney Opera House, Nov 1978. Stereo, Dolby cassette.

During the late 40s Dr Shin-ichi Suzuki, in Matsumoto, Japan, pondered the natural ease with which most children seemed to cope with the intricacies of learning their mother tongue. He reasoned that, given equivalent exposure and encouragement, children should be able to cope as naturally with the language of music. So was born the Suzuki "mother tongue" method of teaching music and, in particular, the violin, using instruments scaled down to the size of the young players.

The method was introduced into Australia in 1970 and, by the end of last year, about 2000 young hopefuls were being taught.

This cassette is from an on-the-spot recording of a concert performance by a visiting group of Japanese students in the 8-13 year age group, joined by some local students. It was taped by Ron Cooper of Audiosound Electronic Services, using a 15ips professional recorder. It was dubbed on to another quality recorder for timing and editing and then on to Ampex cassettes at normal playing speed. Technically, the sound quality of the performance has been well retained.

On the tape, you will find items from Mozart, Kriesler, Reichert, Chopin, Veracini, Vitali-Charlier, Paganini and Vivaldi-Naches. As Ron Cooper is ready to admit, you may not select these performances for their intrinsic musical worth but, they are certainly interesting as a sample of the dexterity of children taught by the mother-tongue method. The method was featured about the time of the concert in "the Bulletin" for November 14, 1978, pp93 & 94.

For further information: Mr Ron Cooper, Audiosound Electronic Services, 148 North Curl Curl, NSW 2099. Phone (03) 938 2068. (W.N.W.)

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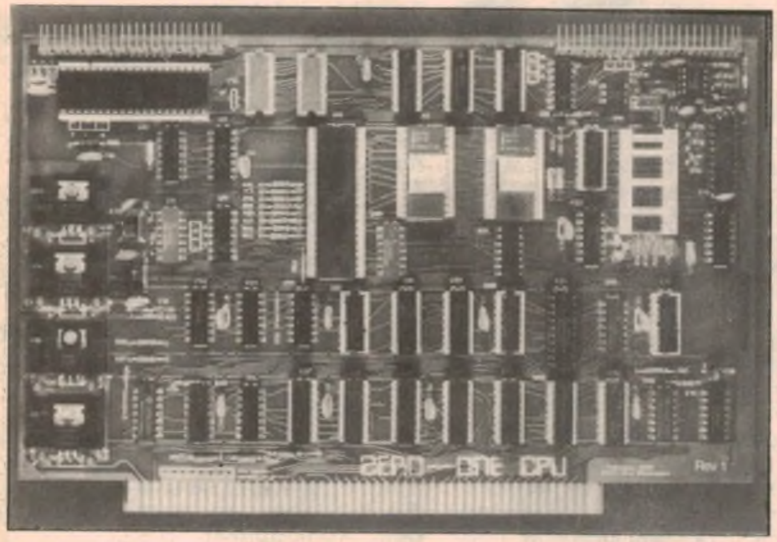

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LIGHTER SIDE — continued

RHAPSODY, DANIEL ADNI. World Record Club WRC R05525.

This beautifully recorded disc would be an ideal gift for some young aspiring pianist amongst your family or friends.

The tracks, listed by composer, include Chopin: Polonaise in A op 40 no I; Waltz in C sharp minor op 64 no 2; Nocturne in E flat op 9 no 2. Schumann: Romance in F sharp op 28 no 2; Arabesque op 18. Schubert: Impromptu in A flat op 90 no 4; Moment Musical in F minor op 94 no 3. Liszt: Hungarian Fantasy no II; Concert Study no 3 "Un Sospro". Brahms: Rhapsody in G minor op 79 no 2.

The very complete sleeve notes add to the value of the music, making a musical delight complete. The World Record club is to be thanked for the way they look after what can only be called a minority interest in these days of "Gold" and "Platinum" hits. (NJM)

☆ ☆ ☆

HAGOOD HARDY, REFLECTIONS. ATTIC, LAT I052. Astor release.

I must admit I had never heard of this musician before. More's the pity, as the group he leads can produce a fine orchestral sound in a variety of styles, ranging from Billy Joel's "Just The Way You Are" to a very "disco" version of "Love Is In The Air". The sound is full; it should be, with 50 musicians listed on the sleeve! It's also very easy to listen to, with these other titles: Harlequin — Promenade — If I Had Nothing But A Dream — Love Song — Sonny's Ragtime — Misty — You Needed Me — Juarez.

The album was recorded at Manta Sound in Toronto. I would like to Hear more of the same. (N.J.M.)

☆ ☆ ☆

SCOTLAND IS ANDY STEWART. Stereo, Harbour MLR-263. Released in Australia by 7 Records. Distributed by RCA.

The picture of Andy Stewart on the jacket is of a chubby, Scot, complete with kilt and a cheerful grin. The program is entirely in keeping with theortrait: as Scottish as the come, a mix of sentiment and fun, with plenty of toe-tapping rhythm supplied by the drums and accordian which provides most of the backing.

One thing you had better know: The program is a generous one of 13 songs and a couple of recitations but Andy Stewart has deliberately omitted most

(Continued on page 113)

Music for children?

MUSIC FOR THE CHILDREN. Cristina Ortiz. Stereo, World Record Club W.R.C. R 05497.

One might legitimately speculate as to the appropriate role for this recording. The central theme is children — for children and about children — but that does not mean that the average child would recognise anything in it for him/her; quite the contrary.

On the other hand, given the background and title of some items, a few might respond in an imaginative way, particularly in the context of creative movement.

Thoughtfully, the jacke' notes cover the individual tracks fairly thoroughly and suggest the further possibility that the musically aware adult listener may find, in these simple pieces, the style of the respective composers, and a hint of their larger, better known compositions.

There are five major tracks, each containing a number of small items or movements: Children's Corner (Debussy) — Four Pieces from "Pictures of Childhood" (Khachaturian) — Scenes d'Enfants (Mompou) — Old Grandmother's Tales, Op. 31 (Prokofiev) — Histories (Ibert) — A Glimpse Of The Ballet (Khachaturian).

Having said all that, dare I suggest that the album, which plays for about an hour, might even service as a gentle piano background of a different kind.

From an original recording by HMV, the quality and surface are both excellent. It is encoded for SQ quadrophonic but I saw no reason to play it that way; I prefer a piano out front, in ordinary stereo! (W.N.W.)

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LIGHTER SIDE — continued

of the traditional airs and substituted others of more recent origin: Aberdeen — The Girl From Glasgow Town — The Fair Maid O' Perth — The Gallowa Hills — The Rumour (rec.) — The Lassie O'Dundee — I Will Go — Heart Of Midlothian — The Song Of Inverness — Bonnie Strathyre — Song Of The Clyde — The Kelso Collie (Rec.) — Granny's Heilan Hame — The Big Kilmarnock Bunnet — Mull Of Kintyre.

The performance is very much Andy Stewart on stage, with an audience keen to share his good humour and to forgive the occasional off-pitch note or phrase. You'll have to forgive him, too, but you will if your hearts in the heather and the hills! (W.N.W.)

☆ ☆ ☆

FIRST LIGHT. Richard & Linda Thompson. Chrysalis Records L 36697 Festival release.

"First Light" is Richard and Linda's first album on Chrysalis, although they have both previously recorded under different record labels.

Richard Thompson is one of the most important of contemporary songwriters in Britain today. This is reflected in this album where 8 of the 9 tracks were written by him and one of the tracks was written in collaboration with his wife. He also co-produced the album.

The 9 tracks on this refreshing album are: Restless Highway — Sweet Surrender — Don't Let A Thief Steal Into Your Heart — The Choice Wife — Died For Love — Strange Affair — Pavanne — House of Cards — First Light. (D.H.)

☆ ☆ ☆

KAREN CHERYL. Karen Cheryl. 7 Records. MLF 270.

This is 21-year-old Karen Cheryl's first album release. She is a French singer, although her songs are fairly Americanised.

Her vocal abilities lie somewhere between Dianna Ross and Donna Summer, and she is destined to be a success.

Her single "Sing To Me Mama" and the album have reached No. 1 in France and Belgium.

The eight tracks on the album are: There's A Sweet Melody — Sing To Me Mama — Let Me Be — Hold On — Like A Movie — Sugar Pie — Evil Lion — Fever Blues.

I suggest you listen to this new album. (D.H.)

SEONA McDOWELL, Down Country Roads On Gossamer Wings. Platypus Platters. APASLP 1001 Stereo. (APA Promotions, 43 Barker Crescent, Forest Hill, Vic 3131).

This attractive young performer is making a name for herself in the field of country and Australian music and has appeared with such performers as Don McLean and Roy Orbison. Her warm voice gives lots of life to these twelve tracks:

Follow Me — Foolish Games — Coat Of Many Colours — Gossamer Wings — Morning Morgantown — Crossroads — Bo The Banjo Man — Three Empty Bottles — Oh Dan — For Baby For Bobbie — Break O'Day — Take Me Home Country Roads.

Four of the songs; Foolish Games — Gossamer Wings — Bo The Banjo Man and Oh Dan are composed by the singer and reveal what must be a growing talent to watch. A record to enjoy. (NJM)

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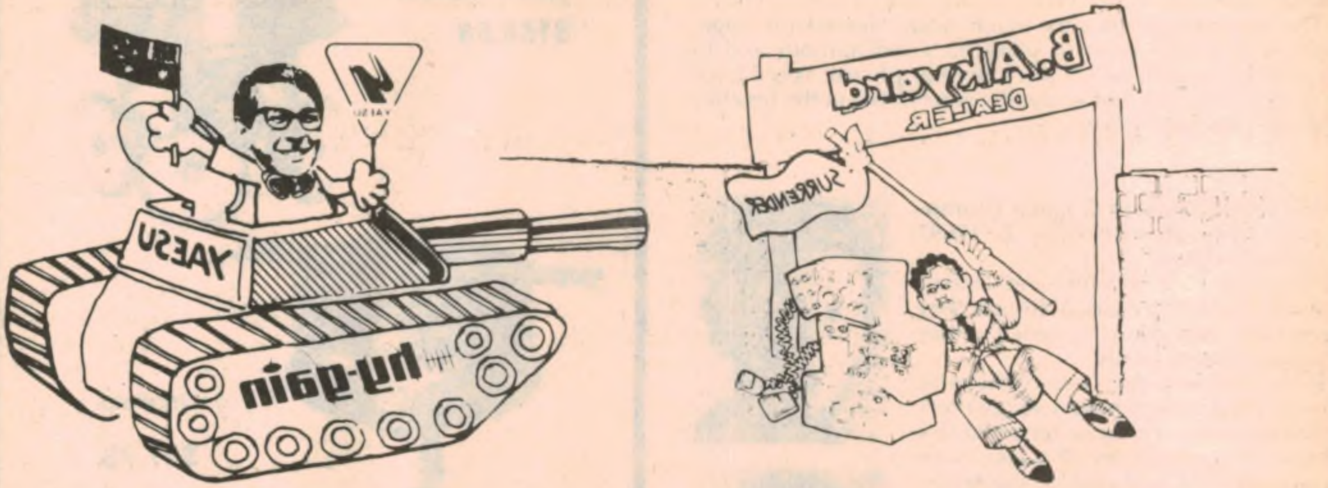

Reinforcements are on the way!! Yes, to help in the war we have sent for reinforcements. The long awaited FT-625R (6m all mode transceiver) should hit the beaches mid August.

After the loss of the FT-7, the more powerful FT-7B has joined the war to fill the gap for a good mobile transceiver (available mid August).

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AMATEUR RADIO

by Pierce Healy, VK2APQ

Mt Bindo amateur repeater destroyed by vandals

In a completely moronic and pointless act of destruction, some person or persons of sub-human intellect wiped out more than two years' effort by a dedicated group of amateurs, who had worked tirelessly to provide a service for their fellow enthusiasts. Heartbreaking though this set-back has been, the repeater group is determined that Mt Bindo will be restored.

On the weekend of June 2 and 3, 1979, after many weeks of testing and checking — and as the culmination of two years' work — a repeater designed and built by the St George Amateur Radio Society was installed at Mt Bindo in the central Blue Mountains, near Oberon.

The repeater was unique in that — being remote from commercial power supplies — it was powered by a wind driven generator charging a bank of batteries. The site had been selected to provide extended VHF communication facilities between coastal areas and the plains west of the mountains.

For five days VK2RDX operating on channel 1 (146.050MHz in — 146.650MHz out) with an ERP of 50 watts, provided such a service. Notable contacts included Newcastle to Griffith and Ballina to Canberra.

About mid-evening on Friday, June 8, 1979, the repeater ceased to function and an inspection the next morning revealed that a person or persons had cut the legs of the wind generator tower with a hack saw, at ground level, causing the entire structure to crash. The generator was completely destroyed and the tower severely damaged.

In addition, the building containing the electronic equipment was damaged and the coaxial cable with its protective pipe was cut to silence the repeater.

The reason for this outrageous action is not known and cannot be understood by anyone who has any vestige of consideration for the property or rights of others. It must be condemned in the strongest possible terms.

The destruction of an installation such as this, built and installed voluntarily, for the benefit of any amateur who may wish to use it, can only be attributed to someone with a morbid or mentally twisted sense of self-expression or achievement.

