# ELECTRONICS AUSTRALIA

APRIL, 1982 AUST $1.90*
NZ $2.10


144 PAGE DICK SMITH CATALOG

FUNCTION GENERATOR WITH DIGITAL READOUT

BUILD A VOICE OPERATED RELAY

PHOTOGRAPHIC TIMER FOR DARKROOMS

FULL-SIZE KEYBOARD FOR THE ZX-81

VOCAL CANCELLER: LETS YOU BE THE STAR

REVIEW: MITSUBISHI LT-5V TURNTABLE


Enter the state of higher fidelity with the new Walkman 2 stereo player, the world's smallest Hi-Fi. It's a sensational way to listen to music on cassettes and raise your awareness of sound. Walkman is so light it practically feels weightless. So small it's hardly bigger than the plastic case that cassettes come in. And so personal, with headphones that weigh next to nothing, that HiFi has never been more intimate.
The new Sony Walkman. It can make your experience of sound infinitely wondrous.

The World's Smallest HiFi
WALKMAN

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# ELECTRONICS AUSTRALIA

Volume 44, No. 4
April, 1982

## AUSTRALIA'S LARGEST SELLING ELECTRONICS MAGAZINE


This new Function Generator produces sine, triangle and square waves, covers the frequency range from 20Hz to 160kHz, and features a 4-digit readout for accuracy of frequency setting. Construction begins on page 36.


Want an enlarger timer that's easy to build? Phototimer has 12 settings from two to 90 seconds and can handle enlargers rated up to 300W. Details page 52.

COMING NEXT MONTH! – Find out what's coming by turning to page 116.

## On the cover

*"I built one just like it in 1952", says Dick Smith to daughters Hayley (right) and Jenny. That humble crystal set – Dick's first project – was described in the September 1952 edition of "Radio and Hobbies" by staff member Maurice Findlay. On p68, we tell you how to build a crystal set just like that 1952 version, and meet an eight-year-old Dick Smith in his lizard pit and Maurice Findlay 30 years on.*

## FEATURES

**THE ENGINEER'S DILEMMA** *Quantity of goods or quality of life?* ... 8
**THE STORY OF UNDERSEA CABLES** *Messages under the sea* ... 12
**AUSTRALIA'S RADIO PIONEERS PT 4** *The 1920s to WWII* ... 18
**50 AND 25 YEARS AGO** *Items from past issues* ... 89

## HIFI, VIDEO AND REVIEWS

**LAS VEGAS ELECTRONICS SHOW** *A glimpse of the future* ... 26
**HIFI REVIEW** *Mitsubishi LT-5V turntable* ... 34

## PROJECTS AND CIRCUITS

**FUNCTION GENERATOR WITH DIGITAL READOUT** *20Hz to 160kHz* ... 36
**VOICE-OPERATED RELAY** *Controls tape recorders, slide projectors* ... 46
**PHOTOGRAPHIC ENLARGER TIMER** *12 settings from 2-90 seconds* ... 52
**VOCAL CANCELLER** *Cancels out the lead vocal* ... 64
**REDISCOVER THE CRYSTAL SET** *It works during blackouts!* ... 68
**XR-2243 TIMER IC** *For extra-long time delays* ... 72

## PERSONAL COMPUTERS

**A FULLSIZE KEYBOARD FOR THE ZX-81** *New keyboard kit* ... 74
**HOW TO PROGRAM IN MACHINE LANGUAGE** *Pt 2: extended addressing* ... 76
**MICROCOMPUTER NEWS & PRODUCTS** *SAA moves on RF interference* ... 106
**COLUMN 80** *Attitudes to programs and programming* ... 113

## AMATEUR RADIO, CB SCENE, DX

**AMATEUR RADIO** *The Antarctic expedition* ... 82
**SHORTWAVE SCENE** *Alaska site of planned gospel station* ... 86
**CB SCENE** *23-channel transceivers acceptable again* ... 88
**THE OFFICIAL LINE** *Monitoring satellite transmissions* ... 96

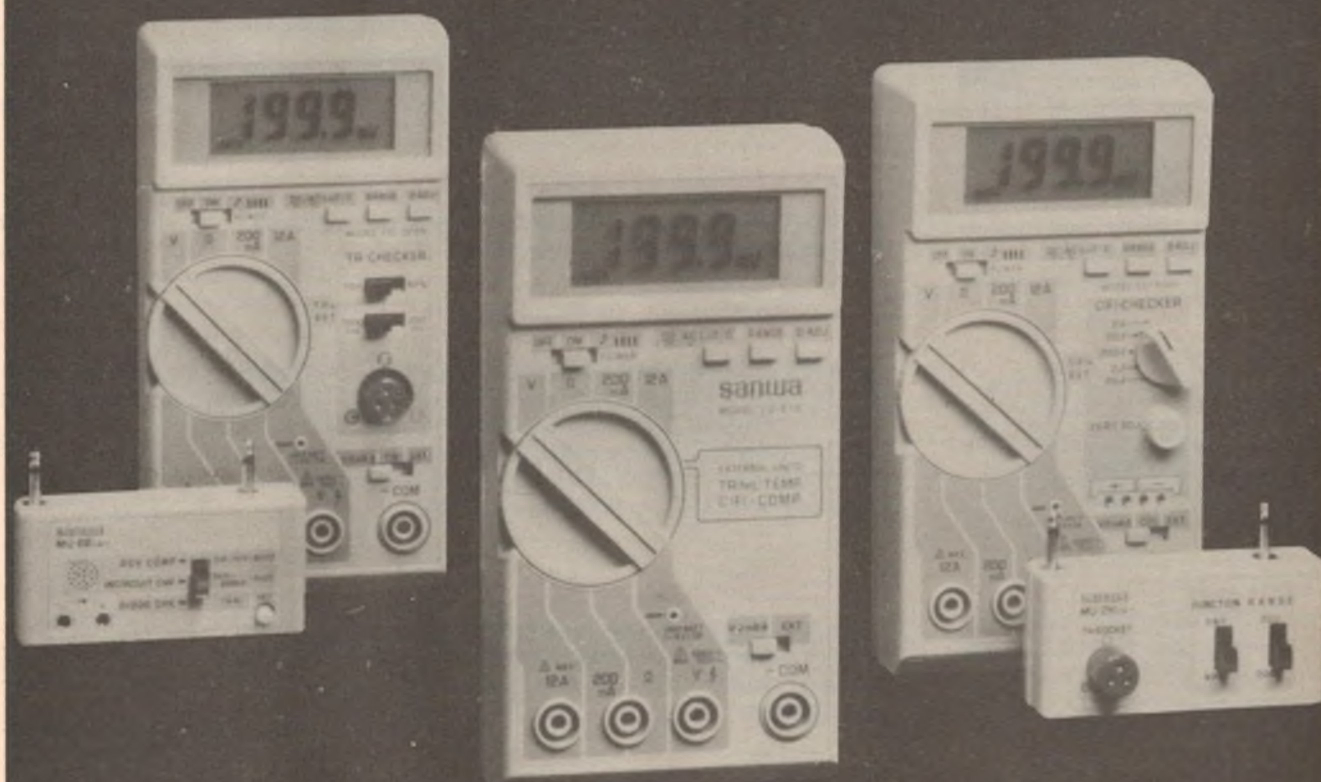
## COLUMNS

**FORUM** *A tangle in tape compensation* ... 22
**THE SERVICEMAN** *It never pays to be over confident* ... 58
**RECORD REVIEWS** *Classical, popular, special interest* ... 100

## DEPARTMENTS

**EDITORIAL 3 — NEWS HIGHLIGHTS 4 — CIRCUIT AND DESIGN IDEAS 61 — NEW PRODUCTS 92 — BOOKS AND LITERATURE 98 — INFORMATION CENTRE 114 — READER SERVICES 117 — MARKETPLACE 118 — NOTES AND ERRATA 117**

# Sanwa's new versatile auto-ranging family!




**LD-520H**

In addition to the functions of the LD-510, the LD-520H also has built-in hFE ranges of 200 and 2000. Measuring ranges are the same as the LD-510. Accuracies: DCV: ±(0.5%rdg + 0.2%fs) ACV: ±(0.8%rdg + 0.25%fs) Ω: ±(0.5%rdg + 0.2%fs) LO•Ω: ±(0.8%rdg + 0.5%fs) DCmA: ±(0.9%rdg + 0.2%fs) ACmA: ±(1.2%rdg + 0.25%fs).

**LD-510**

Automatic range selection for DCV, ACV and OHM. Manual selection and range holding devices provided. In addition to the basic measuring ranges, optional adaptor units add the functions of hFE, capacity, temperature and circuit check. Supplied with safety test leads which have vanishing pins and protected test tip.

DCV: 200m, 2, 20, 200, 1000. ACV: 2, 20, 200, 750. Ω: 200, 2k, 20k, 200k, 2000k. LO•Ω: 2k, 20k, 200k, 2000k. DCA: 200m, 12. ACA: 200m, 12. Indication: 3.5 digits, max 1999, LCD, first figure "1" flashes when an overload occurs with the piezo electric buzzer sounding simultaneously. Automatic polarity selector provided. Cells: 1.5V (UM-3 or R6) x 2. Dimensions & weight: 168 x 90 x 46.5mm & 400g.

**LD-530F**

The LD-530F also has built-in capacitance ranges of 2n, 20n, 200n 2μ, 20μF. Measuring ranges and accuracies are the same as the LD-520H except the hFE ranges. Other specifications are the same as the LD-510/LD-520H.