Anyone who has any information that may assist in apprehending those responsible, or who is aware of anyone displaying extreme animosity towards amateur radio in general, or the work of individual amateurs or groups, should, as a service to the community, advise the Police Department.

Unfortunately this is not the first case of unattended amateur installations being severely damaged. Other cases were: the moonbounce experimental project at Dapto, conducted by members of the Illawarra Amateur Radio Society in conjunction with the University of Wollongong; the channel 7 repeater at Mount Genini near Canberra, installed by members of the ACT Division WIA; and the channel 2 repeater at Mount Dandenong near Melbourne, installed by members of the Victorian Division WIA.

It is understood that in Melbourne several persons are currently charged with a wide range of offences against various radio services, including the Mount Genini and Mount Dandenong services.

The latest outrage not only affected normal communication between amateurs but has disrupted an important addition to the amateur civil emergency network and therefore a service by amateurs to the community. However, a meeting of the St George Amateur Radio Society has decided to replace the service and to this end a re-establishment fund has been started. Contributions to the fund may be sent to the Mount Bindo Fund, c/- WIA PO Box 123, St Leonards, NSW 2065.

WIA NEWS

The Wireless Institute of Australia federal executive advises that there was a joint Posts & Telecommunications Dept/WIA committee meeting on May 23, 1979. This was attended for the first time by Mr J. Wilkinson, First Assistant

The vandalised tower lying where it fell, with some of the distorted members clearly visible. The tower probably can be repaired, but the wind charger was a write-off. The building in the background houses the repeater.

AMATEUR RADIO

Secretary P&T Dept, Radio Frequency Management Division. The main topic was the proposed new Wireless Telegraphy Act and the revised edition of the P&T Dept Handbook for Amateurs. The printing of this was stopped by the Postmaster General, following an expression of views by the WIA representatives at the recent WIA federal convention.

New terms of reference dealing with the Amateur Advisory Committees has been forwarded to the WIA for comment.

The AOCP exam in August will offer the choice of answering either (I) the existing essay style format or (II) a 50 multi-choice question paper. The latter format has been advocated for some time by the WIA.

REMEMBRANCE DAY CONTEST

This contest, unique in the field of amateur events, is sponsored by the WIA to perpetuate the memory of Australian amateurs who paid the supreme sacrifice during World War II.

The contest will be held over the weekend August 11 and 12. A perpetual trophy is inscribed with the name of the division whose members, collectively, and in accordance with a formula, gain the highest number of points.

An appropriate address recorded by a prominent public figure will open the contest at 0800GMT Saturday evening. The contest will conclude at 0800GMT Sunday evening.

Rules and scoring table were not received in time for these notes. However it is understood that there has been a number of minor changes, which will be available through WIA sources.

This is a friendly contest and is open to all Australian and New Zealand amateurs whether or not they are members of the WIA or NZART.

NEW MORSE CODE PRACTICE AID

Sydney amateurs who cannot conveniently use the HF Morse code sessions (3550MHz, 7.30pm) now have an alternative service on VHF. It is available on 147.4MHz at any time of the day or night. This facility has been made available by the Hornsby and District Amateur Radio Club through their Morse code practice machine and station VK2RCW at Normanhurst.

VK2RCW operates continuously except at times of message loading or periods of program development. Signal reports would be appreciated and should be sent to Barry White, VK2AAB, C/- HADARC, PO Box 362, Hornsby, NSW 2077.

MUSEUM RADIO CLUB

The inaugural meeting of the Sydney Museum of Applied Arts and Sciences Amateur Radio Club — MAASARC — was held at the Museum on Wednesday evening, May 23, 1979.

The objects of the club are to assist the Museum authorities to demonstrate radio communication and amateur radio as a worthwhile hobby to the general public. It will also provide a pool of operators to man the Museum station, VK2BQK, during Museum visiting hours.

More than 30 amateurs attended the meeting, which was conducted by Pierce Healy, VK2APQ.

Dr Lindsay Sharp, Museum Administrator, welcomed those present, expressed his keen interest in the project, and outlined the Museum's plans for future expansion.

Mr Jeff Sergel, VK2BQI, Curator of Electronics at the Museum, was elected secretary-general of the club and a committee of five consisting of Peter Naish, VK2BPN; Pierce Healy, VK2APQ; Tony Bishop, VK2YFL; Geoff Campbell VK2ZQC and Bob Luther, VK2BLU, was formed to draw up a constitution.

It was also agreed that the club should meet bi-monthly on the fourth Wednesday of May, July, September, November, January and March at the Museum, Harris Street, Ultimo, Sydney (near Railway Square). Time 7.30 pm.

Membership of MAASARC is open to licensed amateurs and visitors are welcome. There are no membership fees. However, members are expected

AMATEUR RADIO

to occasionally be rostered as station operators.

Membership application forms may be obtained from Jeff Sergel, at the Museum, telephone 211 3911.

NOVICE LICENCE COURSES

The Novice Amateur Radio Group, which is affiliated with the NSW division WIA, aims to introduce people to amateur radio, and to help them to obtain their novice licence with the aid of lectures on theory and regulations, and Morse code practice.

The NARG will be providing these aids at the Wireless Institute Centre, 14 Atchison Street, Crows Nest, NSW, commencing June 30, 1979 and until the November 1979 P&T exam.

For further information contact, Jim Berry, VK2VFC, telephone (02) 457 9158 or (02) 428 4215.

Hornsby and District Amateur Rado Club novice study course is planned to begin on Monday, August 6, 1979. The course is of 12 weeks duration and will cover the complete novice syllabus of radio theory as well as Morse practice and regulations.

The course will be held at the Hornsby Evening College, Pacific Highway, Hornsby.

For more information contact Gerry McCulloch, on telephone (02) 868 2585 (AH) or write to the club at PO Box 362, Hornsby 2077.

AMATEUR RADIO EXHIBITION

For the second year, the St George Amateur Radio Society provided a display at the Rockdale Arts and Crafts Exhibition in the Rockdale Town Hall.

The display, which was co-ordinated by Bill Shakespere, VK2AGF, occupied half the stage area at the Town Hall.

Surmounted by a large eyecatching banner bearing the society's title, the display included large WIA show cards giving information on WIA membership, Youth Radio Scheme, WICEN, OSCAR satellites, and amateur repeater stations.

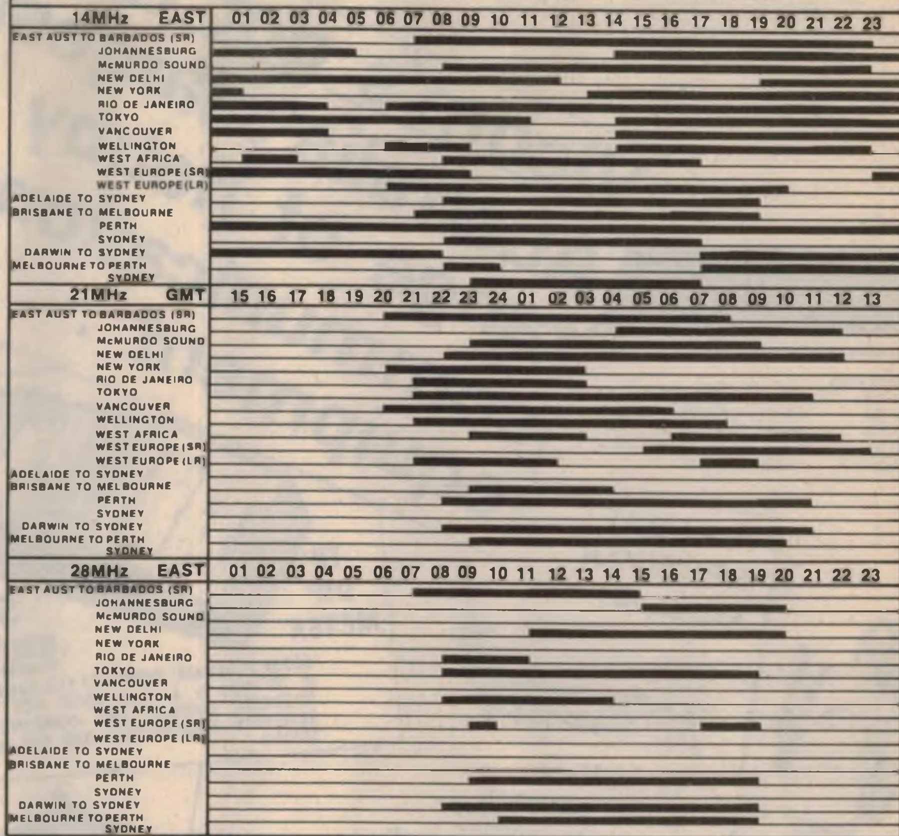
Equipment includced a two metre transceiver, teletype tape transmitter and video display unit, FT101B transceiver, audio oscillators and Morse keys, and a cassette tape recorder demonstrating the novice education kit Morse code practice tapes. Several amateur magazines, call books and hand-out pamphlets on various aspects of amateur radio were available to visitors. On air operation was demonstrated on two metres using the society's call sign VK2LE and channel 4 repeater VK2RLE. Reception on the HF bands, including teletype from the USA, was also featured.

The main activity however, was greeting visitors to the display and answering questions. The most repeated of them being — How can I become an amateur? How much will it cost? How long will it take? The younger visitors showed great interest in the audio oscillators and were encouraged to use the Morse keys.

Many SGARS members assisted Bill during the exhibition.

IONOSPHERIC PREDICTIONS FOR AUGUST

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. 8.79



VK7 AMATEUR HISTORY

The historical officer of the Northern Branch WIA, Mr W. Tanner, VK7TE, is endeavouring to collate a history of all VK7 amateurs, past and present. He would like photographs (colour if available), plus a short biography covering activities, hobbies, work, date call allocated, other calls held, etc. Details of ex-VK7 amateurs, or of silent keys, would also be appreciated.

If any readers can help with this project we would appreciate it. If practical we would call to collect information or record details. If you have such information contact Lucy Lockett, VK7NSB, secretary of the Northern Branch, WIA, PO Box 275, Launceston 7250

WAC 144MHz

By working Chris Skeer, VK5MC, via moonbounce, Dave Price, GW4CQT, has achieved the first 144MHz Worked All Continents. For some time Dave has concentrated on moonbounce experiments which culminated in his contact with Australia.

Although no details have come to hand, it is understood that the equipment used at GW4CQT was home built.

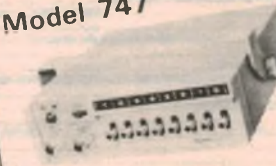
Radio clubs and other organisations, as well as individual amateur operators, are cordially invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown 2200.

Vicom's got it! Australia's largest range of hobby communications equipment . . .

Morse Keys

HK702	Deluxe Key with marble base	$41.00
HK708	Economy key	$23.00
HK706	Operator's Key	$25.00
MK701	Manipulator (side swiper)	$45.00
PALOMAR	IC Keyer	$149.00

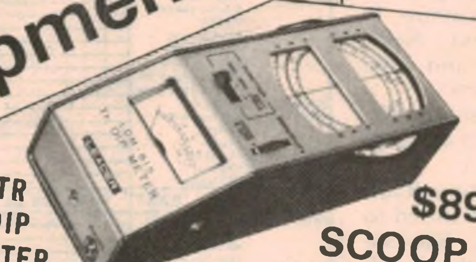
AIRCRAFT RECEIVER
Model 747



- 16 channels
- AC/DC operation
- 4 crystals supplied

New Shipment Just Arrived!

TR DIP METER



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TS520 S	HF Transceiver	$635.00
TS120 V	Solid state HF transceiver	$530.00
TS120 S	HF transceiver 100 W	P O A
SM220	Station Monitor	P O A
TS180 S	HF transceiver	P O A

CALL US FOR A GOOD DEAL ON KENWOOD PRICES!

ICOM GEAR

IC22S	2 m fm synthesised transceiver	$299.00
IC280	2 m fm remotable cpu controlled	$450.00
IC215	2 m fm portable inc 1 channel	$229.00
IC402	70 cm ssb portable 3 watts	$439.00
IC502	6 m ssb portable, 3 watts	$239.00
IC202S	2 m ssb portable, 3 watts	$349.00
IC211	2 m all mode ac dc transceiver	$799.00
ICRM3	Remote control unit	$159.00
ICSM2	Condenser electret desk mic	$45.00

PROGRAMMABLE! VHF+UHF SCANNING RECEIVER

BEARCAT 210 10 CHANNELS
BEARCAT 250 50 CHANNELS

HAM ACCESSORIES

Antenna Couplers

CL67A	Daiwa 1.9 – 28 MHz 500 W pep	$135.00
CNW217	Daiwa incl. SWR/PWR meter. 200 W	$165.00
CNW417	Daiwa incl. SWR/PWR meter. 500 W	$199.00
MFJ901	MFJ Matches everything 1.8 – 30 MHz	$119.00
MFJ16010	MFJ Random wire tuner 160 – 10 M	$71.00
MFJ941	160 – 10 M, 300 W, incl SWR/PWR	$157.00
LAC 895	Leader 3.5 thru 28 MHz	$169.00

Antenna Rotators (Daiwa)

DR7600S	Heavy Duty with controller & mast clamps	$259.00
DR7500S	Medium Duty with controller & mast clamps	$189.00
6 Core	Cable for above (200 m rolls)	$1.00/m

QRP Transmitter (MFJ)

MFJ40T	5w 40 meter CW (Xtals not included)	$59.00
MFJ40V	UFO unit for above	$59.00

Hand Held Transceiver

AR240	2 meter 800 ch. synthesized. 1.5 w.	$365.00

Daiwa Low Pass Filters

FD30LS	32 MHz, Fc, 200 w., 3 stages	$20.00

Baluns

AS BL	Asahi 50 ohm for beams	$34.00
BL50A	50 ohm, 4 KW, 1:1 for dipoles	$30.00
BL70A	70 ohm, 4 KW, 1:1 for dipoles	$30.00

STACKS OF HAM GEAR TOO!

Tubes

6KD6	Finals for Yaesu linears	$9.00
6JS6C	Finals for Yaesu transceiver	$9.00
12BY7A	Driver	$3.75
6146B	Finals	$12.00

SWR/PWR Meters & Dummy Loads

VC 2	Twin meters 3 150 MHz with cal. chart	$35.00
SWR200	Oskerblock 3 200 MHz, 2/20/200/2000 W	$86.00
SW210A	Daiwa 1.8 thru 150 MHz, 20/120 W, direct	$99.00
SW410A	Daiwa 140 500 MHz, direct reading	$129.00
CN620	Daiwa Cross needle, 18 150 MHz, direct	$99.00
CN630	Daiwa 140 450 MHz, 20/200 W, direct read	$135.00
CN650	Daiwa 1.2 – 2.5 GHz 2/20 W direct read	$169.00
LPM 885	Leader SWR/PWR meter	$89.00
LPM 880	RF Power Meter	$135.00
RW 155D	Kuranishi RF Power Meter	$185.00
RW 151D	Kuranishi RF Power Meter	$165.00
RW 1002L	Kuranishi RF watt meter	$139.00

Coaxial Change Over Relays (Daiwa)

CX 2L	1.8 thru 170 MHz, 100 W pep max	$45.00
CX 2H	1.8 thru 450 MHz, 200 W pep max	$69.00

WRITE FOR OUR NEW ICOM COLOUR CATALOG

Coaxial Switches

CS201	2 position, high pwr. to 500 MHz	$23.00
CS401	4 position, high pwr. to 500 MHz	$59.00

Jaybeam Antennas

5Y/2m	5el 2 m, 7.8 dBd gain length 1.6 m	$43.00
8Y/2m	8el 2 m, 9.5 dBd gain length 2.8 m	$51.00
10Y/2m	10el 2 m, 11.4 dBd gain, length 4.4 m	$84.00
10XY/2m	10el 2 m, cross yagi, 11.3 dBd	$114.00
D8/70cm	Twin 8el, 70 cm, 12.3 dBd, 1.1 m	$64.00
PBM 18/70	18el, 70 cm, 14.9 dBd, 2.8 m	$96.00
MBM 48/70	48el, 70 cm, 15.7 dBd, 1.83 m	$83.00
MBM 88/70	88el, 70 cm, 18.5 dBd, 3.98 m	$105.00
PMH/2C	Phasing harness	$20.00
8XY/2m	2 m cross yagi, 8el, 9.5 dBd, 2.8 m	$99.00
12XY/70 cm	70 cm cross yagi, 12el, 13.0 dBd, 2.6 m	$139.00

VICOM

AMATEUR RADIO DIVISION

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Ph (03) 699 6700

Sydney 635 6399 Gold Coast 32 2644 Melbourne 836 8635 Hobart 43 6337 Launceston 44 3882 Wellington (NZ) 287 946
Adelaide 43 7981 Canberra 31 6685 Perth 321 3047 Cairns 54 1035 Brisbane 38 4480 Wagga 212125

SHORTWAVE SCENE

by Arthur Cushen, MBE

Russia jamming broadcasts from Western Europe

Recent information given by an executive of Radio Liberty and Radio Free Europe indicates that the Russians are spending around $500 million a year on their radio services. At least half this amount is spent in jamming broadcasts from Western Europe.

The economics of this huge undertaking must be a massive burden. It is estimated that Russia employs more than 2500 transmitters solely for the purpose of jamming transmissions. In addition Radio Moscow has recently opened a world service and has put into operation 24 new transmitters, each of 500kW. It is estimated that the cost of the Radio Moscow transmissions world-wide is around $M250.

Radio Moscow uses around 150 high powered transmitters to carry its broadcasts in over 70 languages.

The incidence of jamming does seem to be decreasing. In fact, evidence has shown that when jamming ceases on broadcasts from any particular country there is little change internally except that the listeners view of world-wide events is broadened. This was shown by the ending of jamming in the Hungarian and Romanian languages.

According to the Radio Free Europe official it is most frustrating for the program staff to put in hours of work in music, religious and other popular programs knowing that they are to be jammed and may never be heard by the audience they are intended for. Nevertheless Radio Liberty and Radio Free Europe continue to broadcast to the communist countries in the hope that some day jamming will cease.

NEW MOSCOW PROGRAMS

The World Service of Radio Moscow has now settled into a new program format, and this includes plenty of features for the hobbyist. In an hour long series, both the short-wave listener and stamp collector are catered for. According to Andrew Lord, Box Hill, Victoria the schedule is as follows:

Saturday: 0532-0632GMT, 1532-1632, 2132-2232.

Monday: 0732-0832.

Tuesday: 0732-0832, 1532-1632.

In the hour long program, the first half hour of "Hobbyland" contains DX information, music and other hobbies. The second half hour contains the stamp program and further hobbies.

NEW COSTA RICAN STATION

Since early May, a new Costa Rican Station using the slogan Radio Noticias del Continent, has been heard on 9615kHz till closing at 0400GMT. According to the Spanish announcements, the test broadcast is beamed to Latin America on the 31 metre band. The address for reports is Apartado, 162, San Jose, Costa Rica.

A late report from the BBC Monitoring Service, indicated that reception has been on 9610kHz, and tests are being carried out in both the 31 and 49 metre bands. At the time of going to press, the station was still using 9615kHz.

WORLD'S SMALLEST STATION

What is claimed to be the world's smallest station, CKFX, in Vancouver, Canada, operating on 6080kHz with 10 watts, is again being looked for by many listeners in the South Pacific. The best time is after 0730GMT, when the frequency is clear.

CKFX relays the medium wave station CKWX, and was first heard on August 28, 1940. The verification letter stated: "With regard to the power of our short-wave station, we are still using 10 watts. The fact that we have changed its location from the centre of town to outside the city limits may account for the change you have noticed. It may interest you to know also that, since receiving your letter, we have erected a new antenna system, now using a 'V' Beam type."

It will be interesting to observe after some 39 years, that this station is again being heard in this part of the world, and the power is still 10W.

MEXICAN SIGNALS

Signals from Mexico in the 49 metre band have been heard over many years, but from time to time they are reported widely when favourable conditions permit. This is the case of XEUW on 6020kHz, which has been heard at 1200GMT, with a news bulletin in Spanish. This station has been broadcasting for many years, and in fact our verification was received in 1956. The card showed the photo of the station.

Signals from the Mexico City broadcaster, on 6185kHz, have been heard to closing at 0710GMT. This education station has light music and plenty of announcements and gives the call of XEEP, which operates on medium wave on 1060kHz. The short-wave station is new as the frequency of 6185kHz was formerly occupied by another Mexican station which seems to have been closed down.

NEW HCJB FREQUENCY

Broadcasts from HCJB are now being heard on the new frequency of 3220kHz, when this outlet is used for broadcasts in the local Quechua language. The power on the frequency is 10kW, and broadcasts are 0900-1300 and 2130-0200GMT. The transmitter was built by HCJB engineers, and the finance was provided by the local Quechua population, who will also be responsible for the program material.

Another 10kW transmitter is also under construction and this will operate in the 49-metre band. A special aerial is used to try and concentrate the signal into Ecuador, because of the regional nature of the broadcast.

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.

25—240 Watts!

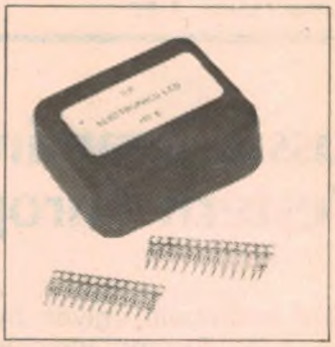
HY5
Preamplifier

The HY5 is a mono hybrid amplifier ideally suited for all applications. All common input functions (mag Cartridge, tuner, etc) are catered for internally. The desired function is achieved either by a multi-way switch or direct connection to the appropriate pins. The internal volume and tone circuits merely require connecting to external potentiometers (not included). The HY5 is compatible with all I.L.P. power amplifiers and power supplies. To ease construction and mounting a P.C. connector is supplied with each pre-amplifier.

FEATURES: Complete pre-amplifier in single pack—Multi-function equalization—Low noise—Low distortion—High overload—Two simply combined for stereo.

APPLICATIONS: Hi-Fi—Mixers—Disco—Guitar and Organ—Public address.

SPECIFICATIONS:
INPUTS: Magnetic Pick-up 3mV. Ceramic Pick-up 30mV. Tuner 100mV. Microphone 10mV. Auxiliary 3-100mV; input impedance 4-7k Ω at 1kHz.
OUTPUTS: Tape 100mV; Main output 500mV R.M.S.
ACTIVE TONE CONTROLS: Treble ± 12dB at 10kHz. Bass ± at 100Hz.
DISTORTION: 0.1% at 1kHz. Signal/Noise Ratio 68dB.
OVERLOAD: 38dB on Magnetic Pick-up. SUPPLY VOLTAGE ± 16-50V.
Price $34.00.



HY50
25 Watts into 8 OHMS

The HY50 leads I.L.P.'s total integration approach to power amplifier design. The amplifier features an integral heatsink together with the simplicity of no external components. During the past three years the amplifier has been refined to the extent that it must be one of the most reliable and robust High Fidelity modules in the World.

FEATURES: Low Distortion—Integral Heatsink—Only five connections—7 amp output transistors—No external components.

APPLICATIONS: Medium Power Hi-Fi systems—Low power disco—Guitar amplifier.

SPECIFICATIONS: INPUT SENSITIVITY 500mV.
OUTPUT POWER 25W RMS into 8 Ω. LOAD IMPEDANCE 4-16 Ω. DISTORTION 0.04% at 25W at 1kHz.
SIGNAL/NOISE RATIO 75dB. FREQUENCY RESPONSE 10Hz-45Hz-3dB.
SUPPLY VOLTAGE ± 25V. SIZE 105.50.25mm.
Price $44.00.

HY120
60 Watts Into 8 OHMS

The HY120 is the baby of I.L.P.'s new high power range. Designed to meet the most exacting requirements including load line and thermal protection this amplifier sets a new standard in modular design.

FEATURES: Very low distortion—integral heatsink—Load line protection—Thermal protection—Five connections—No external components.

APPLICATIONS: Hi-Fi—High quality disco—Public address—Monitor amplifier—Guitar and organ.

SPECIFICATIONS:
INPUT SENSITIVITY 500mV.
OUTPUT POWER 60W RMS into 8 Ω. LOAD IMPEDANCE 4-16 Ω. DISTORTION 0.04% at 60W at 1kHz.
SIGNAL/NOISE RATIO 90dB. FREQUENCY RESPONSE 100Hz-45kHz—3dB. SUPPLY VOLTAGE ± 35V.
SIZE: 114.50.85mm.
Price $99.00.

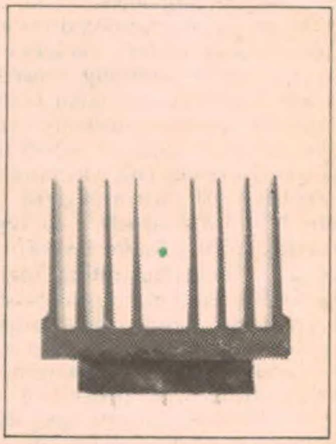
HY200
120 Watts into 8 OHMS

The HY200 now improved to give an output of 120 Watts has been designed to stand the most rugged conditions such as disco or group while still retaining true Hi-Fi performance.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—Integral heatsink—No external components.

APPLICATIONS: Hi-Fi—Disco—Monitor—Power slave—Industrial—Public Address.

SPECIFICATIONS:
INPUT SENSITIVITY 500mV.
OUTPUT POWER 120W RMS into 8 Ω. LOAD IMPEDANCE 4-16 Ω. DISTORTION 0.05% at 100W at 1kHz.
SIGNAL/NOISE RATIO 96dB. FREQUENCY RESPONSE 10Hz—45kHz—3dB. SUPPLY VOLTAGE ± 45V.
SIZE 114.50.85mm.
Price $139.00.



HY400
240 Watts into 4 OHMS

The HY400 is I.L.P.'s "Big Daddy" of the range producing 240W into 4 Ω. It has been designed for high power disco address applications. If the amplifier is to be used at continuous high power levels a cooling fan is recommended. The amplifier includes all the qualities of the rest of the family to lead the market as a true high power hi-fidelity power module.

FEATURES: Thermal shutdown—Very low distortion—Load line protection—No external components.

APPLICATIONS: Public address—Disco—Power slave—Industrial.

SPECIFICATIONS:
OUTPUT POWER 240W RMS into 4 Ω. LOAD IMPEDANCE 4-16 Ω. DISTORTION 0.1% at 240W at 1kHz.
SIGNAL/NOISE RATIO 94dB. FREQUENCY RESPONSE 10Hz-45kHz-3dB. SUPPLY VOLTAGE ± 45V.
INPUT SENSITIVITY 500mV. SIZE 114.100.85mm.
Price $188.00.

All above prices are including tax. We reserve the rights to alter prices without notice. Trade enquiries invited.

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Please Supply ____________________

Total Purchase Price ____________________

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Name and Address ____________________

Signature ____________________

SHORTWAVE SCENE

The Quechua language is also broadcast on other HCJB frequencies: on 6050kHz from 0930-1030; 6070 and 9705kHz 0900-0930 and 1030-1130; and 9745 and 11900kHz 2200-0030GMT. These transmissions directed to South America.

CANADA'S DX DIGEST

The popular Radio Canada's DX Digest program, which is broadcast in the Sunday transmission in two parts, has now been extended to four sections each Sunday. These segments, of six minutes, are heard at the end of the half hour transmission with Ian McFarland introducing the Digest with some technical news, and then follows a contribution from one of the Canadian or United States radio clubs.

The schedule for listeners in Europe and Africa, which is giving good reception in this area is from 1800-2000GMT. On Wednesday, at 2130GMT, two further editions are broadcast. The broadcasts at 1800 and 1900GMT are on 15260 and 1780kHz; at 2000 the frequencies of 15325 and 17820kHz are used; while at 2130 broadcasts can again be received on the last two channels.

The transmissions to North America, heard during Monday afternoons in this area from 0300-0327GMT are on 5960, 9535, 11845 and 11940kHz, while from 0400-0427GMT, the first three frequencies only are used.

Some of the features to be included in the expanded DX Digest include a report from the North American Association of Radio Clubs, and a regular contribution from a woman radio listener. Member clubs of ANARC will be giving some background information on their organizations and a special section will feature reviews on new receivers which have been introduced onto the world market and are of special interest to the short-wave listener. The address of DX Digest is Radio Canada International, Box 6000, Montreal, from which a complete schedule of the various programs can be obtained.

FLOATING BROADCASTER

The radio ship "Mebo II" has been renamed "Al Fateh" and is anchored in Tripoli Harbour, Libya. This ship was formerly the "Radio North Sea" which broadcast off the coast of Holland for some years until its purchase by the Libyan Government. According to the WRH Newsletter it carries the Holy Koran program on 6206kHz with 10kW. It is irregularly heard also on 1611kHz medium wave. The reported schedule is 0600-1800GMT.

LISTENING BRIEFS
EUROPE

ALBANIA: Radio Tirana has been heard on 9750kHz with an English broadcast to North America at 0300GMT. Broadcasts to Australia are now heard at 0700, 0930 and 1400GMT on 6200, 7090 and 11990kHz.

AUSTRIA: Vienna, using 15560kHz, have been heard 1600-1900, with English at 1830GMT. The service to Australia, with English 0830-0900, is on 21630 and 21735kHz. On Sunday Austrian Shortwave Panorama is broadcast at 0900GMT.

ITALY: Rome broadcasts in English 2200-2225GMT on 9710, 11905 and 15315kHz. Broadcasts in Italian to Australia are 0830-0930GMT on 9580, 11810, 15330, 17780 and 21690kHz.

AFRICA

CAMEROON: The regional station at Douala has been heard on 7240kHz around 0530GMT, with Africa music and announcement in French. The signals are followed up to 0600GMT, when the channel is blocked by Radio Liberty and Bucharest.

SOUTH AFRICA: English broadcasts from Radio South Africa have been noted at 0500GMT on 4835kHz. This service is non-commercial and provides fair reception during April and August. Radio South Africa recently announced that the relays of the commercial service on short wave, known as Springbok Radio, have been cancelled. These programs are now carried only on medium wave and FM in South Africa.

Trans World Radio has reached agreement with the government of the homeland of Bophuthatswana to build a medium wave 50kW transmitter. The on-the-air date and frequency are still unknown, reports Colin Miller on Johannesburg.

NIGERIA: Last month we reported reception of the new external service of RADIO Nigeria, Lagos, on 15185kHz and heard from 0600-0835GMT. An additional transmission has now been noted 2000-2100GMT in German and 2100-2200 in English, while French has been observed 1900-2000GMT.

U.H.F. CB antenna strength loss is no longer a problem.

Philips introduce the battery operated Field Strength Meter which lets you measure the efficiency of your U.H.F. C.B. band antenna. F.S.M. sensitivity is such that measurements are normally made at distances greater than 20 metres from the antenna being monitored or tested. The small detachable quarter wave pick-up antenna is inserted into the INPUT socket on top of the F.S.M. If a remote antenna is required in place of the one provided the feeder from the antenna is connected to the input socket.

The F.S.M. enables day to day checks of transmitted radiated power, comparison of relative gain between antennas, and accurate measurement of radiated power to construct a polar diagram.

Service
Service
Service

PHILIPS

An important addition to your U.H.F. C.B. radio operation. For further information contact your local Philips Service Branch on the following telephone numbers, or bring your rig in for a test.

Sydney 736 1233, Newcastle 61 1631, Canberra 95 0321, Melbourne 699 2731, Hobart 28 0121, Brisbane 221 5422, Townsville 79 7422, Adelaide 223 4735, Perth 322 4653.

Specifications of the Philips U.H.F. field strength meter

Frequency Range........477MHz + 5MHz. Input Impedance...50 Ohms.
Input Level..................−30dBm (+ 1.5dB) at maximum sensitivity.*
Scale Calibration ....−10dB to + 1dB, relative to −30dBm input.
Power Supply ....2 Standard 9V transistor radio batteries.
Battery Life ....With normal intermittent use – over 150 hours. This will be double with long life batteries.

*When the sensitivity control is set at MINIMUM, a further reduction of approximately 10dB is provided. This control is combined with the ON/OFF switch.

(Also illustrated are 2 of the new Watt meters for signal measurement)

McCANN 184 0013

The Australian CB SCENE

UHF CB IS MAKING ITS MARK IN THE COUNTRY

Encouraged by the recent rise in farm incomes, many property owners are currently investing in two-way radio as a way to reduce isolation, not only in the communal sense, but between people working on the same property.

by STEPHEN COOPER

To date, farmers have relied heavily on the telephone and they will continue to do so for normal purposes. But the telephone has its limitations. Quite often, in response to an urgent call, wives have to jump into the family ute to contact somebody on the property and to bring the reply — or the person concerned — all the way back to the phone!

Theoretically, farmers have had a longstanding right to instal licenced 2-way radio equipment on their properties but the equipment has been relatively expensive to buy and maintain and hedged around with a variety of traditional, formal regulations. CB radio has pushed aside both barriers and, particularly on the UHF band, provided a means of communicating direct with farm personnel in sheds and vehicles, and with people on neighbouring properties.

Close-knit communities at Condoblin, Gunnedah and Dubbo in NSW, Mildura and Horsham in Victoria, Dalby, Biloela and Bundaberg in Qld, and Streaky Bay in South Australia are the "tip of the iceberg" of those turning to networks utilising the UHF CB band and the Philips FM 320 transceiver.

These are typical of areas where farmers have seen field day displays or spot demonstrations by enterprising radio dealers showing the quality and predictability of UHF transmission and the attractions of the FM 320 unit. Some 60 per cent of this set's current sales are outside of the metropolitan area, and Philips are encouraging their dealers to participate in agriculture equipment demonstrations and field day displays.

Country dealers confirm that professionally licensed commercial two-way UHF systems have always been too expensive for the farmer, and offer communications only within the specific network he pays to use.

Many have tried communicating with 27MHz CB but were disillusioned when swamped with unwanted conversations and interference, particularly that resulting from "skip" effects. They are now "discovering" UHF CB, which allows them to buy up to five sets over-the-counter on the one instantly obtainable $25 licence. They can plug in antenna and power, switch on, and communicate effectively.

Farmers have found that, with 40 channels, there's room for their own network (dare anybody say "party line"?) and the ability to flick the electronic channel-change switch on the mike to talk to similarly-equipped neighbours — and maybe even a supplier in town running a UHF base for his own service or delivery fleet.

"We expect a snowballing of the word of mouth reputation the FM 320 is getting in rural areas now," says Philips

Trevor MacAlister (left) and his wife Cleone are typical of many rural users of UHF CB. Contributing to an efficient operation, it has become an essential "implement" for the day-to-day running of the farm. Their property is at Brassi, near Deniliquin and the equipment was installed by Wimmera Communications at Horsham, just across the Victorian border. The equipment gives them the opportunity of talking also to neighbours and suppliers.

BRASS SHIPS CLOCKS SMITHS 8 DAY 7 INCH DIAMETER $110

Post A $1.75; B $3.00; C $3.60.

GENUINE EX ARMY WRIST WATCHES

Complete with nylon band $19.50
Post $1.10

P.M.G. TYPE TELEPHONES

Standard desk type with magneto bell calling device. Range 30 miles. Uses standard batteries at each phone. Any number can be connected together on single line **$39.50**

(2 TELEPHONE SETS)

$2 Cartage to Rail. Freight payable at nearest attended Railway Station

RECEIVER No. 210

2-16 M/cs $65
Transmitter No. 11 suits 210 $35.
24 volt Power supply to suit above $15.
Or complete station with Headphones. Mic $110

EX ABC MAGNETIC RECORDING TAPES ¼"

PROFESSIONAL QUALITY

5" x 600'	$1.50
7" x 1200'	$2.75

P + P $1.30
10½" x 2400' $7.95
P + P A $1.65 B $2.75 C $3.10

COLLINS INDEPENDENT SIDEBAND TRANSCEIVER TRC/75

Fully synthesised transceiver with am, upper, lower and independent sideband operation. 1KHz steps from 2MHz to 29.999MHz. 1 microvolt sensitivity. 2.5KHz bandwidth ssb. 6KHz bandwidth AM. 1 RW PEP max output. Fully automatic tuning of both transmitter and receiver from remote control unit. Complete with automatic aerial coupling unit, mic, headset, etc. 400Hz supply.

Ideal for amateur use

PRICE $750

COLLINS SYNTHESISED 1 SB RECEIVER

TRC/75 receiver section of transceiver specification as above
PRICE $400

TELEPHONE WIRE

1 mile twin (2 miles) genuine ex-Army Don 8 perfect condition $45.00 per drum. $2.00 cartage to rail freight payable at destination.

20X to 60X ZOOM TELESCOPE

With Tripod. $115.50.
Post A$2.25, B$4.10, C$6.10.

RCA 44BX MICROPHONES

PROFESSIONAL QUALITY $75
P&P A. $1.80. B. $3.50. C. $4.55. D. $4.55

AERIAL CAMERAS

WITH 8" FL 3" DIAM LENS F24 MARK IV 2.9 LENS STOPS 11, 8, 5.6, 4, 2.9 — $65

$2 cartage to rail freight. Payable to nearest attended railway station

PENTAC LENSES

3" DIAM. 8" FL WITH DIAPHRAGM STOPS 11, 8, 5.6, 4, 2.9 MOUNTED IN METAL HOUSING — $65
POST. A. $1.85. B. $3.25. C. $4.10

PRISMS

4" SQUARE FACED RIGHT ANGLE PRISMS TOP QUALITY EX AIR FORCE — $65; OR LENS & PRISM FOR $120.
POST A. $1.75. B. $3.00. C. $3.60

SOLENOIDS

200 MA 24 volt. ⅛in push movement. $2.50 P+P 80c

NIFE CELLS

1.2 volt, fully charged 4in x 3in x 1in 4 AH
$1.50 each P&P 80c

ROLA 66 MK 2 TAPE RECORDERS

Good condition $275.00

ARTILLERY DIAL SIGHTS MK2

Can also be adapted as a Dumpy Level or as base for a telescope has full 360° 5½" diam gunmetal rotating circle. Adjustable elevation and depression. Has top grade ¾" diam. object lens F.L. 10" with cross hairs, eyepiece ½" right angle prism — height 10" — weight 3½kgs. With leather carrying case. Original cost $300
Our Special only $27.50
P&P A $2.25 B $4.00 C $6.00

POSTAGE KEY:

A: NSW
B: Vic. Qld. SA
C: NT. Tas.
D: WA

VALVES

BRAND NEW

6SN7	$1.95	6BM8	$1.95
5U4	$1.95	6GV8	$1.95
EF50	$1.50	6AK5	$1.95
		1H6	$1.50
2x2	$1.50	832	$5.00
	P+P 80c		
6x4			$1.95
VR65			$1.50

STC HIGH IMPEDANCE HEADPHONES

3400 ohms, brand new, only $4.95 pair
P&P. A $1.65, B $2.75, C $3.10

ZOOM SPOTTING SCOPES

30 x 30
LENGTH 12½", HEIGHT 10"
WEIGHT 1¾ lb
$32.50

45 x 40
Length 16in
Height 10in
Weight 2lb
$49.50

High grade coated lenses. Ideal for pistol and rifle ranges or general viewing. Zooms in from very low to high powers. Complete with tripods.
POST. A $1.75, B $3.00, C $3.60

TELESCOPES

25 x 30 $13.50
P&P A $1.30

SPY TELESCOPES

8 x 17 mag size of a rifle cartridge extends to 8". Only $8.95 each, post 60c

BINOCULARS

PRISMATIC Coated Lenses. Brand new. Complete with case

8 x 30	$42.00		
7 x 50	$48.95	P&P	
10 x 50	51.00	A	$1.75
12 x 50	53.00	B	$3.00
20 x 50	65.00	C	$3.10

SMALL CLIP-ON POCKET TELESCOPE

15X $7.00. P+P 80c

3" ASTRONOMICAL REFLECTOR TELESCOPE

117X magnification FL 700mm with 5x24mm finder scope and two section hardwood tripod. $169.25.
Post A$2.25, B$4.10, C$6.10.

C42 set 36 to 60M/Hz with 24 volt power supply headphone mic. leads etc. $95.
Or 42 set separate $65

AIRCRAFT INSTRUMENTS

Directional Gyros
AN5735-1 Air Operated
$35
Sperry Artificial Horizon
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$45
Slip and Turn Indicators
$17.50
P&P
A. $1.65. B. $2.75. C. $3.10

SIEMENS Typing Perforator

240 Volt Type with Keyboard $57.50

ANEROID BAROMETERS

In brass case, made in London. $49.50
P&P A. $1.65
B. $2.75
C. $3.10

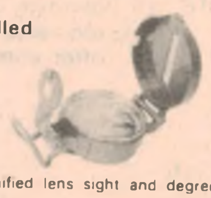
CONDENSER LENS

1½" diam. 4½" F.L. 75c. 2½" diam 2" F.L. $1.50 each or $2.50 per pair. P&P 80c

IMPELLER PUMPS

New gunmetal body. Stainless Steel Shaft. Neoprene Impeller. Up to 15ft Lift, suitable for almost any type of liquid. Self priming. Ideal boat bilge pump, sullage drains, etc. Approx. size 8" x 5". ⅜" $30.35, ½" $43.30, ¾" $47.60
P+P. A. $1.95. B. $3.50. C. $4.60

Liquid filled compass



With magnified lens sight and degree reader.
Only $7.95 each. Post $1.30

POLARITY & CURRENT CHECKER

3 volt to 400 volt. Simple leads and prods quickly determines positive or negative with illuminated indicators, also checks AC current and intensity, fully insulated only $4.95, pp $1.30

COLLINS COMMUNICATIONS RECEIVER

Type SIJ-4
500kHz to 30mHz
$350.00

WRIST WATCHES SWISS JAEGER

Le Coultre ex RAAF rated one of the world's best in smart chrome case with black dial. Original cost $250

SPECIAL $49.50
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THEODOLITES

Made by Wilds Microptic with tripod. Model T1 reads down to one minute of ARC $750 (Usual Price $1750)
Model T2 reads down to one second of ARC $1000 (Usual Price $3200)
Freight payable at nearest attended R'way Stn

ZOOM FOCUSING MICROSCOPES

Zoom focusing microscopes. 750X battery and mirror illuminated $31.75
Zoom 1200X similar to above $47.95
P&P A $1.65 B $2.75 C$3.10

DIRECTOR LEVELS

Ex Army No 9 with azimuth horizontal circle and vertical adjustment suits all types of levelling. In leather case $90.

P + P A$1.75 B$3 C$3.60

EX-ARMY TWO-WAY FM RADIOS

1.2 WATTS OUTPUT
SUPERHET
PRC9 AND 9A 27 to 39M/HZ
PRC10 AND 10A 38 to 55M/HZ
WITH HANDSET ANTENNA $25 EA
UNTESTED
Battery $3.95 extra. Harnes $4.50 extra
$2 Cartage to Rail. Freight payable nearest attended Railway Station

16MM SOUND PROJECTORS IN GOOD WORKING ORDER

240 volts operated complete with Speaker and Amplifier.
RCA $275
BELL & HOWELL $195.
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SELSYN MOTORS MAGSLIP

RECEIVERS 2" MK2 $8.50
TRANSMITTER 3" MK2 $20.00

Post Packing A. $1.75. B. $3.00. C. $3.10

COMMUNICATIONS RECEIVER

COLLINS R — 391/URR

Continuous tuning of range 500 Kills — 32MHz in 32 bands. Receive frequency indicated directly on digital counter type readout to within 300Hz. Selectivity adjustable in six steps. From 100Hz to 16KHz bandwidth. Sensitivity 1 microvolt or better 240 VAC operation — 10 inch rack mount — autotone on eight preset channels available complete with instructions and service manual and tested.
PRICE $500

Deitch Bros.

70 OXFORD STREET, SYDNEY 2010

SORRY NO C.O.D.

The Australian CB SCENE

CB Radio product manager, Ian Miller at Clayton. "Keen country dealers are now selling a network (one to three bases and between two and ten mobiles) a week.

"Harvest time later this year, when radio communication is even more useful in co-ordinating harvesters and trucks, could heighten the boom.

"Property owners find the installation and operation couldn't be simpler, and that range on UHF is very predictable," he said.

On broadacre properties a gain base aerial works adequately over the flat land when clipped to the top of the TV mast. (And there is no problem with TV interference when using UHF CB.) In hillier country the size of the properties tends to be smaller, so performance is consistent and UHF particularly suits base-to-mobile application.

Also the group spirit — which gains momentum, for example, when teams chat to each other on all-night harvesting operations — results in members performing relay services for each other to get messages sent long distance between the remotest paddocks.

Dealers claim that base to base operation is usually about 40-50km (as the crow flies) and probably somewhat less to mobiles, depending on geography and topography. There are no set distances, but whatever range there is, rarely varies from one day to the next, giving maximum predictability regardless of climatic change. Buyers are invariably delighted with the range say the dealers.

After researching the equipment available, the Ford Motor Company's Tractor and Equipment Operations division has chosen Philips UHF as an optional accessory for their tractor based equipment. "It's not CB it's realistically-priced two-way radio!" said David Hosking, Parts Sales Manager of the Division.

The division has established an Australia-wide distributorship for Philips FM 320 sets through all Ford Tractor and Equipment dealers, and is working towards FM 320 sales by every Ford auto dealer as well.

"We sell with the knowledge that the farmer can fit the set to his tractor and instal the base himself if he wants to simply by plugging each element into the next." said David Hosking. "Mobile aerial placement is flexible, and there is no need to SWR."

There is a choice of either the roof-mounted 15cm quarter-wave whip or co-axial dipole unit which clamps to a mirror frame or cabin gutter.

Ford dealers are fitting their own UHF networks as base-to-mobile communications for their service fleets. A bonus is that a farmer with a tractor fitted with UHF transceiver can often call directly to town from wherever his vehicle needs attention, to describe what is needed and direct the serviceman to the location.

According to David Hosking, any well-organised dealer discusses with the buyer which channel he would like as the preference channel, (to which the set automatically goes at switch on, or by command.) Good selection of the preference channel minimises the risk of cross-talk from another network.

"Applications such as this show that the convenience of UHF is limited only to the imagination of the user.

"A similar pattern of acceptance for UHF has developed in the rural market as we have in the trucking community — a demonstration of UHF quickly shows that field clarity and range are so much better than the prospect expects from a CB radio."

1979 NCRA FESTIVAL/CONVENTION

The Annual NCRA Festival to be held in Canberra on September 8 and 9 should be a drawcard for all those associated with CB radio, from the motorist to the avid hobbyist, not forgetting industry representatives.

by PETER KRAMER (National Director, NCRA)

The 1979 festival will centre around a country music show featuring "Roadapple", an industry and trade exhibition, a UHF seminar, and the NCRA National Assembly itself.

The festivities will actually commence in each capital city on the Friday evening when planes or specially chartered tourist coaches will carry groups of Festival visitors and delegates to Canberra, in many cases to the accompaniment of CB and Country Music, and at group return rates.

Accommodation has been arranged, also at very economical rates, in Motel and Chalet style units on site, for groups of people from six to singles. The accommodation is limited and will be allocated on a first come first served basis.

For campers, powered caravan sites are available together with on-site vans, although blankets, crockery etc. must be brought along. If you are very hardy areas are available for pitching tents.

Warm, informal clothing will be the recommended dress for the duration of the weekend as most of the activities will be "open-air, country-style", and Canberra in September is anything but hot!

The Festival will incorporate the 3rd Annual NCRA Convention and affiliated clubs are invited to send authorised delegates to be their spokespersons. Each delegate will be entitled to raise any issue on behalf of their club at the National Assembly and to observe the resulting action at the National Council meeting. All official club delegates should have a written authority from their club, in order to be able to vote at the National Assembly.

As many NCRA members are now operating in the UHF bands, it has been decided to provide an opportunity for operators and industry representatives to get together at the UHF seminar to formulate the future requirements of the service. All UHF users are invited to make their views known.

The trade exhibition will be set up to show the latest developments in CB, such as antenna towers, rotators, etc. There will also be displays of equipment by associated companies dealing in such diverse products and services as records, car accessories advertising and printing.

The quality of the displays should prove to be of a high standard, since a competitive air will be created by the presentation of trophies (donated by the NCRA) for the best presented trade display and the best presented retail display.

Further prizes will be presented to the best presented truck, panel-van, four-wheel drive and farm unit that is fitted with a CB radio. Those many operators who give many hours of tender loving care to their vehicles each week are inivted to complete!

The festival will cater for the younger members of the family with playground facilities, carnival etc., as well as a baby-sitting service to take care of the little kids while the "big kids" have some fun for a change!

The whole family will enjoy a pig-roast prior to the evening's entertainment, which will consist of a country music show featuring the Sydney based Bluegrass band "Roadapple", supported by country music singer and recording artist Peter Caulton, as well as a supporting band and guest compere.

Tours of Canberra will be operating from the festival site for those people who wish to become a little better acquainted with the National Capital.

As an incentive, $50 will be paid to any club or group that arranges a bus charter group of 40 people, of which at least 30 must be adults.

If you require further information on costs, registration forms, etc., contact the NCRA public relations officer, Mr Graeme Evans, PO Box 242, Clayton, Victoria 3168.

See you there!

136 VICTORIA RD, MARRICKVILLE, NSW 2204 PHONE 51 3845

A.C.E. RADIO ELECTRONICS CENTRE

BARGAIN PRICES ● PERSONAL ATTENTION ● SLICK MAIL ORDER SERVICE ● SATISFACTION ●

● SUPER SCOOP ● EMI TAPES ●
● REEL TO REEL AND CASSETTES ●

LOW NOISE

HIGH OUTPUT

● TOP QUALITY HI DYNAMIC EMI TAPE ● GUARANTEED BRAND NEW CURRENT STOCK IN SEALED PLASTIC CONTAINER ●

18cm x 549m (7in x 1800ft) long play	$5.95
18cm x 366m (1200ft) standard play	$3.95
13cm (5in) x 366m double play	$3.95
13cm x 274m (900ft) long play	$3.35
13cm x 183m (600ft) standard play	$2.95
10cm (4in) x 183m double play	$2.50

PACK & POST $1.00

HI DYNAMIC CASSETTES ●

C60 10 for $10.00 C90 x 1000 10 for $17.90

P P NSW $1.50. V Q SA T $2.25. NT WA $2.60

C-CORE TRANSFORMERS

LOW NOISE HI EFFICIENCY
PRIMARY 240V 50Hz

MODEL JT266 0-18V 8A	$22.95
MODEL JT235 26.0-26V4A	$21.95
MODEL JT248, 10V, 10A	$22.95
MODEL JT249 0-15V 8.5-0-8 5V 4A FOR MICRO PROCESSOR	$23.95
MODEL JT274 10V 10A 2 x 12V 1A	$22.95
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P P MODEL 253A NSW $3.50 V Q T $5.50 SA WA NT $7.00
P P ALL OTHER MODELS NSW $2.95 V Q T $3.75 WA SA NT $5.50

AWA 12" SPEAKER SPECIAL

MODEL 12UA 30 WATTS RMS
Freq 35-6000Hz 8-15 OHMS
ONLY $19.50
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GEARED MOTOR

240VAC 50Hz 3W
$2.50
P&P 50c
5 RPM Plenty of torque With Cam and N/O N/C microswitch 15 switch contacts per min OA size 65 x 60 x 35mm

HEAVY DUTY NI-CAD RECHARGABLE BATTERIES

Top quality guaranteed
Used by many Govt Depts
SIZE D 1.2V 4aH
$6.25 ea. *PP 75c*
4 for $23.00 *PP NSW $1.60 Interstate $2.50*

EX-PMG GEAR

Stripped from new and near new current equipment
METAL CABINET 485l x 155w x 120h mm. Very rugged, ideal for power supply, etc. Ventilated. Will mount on 19" rack.
$6.50
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HEAT SINK Double sided fin suit 2N 3055 etc Heavy gauge aluminium 135 x 107 x 60mm
$3.50 *NSW* $1.25 *PP Interstate* $2.40

4 DIGIT COUNTERS
500 ohms 25 x 25 x 95mm
5 for $4.95 *NSW* $1.50 PP Interstate $2.50

KEY SWITCHES 5 for $1.90
PP NSW $1.50 Interstate $2.50

2000 UF 100V ELECTROLYTICS
100 x 65mm 2 for $2.50
PP NSW $1.50 Interstate $2.50

EX-PMG POWER TRANSFORMERS

Excellent quality. 115 x 95 x 90mm approx. Each type has multi-trapped primary 0-200, 210, 2120, 230, 240, 2450V, 50Hz

No 1	0-110V 2 Amp
No 2	55-0 55V 2A
No 3	85-0-85V 2A
No 4	48, 30, 20-0-20, 30 48V 2A

$12.50 ea *PP NSW $2.75 Interstate $4.00*

CAPACITOR FOR C.D.I.

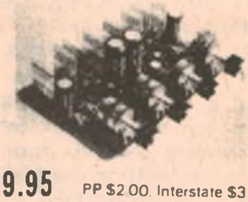
Ducon 1UF 440VAC = 1200V DC
Oil filled paper 65 x 45 x 25mm
$1.75. *PP 65c*

FLOOR MODEL MIC STAND

1.7M Telescopic Pro quality Cast iron base with buffers Std mic thread
$27.95 Fon road, rail, air
Table Mic stand 340mm Adjustable to 200mm Die cast base Very stable
$8.95 PP NSW 90c Interstate $1.50

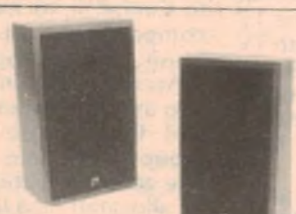
20 WATT STEREO AMPLIFIER

Excellent reproduction ● Replaceable discrete components ● 18 transistors ● Easy to install in record player base or own cabinet ● Power transformer, plug and cable included ● Attractive black aluminium knobs ● 240V 50Hz ● Transformer included ● Circuit ● Specs ● Output 8-16 ohms ● 10 watts RMS per ch ● Distortion 0.5% ● Freq response 35-1800Hz ● Input sen 500MV ● Bass, treble, balance, volume controls ● Size 180 x 125 x 50mm



$29.95 PP $2.00, Interstate $3.50

MAGNETIC CARTRIDGE PRE-AMPLIFIER
RIAA equalization. Low noise LM-382 1-C Operates perfectly with above amp
$11.75 (available only with amp)



RANK ARENA 2-WAY SPEAKER SYSTEM

LESS THAN ½ PRICE

8 OHMS 10 watts teak cabinets 18¼" H 11"W 9½"D
Pack & Post NSW $2.00 VIC QLD $3.50 SA TAS WA NT $5.50

$42.00 PAIR

BSR STEREO CHANGER/PLAYER

THE VERY LATEST MODEL C197 JUST RELEASED

ONLY **$47.50**

PP NSW	$2.75
V. Q. SA	$3.75
T. WA NT	$4.75

With all the wanted facilities ● Auto or manual operation ● Cueing lever ● Bias compensator ● Adjustable stylus pressure ● 33, 45, 78rpm ● Plays 7", 10", 12" records ● Separate changer and player spindles ● Operating instructions ● Template for cut out ● Big 28cm turntable ● Ceramic cartridge ● Diamond stylus ● 240V AC 50HZ

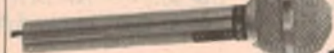
MOTOROLA PIEZO-ELECTRIC SUPERHORN TWEETERS

$11.95
MODEL KSN1005A 4-30KHZ
85mm sq.

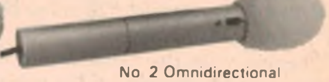
$21.95
MODEL KSN1025A 2K-30KHZ
188x80mm

NO CROSS-OVER NETWORK REQUIRED
75 WATTS/8 ohms. 150 WATTS/4 ohms.
Send SAE for full tech specs. PP NSW $1.00. Interstate $1.50

FM WIRELESS MICROPHONES



No. 1 Unidirectional
$34.75 *PP $1.00*



No. 2 Omnidirectional
$26.75

You can't trip over the mic cable — there isn't any. The signal transmitted by FM microphones is picked up by an FM receiver, operating in the 88 106MHZ sfreq band. Mics can be tuned in this band. Specs FM modulation. Field strength 50 UV/M at 50ft max freq deviation +-75KHZ Electret Condensor Mic 2 transistors 1.5 VDC
Our lightweight, efficient, plastic housed model WM-1 now available.
Only **$10.95**

VERNIER DIALS

8:1 reduction Calibrated 0-110 180 degrees rotation Front panel mounting ¼" shaft

70mm	$2.95	PP NSW	70c
100mm	$3.95	Interstate	$1.25

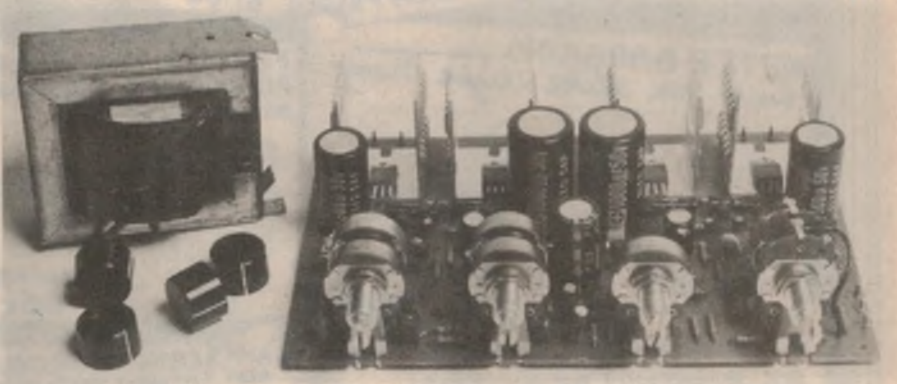
SERVICE

Moderate charges — Repairs guaranteed. Radios, Tape Recorders, Cassettes, Amps.

New Products

This ready-built module can form the heart of a home-assembled music system

An interesting stereo amplifier module is currently available from two of our regular advertisers. Add a power transformer and power cord, appropriate input and output connectors and it is ready to deliver 10 watts or so per channel from a radio tuner, a high output phono cartridge or a tape deck.



We understand that, in the first instance, the modules were brought into Australia for use in locally assembled music systems. Those now available are the several hundred left over from that exercise; presumably, no more will be imported.

Branded "Made in Korea", the modules measure 185mm wide by 123mm deep (not including the shafts) and are about 50mm high. Four potentiometers are mounted directly on the board, from left to right: volume, balance, treble and bass. The controls have splined shafts but should accommodate ordinary quarter-inch knobs.

Connections for power transformer, input, and loudspeakers are clearly marked on the pattern side and are accessable at the top via short pins. Clearly, the intention is that mating clips be used, since any attempt to solder to the pins is likely to dislodge them.

No provision is made for input selection and, if a phono-radio-aux switch is required, it would need to be mounted external to the board.

We understand that the power transformer originally used with the modules was rated at 28-0-28V AC at a nominal 1.3A. Commonly available transformers are likely to be somewhat larger than this, with either a 1.5A or 2A rating. If required, a panel type off-on switch would need to be wired separately in the mains lead to the transformer primary.

The module, with separate transformer, would obviously lend itself to direct installation in a phono player plinth, requiring only the connection of external speakers. Alternatively, the components could be mounted in a hand-made amplifier case, to provide a very economical free-standing unit.

As mentioned earlier, the modules are available from two sources:

The bare module is available from Electronic Agencies of 115-117 Parramatta Rd, Concord, NSW 2137. Phone (02) 747 6472. Their price is $19.90 plus $2.00 pack and post, where appropriate. Electronic Agencies can supply other components as necessary and suggest the Ferguson PF3577 or the Jones JT144 as suitable transformers.

ACE Radio, on the other hand, are offering a package deal including the amplifier module, power transformer, power cord and plug, four splined knobs to suit, and a circuit diagram. All-up price is $29.95 plus $2.00 pack and post to NSW, $3.50 to other states. ACE Radio is at 136 Victoria Rd, Marrickville, NSW 2204. Phone (02) 51 3845.

We understand that, as an extra, ACE Radio are also able to supply a low-noise preamplifier for magnetic cartridges using the LM382 IC. The unit is priced at $11.75 and is available only with the module as above.

As it happened, we did not receive a copy of the circuit (or specifications) and we did not have the time to trace one out. Sufficient to say that there were fourteen small-signal transistors to be seen, plus 4 output transistors on heat sinks and 2 power supply diodes. A number of small tab pots on the board would almost certainly have been for setting up and we assumed that they had been adjusted at the factory.

By way of a quick check on the operation of the unit, we strung together a set of the components, as supplied by ACE Radio, simply fastening them to a scrap of particle board and attaching the few necessary leads. For safety, the mains cord was clamped to the board and attached to the transformer primary with 240V connectors. The mains earth was taken to the transformer frame and thence to the board earth at the same point as the transformer secondary CT.

The unit operated normally from the moment of switch-on, as one would expect of a module, made to slip into a commercial music system. Without worrying too much about the finer points, we ran the instruments over it to gain some idea of its performance.

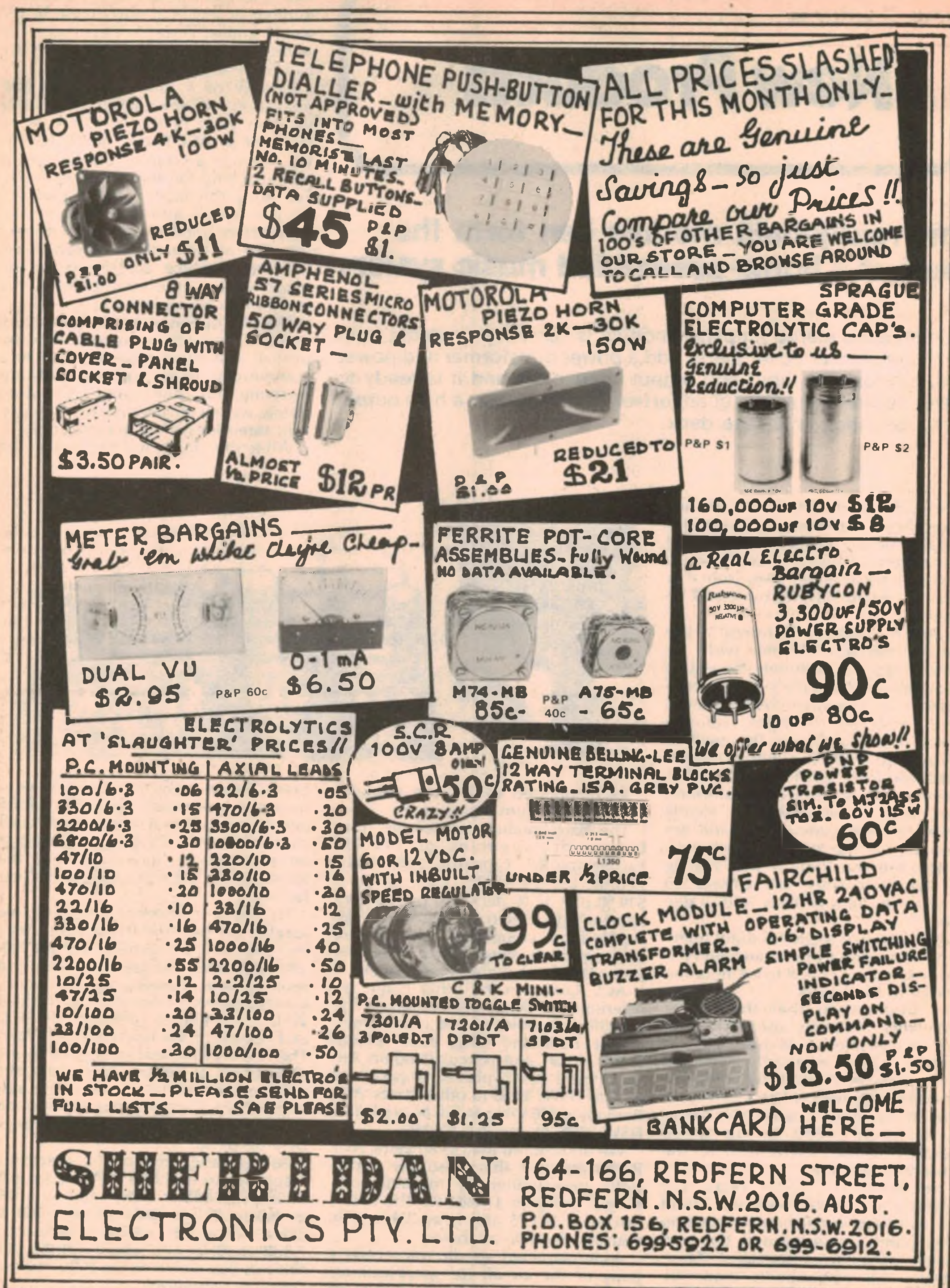
While the output will depend on the exact power transformer used, constructors can expect about 10W RMS per channel into 8 ohms, with both channels driven. Clipping appeared to be symmetrical, indicating that the amplifier had been properly set up, ex-factory.

To check frequency response, we juggled the bass and treble controls so that switching the generator from 100-1000-10,000Hz maintained the output level at 0dB. Running the frequency upward showed a dip of about 0.7dB at 2kHz, returning to reference at 5kHz and remaining on reference to 10kHz. The response thereafter tapered to the -3dB point at about 35kHz with the volume control full on. At other settings of the control, response around 30kHz tended to rise above reference by a dB or so.

At the other end of the spectrum, response was up 1.8dB at 700Hz, up 3dB at 500Hz, 3.4dB at 300Hz, and by 2.8dB at 200Hz. Below 100Hz it was -1dB at 70Hz, -3dB at 50Hz, -4.2dB at 40Hz and -7.5dB at 30Hz. one would assume that this was due mainly to the 500uF output coupling capacitors.

Input for full output was measured at

(Continued on page 129)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RESPONSE 4K-30K 100W
REDUCED ONLY $11
P&P $1.00
TELEPHONE PUSH-BUTTON DIALLER – with MEMORY –
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FITS INTO MOST PHONES –
MEMORISE LAST NO. 10 MINUTES –
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ALL PRICES SLASHED FOR THIS MONTH ONLY –
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Grab 'em whilst they're Cheap –
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NO DATA AVAILABLE.
M74-MB 85c –
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A75-MB – 65c
a Real Electro Bargain –
RUBYCON 3,300uF/50V POWER SUPPLY ELECTRO'S
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10 OF 80c
We offer what we show!!
ELECTROLYTICS AT 'SLAUGHTER' PRICES!!
P.C. MOUNTING | AXIAL LEADS
100/6.3 .06 | 22/6.3 .05
330/6.3 .15 | 470/6.3 .20
2200/6.3 .25 | 3300/6.3 .30
6800/6.3 .30 | 10000/6.3 .50
47/10 .12 | 220/10 .15
100/10 .15 | 330/10 .16
470/10 .20 | 1000/10 .20
22/16 .10 | 33/16 .12
330/16 .16 | 470/16 .25
470/16 .25 | 1000/16 .40
2200/16 .55 | 2200/16 .50
10/25 .12 | 2.2/25 .10
47/25 .14 | 10/25 .12
10/100 .20 | 3.3/100 .24
33/100 .24 | 47/100 .26
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WE HAVE ½ MILLION ELECTRO'S IN STOCK – PLEASE SEND FOR FULL LISTS – SAE PLEASE
S.C.R. 100V 8AMP
50c
CRAZY!!
GENUINE BELLING-LEE 12 WAY TERMINAL BLOCKS RATING – 15A. GREY PVC.
UNDER ½ PRICE 75c
MODEL MOTOR 6 OR 12 VDC. WITH INBUILT SPEED REGULATOR
99c TO CLEAR
PNP POWER TRASISTOR SIM. TO MJ2955 TO3. 60V 115W
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7301/A 3 POLE D.T $2.00
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FAIRCHILD CLOCK MODULE – 12 HR 240VAC COMPLETE WITH OPERATING DATA TRANSFORMER – BUZZER ALARM
0.6" DISPLAY
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PHONES: 699-5922 OR 699-6912.

Car alarm

A & R Electronics Pty Ltd has added a new electronic car alarm to its range of auto accessories. The device, called the CA443, is manufactured at A & R's factory in Box Hill, Victoria.

Heart of the CA443 is a small computer-like module which functions completely automatically once the alarm is set. When the alarm is set, a small red warning lamp on the dashboard flashes to indicate that the system is in operation, and the car's ignition system is de-activated.

Should a thief attempt to enter the car, the alarm triggers the circuit, causing an "ear-splitting" siren to blast continuously for 3 minutes. A 30 second exit delay and a 10 second re-entry delay are built in to allow the driver time to leave and re-enter the car without triggering the alarm.

Two additional circuits are included in the alarm module to protect removeable parts of the car such as wheels, fog lamps, roof racks etc. The special sensors, switches and auxiliary wiring for these circuits are available as optional extras.

For further information contact A & R Electronics Pty Ltd, 30 Lexton Rd, Box Hill, Victoria 3128.

Amplifier . . . from page 127

500mV RMS, and input impedance at about 200k with the volume control at maximum, rising to two or three times this figure with the control at median settings. On these figures, the module would appear to have been designed primarily for use with crystal rather than ceramic cartridges, although we gather that the higher output ceramics do work reasonably well.

Measured at 100Hz, the bass control had a range of +15 to -14dB, while the treble control was measured at +16 to -9dB.

One point we did notice is that the volume control elements are tapped, presumably to provide some form of loudness compensation. What the circuit does do, with square wave input, is to pass the leading transient almost unattenuated, when the volume control is turned down low. On the CRO it looked like the perfect set-up for transient overload — given the right (or wrong?) conditions. We would be tempted to disconnect the lead to each pot tapping permanently; it certainly cleans up the square wave.

However, irrespective of the pattern on the CRO, the amplifier certainly did not misbehave audibly, judged in the context of a budget priced amplifier, operating into modestly priced loudspeakers. In fact, it provided a very high level of sound with no obvious signs of distress.

Oh yes: hum level? One could hear a small amount of hum with the ear close to the speakers but it was not apparent at normal listening distance. How it would be with a magnetic cartridge and ACE Radio's magnetic amplifier in circuit we have no way of knowing; the unit is an extra, not supplied in the normal $29.95 package. (W.N.W.)

The lady with the (arc) lamp . . . from p19

with chlorine and phosgene began. The authorities were not prepared for the new weapon, the gas masks took time to manufacture. Mrs Ayrton designed a fan which could be used to deflect the heavy poison gases upward and away from the troops in the trenches. After a struggle with the massed forces of obstruction represented by the War Office, her idea was accepted, and 104,000 Ayrton anti-gas fans were made; they saved many lives.

After the war her skills were needed in a very different context. The moving-picture theatres needed arc lamps for their projectors, lamps that would not fail or scatter white-hot particles. With this and other electrical work she was kept fully occupied until her death in 1923.

With the encouragement of her husband, and later the support of her two daughters, both of whom became writers, she was throughout her life a strong advocate of women's rights, not just for women with the power and intelligence to make their way in a man's world, but all of the so-called weaker sex.

Her suffragette activities, although they did not include extreme or violent measures, may have had something to do with her failure to be elected to the Royal Society, an honour which she undoubtedly deserved. Nevertheless, in spite of her formidable intellect and will, she was no hard-faced Amazon — she was remembered by all who worked with her for her unfailing gentleness and courtesy.

SPECIAL PURCHASES

GARRARD

Model 60B

RECORD CHANGER AT LESS THAN
½ LIST PRICE — $37.50
(RECOMMENDED RETAIL PRICE $95.00)
SUPPLIED WITH E.E.I. HI-FIDELITY MAGNETIC CARTRIDGE & DIAMOND STYLUS.
SERIES E 400

Also available with ceramic cartridge
All changers new in original cartons

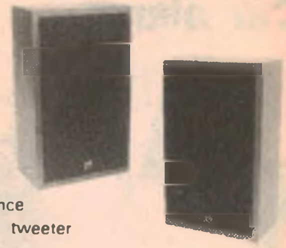
A precision automatic and manual record-playing unit fitted with Garrard 4 pole motor to provide constant speed conditions for the 10½ inch aluminium turntable. The low resonance tubular pickup arm is counter-balanced with a resiliently mounted weight to permit light sensitive tracking, and the slide-in cartridge carrier enables styles inspection and the interchange of replacement of cartridges to be carried out simply and quickly. Fine stylus force adjustment and bias compensation are both calibrated for accurately setting the arm to given optimum playing conditions for the chosen cartridge.

The fluid-damped level-type cue and pause control ensures gentle lowering of the pickup to the surface of the record. A short spindle is supplied for single record play records. Precision engineering is reflected in the styling of the 60B, which is elegantly finished in black and silver.

POST AND PACKING EXTRA
NSW $3.75 — Vic., SA & Qld. $5.75
Tas., WA & NT $7.00 — (Reg. post $2.00 extra)

BASE & PERSPEX COVER FOR GARRARD OR B.S.R. UNITS $35.00 EXTRA PLUS FREIGHT

RANK-ARENA 2 WAY SPEAKER



- 10 Watts RMS
- 8 ohm impedance
- 8" woofer with tweeter
- Supplied with lead and plug
- Teak finish

$42.00 PER PAIR

Dimensions 18"H, 11"W, 9½"D
Freight extra per rail, air or road transport

SPEAKER GRILLE FABRIC AT ½ PRICE

AVAILABLE IN BLACK, BLACK WITH GOLD FLECK, LIGHT & MID BROWNS. WIDTH 60in.

$4.80 Per YARD, post & pack. $1.00
Send two 20c stamps for samples.

NEW RANK-ARENA F.M.-A.M. TUNER AMPLIFIER

MODEL RA402. Output 24 watts RMS (12+12). Response 50HZ to 50KHZ. Mag or ceramic inputs. High & low filters. Loudness control. Provision for 4 speakers.

Freight Extra
$147.00

NEW E.M.I. RECORDING TAPE AT A FRACTION OF LIST PRICE

HI-DYNAMIC EMITAPE — HIGH OUTPUT — LOW NOISE — HI-FIDELITY
HLP18 7" reel 1800ft. long play $5.95
HDP12 5" reel 1200ft. double play $3.95 — $1.00
HI-DYNAMIC EMITAPE CASSETTE C60 TEN FOR $10.00
Post & pack $1.50

NEW AWA HI-FI SPEAKER KITS 8" 2 WAY 3 SPEAKERSYSTEMS

AT LESS THAN ½ LIST PRICE
POWER RATING 20 WATTS R.M.S.
IMPEDANCE 8 OHMS
FREQUENCY RANGE 46 TO 18000 CYCLES

Supplied in kit form (less cabinet) each kit comprises One AWA 8WAC 8in. bass unit, two AWA 4MBC 4in. tweeters with ceramic magnets & curve-linear cones, crossover components, grille cloth, innabond lining and cabinet plans.

CABINETS AVAILABLE
Post & packing extra. NSW $2.50. Interstate $3.50

$18.50 Per Kit

NEW GOODMAN-FOSTER 3-WAY 4-SPEAKER HI-FI SYSTEM

$39.00 PER KIT

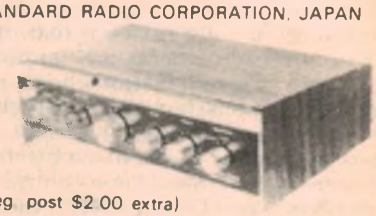
Frequency Range 45 to 22,000 cycles. Power rating 25 watts RMS Imp-8ohms. Supplied in kit form (less cabinet) each kit comprises two English Goodman 8" bass units. Foster 5" mid range. Foster 1" dome tweeter crossover components Ocodensers and inductance innabond, speaker fabric and plans of cabinet. Cabinet dimensions 23" x 13" x 10". CABINETS AVAILABLE.

Post & packing extra: NSW $2.70; VIC. SA, QLD. $4.70; WA $5.70 (REGISTERED POST $2.00 EXTRA IF REQUIRED) cabinets available.

NEW STANDARD 10 WATT STEREO AMPLIFIER

MANUFACTURED BY STANDARD RADIO CORPORATION, JAPAN
PM-158W

$57.00



NSW $3.50
VIC., QLD., SA $5.00
WA, TAS. $6.50
(Reg. post $2.00 extra)

Continuous power 5 watts R.M.S. per channel at 8ohms (10 watts) at 1KHz
Harmonic distortion at 1KHz 0.5%
Power bandwidth 20-20,000Hz at 8ohms
Frequency response 20 to 30,000Hz
Signal to noise ratio Aux. 70db Mag. 60db
Bass control ±10db at 100Hz Treble control ±10db at 10,000Hz
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- HEADPHONE JACK
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Dimensions 13½" by 8" by 4" high SUPPLIED IN WALNUT FINISHED CABINET WITH OPERATION INSTRUCTIONS & SCHEMATIC DIAGRAM

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Complete kit of parts (less cabinet) comprising Magnavox 10-40 10" base unit. 625 mid range 6" two XJ3 dome tweeters, crossover network, innabond, speaker sils and plans of cabinet. Also 6½" and 4½" tubes.

$87.00 PER KIT

Freight extra per rail or air freight
Cabinet available.
830 System also available.

NEW STANDARD B.S.R. C129 RECORD CHANGERS

$27.50 — LESS THAN ½ LIST PRICE

Fully automatic turntable plays up to six records automatically and single records automatically or manually as required. 11" turntable. Bias compensation. Cue & pause control. Record speeds 331/3, 45 and 78 rev./min. Finished in black with silver trim. Player and changer spindles supplied. Fitted with ceramic cartridge. Post & packaging extra. NSW $2.70. Vic., Qld., SA $3.70. WA $4.70 (registered post $2 extra if required).

Spare cartridge and stylus for above supplied free (list price $10.00).

SPECIAL PACKAGE OFFER

Standard 10 watt amplifier, two A.W.A. 2 way 3 speaker systems as adv. above and Garrard CC10A record changer with ceramic cart. $100.00
Freight extra

CLASSIC RADIO

245 PARRAMATTA RD, HABERFIELD 2045. PHONES 798-7145, 798-6507.

Books & Literature

Basic BASIC

BASIC PRIMER, by Mitchell Waite and Michael Pardee. Howard W. Sams Inc., Indianapolis, 1978. Soft covers, 137 x 216mm, 240pp, many illustrations. Price $12.70.

Another introductory book on the computer programming language Basic, written for those coming into contact with computers for the first time. It deals specifically with Microsoft Basic, as used in most personal computers, but stresses that this is very similar to the dialects used on most other systems. The authors are both experienced computer people and technical writers.

The book follows a fairly standardised course, starting with elementary concepts and progressing through program control to more advanced concepts like arrays, data storage, functions and so on. It also provides a string of data appendices on things like number systems, Basic history, Basic dialects, ASCII code, space and time saving techniques and so on. There is also a tear-out reference card of Basic statements, although the printing on this is so small that most readers will need a magnifying glass to use it.

The text itself is well written, and clearly illustrated by examples. There are also little cartoon drawings, to provide relief. As a result it should be found both readable and helpful, even by those who at present have no concept of computer operation.

In short, a good introduction to Basic for the beginner, although considering its modest size it doesn't seem particularly good value for money at the quoted price.

The review copy came from McGills Newsagency Pty Ltd, 187-193 Elizabeth St, Melbourne 3000. (J.R.)

CMOS circuits

SECOND BOOK OF CMOS IC PROJECTS, by R.A. Penfold. Bernard Babani (Publishing) Ltd, London, 1979. Soft covers, 108 x 181mm, 122pp, many circuits and diagrams. Price in Australia (SRP) $4.30.

In the notes on the rear cover of this book, the publisher explains that it is basically a response to the very warm reader reaction to the author's book "50 CMOS IC Projects", published in 1977. The earlier book was apparently so successful that both publisher and author decided that a second volume was indicated, and here it is.

Basically the aim has been to provide a further selection of interesting and useful circuits of a fairly simple nature, so that they will be of value to both beginners and more advanced enthusiasts. Broadly speaking I think this has been achieved quite well.

The new book is divided into four chapters, titled 1—Introduction to CMOS Devices; 2—Multivibrator Projects; 3—Amplifier, Trigger and Gate Projects; and 4—Special Devices.

The projects are given in fairly brief form, mainly in the form of a circuit schematic with notes. However as most are very simple and involve few parts, this seems quite reasonable. The text is brief, but concise and readable.

In short, it seems a worthwhile little book and one which should be of considerable interest to the experimenter.

Two review copies were received, one from the publisher direct and the other from Technical Book and Magazine Co Pty Ltd, 289-299 Swanston Street, Melbourne 3000. (J.R.)

Hobby projects

ELECTRONIC PROJECTS IN HOBBIES, by F.G. Rayer. Newnes-Butterworth, London, 1979. Soft covers, 134 x 216mm, 88pp, many pictures and diagrams. Price in Australia (SRP) $6.00.

A further volume in the current Butterworth "Constructors Projects" series, from which two other volumes have been reviewed in recent months. This one deals with projects which have appeal or application in hobby areas such as model railways, photography and treasure hunting.

There are 13 projects described in all, including a model train controller, a metronome, an enlarging exposure meter, a greenhouse low temperature alarm, a metal locator and a home intercom.

All projects are described in a fair amount of detail, with a brief rundown of circuit operation as well as a description of the construction and adjustment. As a result the book should be found of much greater value than the type which merely provides a bunch of assorted circuits.

The text is brief but concise, and is quite readable. It is also well served by photographs and diagrams.

The review copy came from the local office of the publishers. (J.R.)

INFORMATION CENTRE

TRANSVERTER: Having built the 27/3.5MHz Transverter as described in April 1976, I have one small problem with it. Could the crystal specified as 23570kHz be changed to 23565kHz or 23575kHz, so that I may receive the WIA broadcasts on 3570kHz? (C.P., Maryborough, Qld.)

● First of all, there is no technical reason why you should not change the crystal by 5kHz either way as suggested. It may be necessary to adjust L5 slightly when making any such change. Having done our sums and we find that with the 23565kHz crystal, plus the wanted frequency of 3570kHz, we get 27.135MHz, or channel 11.

On the other hand, when we add 23575kHz and 3570kHz together, we get 27145MHz and this falls midway between channel 11, and channel 12 which is on 27.155MHz. Perhaps you have overlooked the point that there is a gap of 20kHz between channels 11 and 12. However, we imagine that the point has been made and that you can take it from here.

MODEL TRAIN CONTROLLER: The subject of this letter is the High Performance Model Train Controller of October 1978 (File No. 2/MC/16). A very effective project which is giving the boys (and Dad) great fun.

I offer the following comments for what they are worth, as other readers may find them of interest.

1. R15 is reduced to 470 ohms to ensure reliable relay operation.

2. Braking is ineffective if the throttle is not at or near zero. I have disconnected the D3 cathode from the R7 wiper and moved it to the earthy end of R7 (R7/R8 junction).

3. I have made some changes to the R6, R7, R8 divider to eliminate a dead area in the low throttle positions. However, I will omit details of the revised values; as these are best determined by experiment to suit individual controllers and the types of locos. These have also decreased the time needed for the inertia capacitor to charge to the minimum running speed.

4. I have not included the noise circuitry, as I think more realism is required, eg, a greater volume of air for the emergency brake and a diminishing air flow when the brake is released.

5. Position 1 of S1 was deleted, so the brake positions are now; "off", "Lap/hold", "service", and "emergency". This was done by transferring the D7 anode to S1a position 2, instead of position 1.

In addition, R11 has been connected to the N/O relay contact and the common contact connected to S1b position 2. The N/C contact has been connected via a 22k resistor to S1b position 4, and S1b positions 2 and 3 linked together.

This gives normal throttle operation with the brake at "lap" or "off". The relay releases when the brakes are applied and the braking action continues when the brake is returned to the "lap" position, but to a lesser degree than in the "service" position. The throttle becomes operative as soon as the brake is moved to the "off" position.

6. A "kick-in-the-pants" button would still seem to be desirable for some locomotives and track conditions, but I haven't researched this idea yet. (G.L., Hornsby Heights, N.S.W.)

● Thank you for your comments and suggestions G.L., and we have presented these for the benefit of other readers who may like to try them. Our only comments concern item (1) and (4).

Re item (1). You are correct in assuming that the 820 ohm resistor specified was a mistake. The original text specified 180 ohms, which would be closer to an ideal value than the 470 ohms you suggest, although this value obviously works.

Re item (4). A sound effects generator having the characteristics you suggest was described in the March 1979 issue, by the same author. (File No. 2/MS/55).

PLAYMASTER 128: I have just built the Playmaster 128 stereo power amplifier which was described in January 1970 (File No. 1/SA/32). I found that, at switch-on, voltage at the base of T6 takes approximately 10 seconds to reach full value (about 25V) due to the long charge time of the dynamic filter.

If the volume control (of the preamplifier) is varied during this time, a low frequency rumble can be heard at the output, according to the rate at which the pot is moved.

I feel this contributed to the premature failure of the volume pot which became noisy. Could the charge time be reduced, ie, reduce the values of the high input impedance divider or the 10uF filter capacitor?

Secondly, in the article, no mention was made of the 2.2 ohm resistor in the earth rail of the power amplifier. Short circuit or open-circuit of the resistor leads to an extremely unstable amplifier. Should this be so? My power supply is unregulated, with 10,500uF in the filter bank. (R.G., Parafield Gardens, SA).

● It is true that the dynamic filter at the input of the amplifier has a rather long time-constant but this should not present problems. Why twiddle the volume control before the amplifier has had time to settle down? You could reduce the time constant but this may prejudice the performance of the amplifier. The 2.2 ohm resistor is to prevent circulating currents around the two amplifiers. As you have found, shorting or open-circuiting this resistor makes the amplifier unstable.

GRAPHIC EQUALISER: I recently purchased a kit for the Graphic Equaliser (May 1979, File No 1/SC/9) from Dick Smith Electronics. Unfor-

If you are unable to complete an "Electronics Australia" project because you missed out on your regular issue, we can usually provide emergency assistance on the following basis:

PHOTOSTAT COPIES: $2 per project, or $2 per part where a project spreads over multiple issues. Requests can be handled more speedily if projects are positively identified, and if not accompanied by technical queries.

METALWORK DYELINES: Available for most projects at $2 each, showing dimensions, holes, cutouts, etc., but no wiring details.

PRINTED BOARD PATTERNS: Dyeline transparencies, actual size but of limited contrast: $2. Specify positive or negative. We do not sell PC boards.

PROJECT QUERIES: Members of our technical staff are NOT available to discuss individual projects, either in person at our office or by telephone.

REPLIES BY POST: Limited to advice concerning projects published within the past two years. Charge $2. We cannot provide lengthy answers, undertake special research or discuss design changes.

BACK NUMBERS: Available only until our stocks are exhausted. Within three months of publication, face value. Four months and older, if available, $2. Post and packing 60c per issue extra.

OTHER QUERIES: Technical queries outside the scope of "Replies by Post" may be submitted without fee, for reply in the magazine, at the discretion of the Editor.

COMMERCIAL, SURPLUS EQUIPMENT: No information can be supplied.

COMPONENTS: We do not deal in electronic components. Prices, specifications, etc., should be sought from advertisers or agents.

REMITTANCES: Must be negotiable in Australia and made payable to "Electronics Australia". Where the exact charge may be in doubt, we recommend submitting an open cheque endorsed with a suitable limitation.

ADDRESS: All requests to the Assistant Editor, "Electronics Australia", Box 163, Beaconsfield, 2014.

tunately, upon construction, all was not as it should have been. All the controls worked as they should but with all controls set to maximum cut, radio 2CH drowns out the signal from the tape deck. By moving any pot to maximum gain, the RF interference can be almost removed. Please assist. (P.M., West Pennant Hills, NSW.)

We have not experienced any problems with RF interference although we must admit that we did not try the system with all controls set to minimum as you have. We also note that you live in an area where the signal from radio 2CH is particularly strong. In a few months time this will change as the transmitter is about to be moved to the Homebush Bay area. A possible remedy for the RF problem is to connect an RF bypass capacitor (say .001uF) between the common shield connection of the output sockets and chassis.

POWER RELAY . . . from p44

value. Note that each board will need its own 1.2k series resistor.

The leads connecting the power supply to the opto-coupler LED are brought to the outside of the box and terminated in a small terminal block. This lets you run low-voltage wiring to the control switch, wherever that may be located. In most cases it would be a good idea to connect one of the control wires to earth, for added safety. It doesn't matter which one.

The mains output from the relay unit is made available at a normal 3-pin mains socket mounted on the end of the case. The mains input cable enters at the other end of the case via a grommeted hole. Don't forget to clamp the cable securely upon entry, and terminate the active and neutral wires in a small connector block. The earth wire should be soldered to a lug which is bolted to the inside of the metal case; similarly the earth wire for the output socket should be connected to the same lug.

As suggested earlier, one or more relay modules can also be used to provide mains power interfacing for a microcomputer. Here the control power supply may be dispensed with, the opto-coupler inputs being fed from the computer output port lines via suitable series resistors and buffers if necessary. Work on the basis of 5mA control current being required for each opto-coupler LED.

NOTES & ERRATA

6 DIGIT CLOCK (March 1979, File No 7/CL/29): The lead diagram for the LT303 display on page 41 shows anodes F and G transposed. Similarly, the F and G leads to the readout board on page 43 are shown transposed and should be swapped. There is also a discrepancy between the circuit and main PCB in that the 33pF and 40pF trimmer capacitors are connected to the 12V line rathern than 0V. This does not affect the operation.

PLAYMASTER DIGITAL FM/AM TUNER (November, December 1978, January 1979, 2/TU/46, 7, 8): A change to the tuner modules imported by Dick Smith Electronics now requires a change to mode switch, S1b. The switch wiring should be changed so that the wires from P16 and P17 are shorted together only when switched to the MPX mode.

2708 EPROM PROGRAMMER (February 1979, 2/CC/36): The Q output of monostable 1 is used to drive the OPACK-bar line of the 2650 chip. This line must be isolated from the earth of the 2650 system by cutting the copper pattern of the PCB. This will require a wire bridge to maintain the earth connection to other parts of the circuit.

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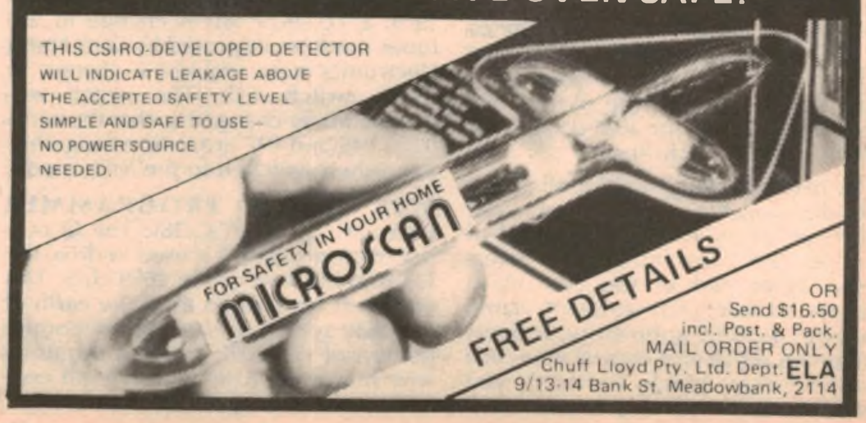

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8 ohm. 10W. 25c
4000 ohm. 10W. 25c
1000 ohm. 5W. 20c
330 ohm. 10W. 25c
220 ohm. 5W. 20c
5 ohm. 5W. 20c
220 ohm. 10W. 25c
950 ohm. 3W. 20c
115 ohm. 5W. 20c
10 ohm. 5W. 20c
1k ohm. 5W. 20c
5000 ohm. 5W. 20c
6.8k ohm. 3W. 20c
330 ohm. 10W. 25c
6800 ohm. 10W. 25c
1500 ohm DUAL 21W. 50c
50 ohm. 5W. 20c
330 ohm. 5W. 20c
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