Optional adaptor units: MU-1F (capacity), MU-2H (hFE value), MU-3T (temperature), MU-6B (circuit check).

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# Editorial Viewpoint



## Appliance power ratings are unimporant . . .

As we head into winter and the power generation problems of the eastern States become more acute, more people are thinking of ways to save power. There are two cogent reasons for this: people are interested in saving money and also in minimising the inconvenience caused by possible power restrictions.

But as we think about this subject, it seems that there are a number of long-lived misconceptions about power and energy consumption. The first example of this is the recent media campaign to make the public aware of the power ratings of appliances when they are being purchased, with an eye to saving on electricity bills. This is misleading and will not necessarily result in any worthwhile savings.

The second example concerns a spokesman for the neon lighting industry who was reported as complaining that whenever there were power restrictions, neon lighting was the first thing to be banned. He apparently went on to state that the power consumed by neon signs was only a drop in the bucket when compared to the total used by commerce. This is probably true but his case was supported by likening the power used by a typical neon sign to the power used by a typical domestic jug.

When we are talking about any electrical appliance, the *power* rating on the nameplate is the maximum rate at which it can consume or use electrical *energy* but it is not necessarily an indication of the total energy consumption over a period of time. This can be illustrated by the electric jug which was cited in the case above.

In reality, a heating appliance such as an electric jug does require a lot of power, typically around 1800 watts. But it does not consume a lot of energy to boil a given amount of water for a cup of tea. And over a three-month period, an electric jug would only account for a small fraction of the total energy consumption of a typical household, or, for that matter, a commercial neon sign.

An even more graphic illustration of this difference between power required and energy consumed is the case of a domestic microwave oven. This may require one kilowatt to run, which is quite a lot. But the amount of energy it uses to cook your meat pie is negligible, because it is only on for a few minutes each time it is used.

The same thinking can be applied to the purchase and use of just about any domestic appliance. Whether you are ironing a shirt, making toast or cooking eggs in an electric frypan, the amount of energy consumed depends as much on the length of time for the task as upon maximum power rating of the appliance.

So when you are buying any small domestic appliance, do not worry too much about the power rating. Buy the one you want and then use it conservatively and you will not waste energy.

***Leo Simpson***


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# News Highlights

## Interscan ready for commercial trials

The first commercial prototype of the advanced microwave landing system Interscan, began demonstration trials recently at the Richard Gebaur Air Force Base in Kansas City, USA.

Interscan consists of equipment for measuring the angle of the aircraft from the centre line of the runway, its elevation and its distance from the beginning of the runway. Incoming aircraft are scanned by narrow fan-shaped beams of microwaves from two antennas near the runway. A receiver inside the plane measures the time between pulses of the microwaves, and an on-board computer calculates the position of the plane from this information, up to 40 times a second.

The principle is known as time-reference-scanning-beam (TRSB) and is the basis of Interscan. Up and down scanning produces pulses in the receiver that give information on the plane's elevation, while side-to-side sweeps give azimuth angles.

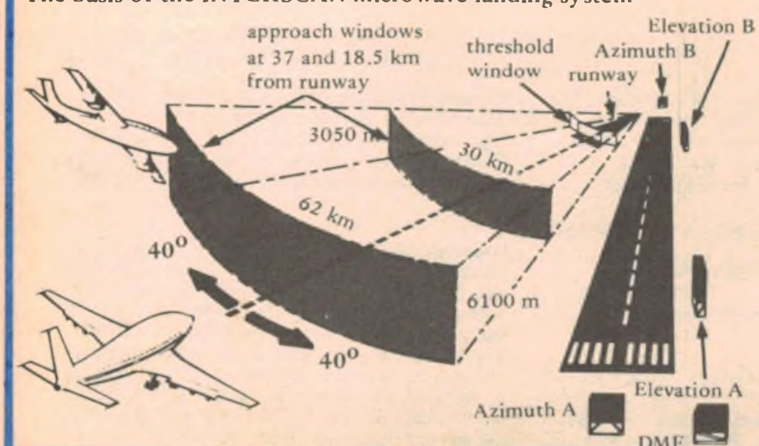
Unlike conventional landing systems which guide aircraft along a straight approach path, Interscan allows curved approaches to the runway. It enables the plane to fly on any one of a number of approach paths which can be chosen to suit the requirements of particular airports or aircraft types. In addition, Interscan is not affected by rough terrain near the airport, and will allow more aircraft to be handled in a given time. It is also much less affected by poor weather conditions.

Interscan Australia produced the prototype, with initial development work carried out by the CSIRO. The company has now teamed up with the US company Wilcox Electric Inc to market the system internationally. Wilcox is the world's largest supplier of aircraft landing aids, and has designed the electronics needed for Interscan in the United States. In Australia, AWA developed the microwave electronics and Hawker de Havilland Australia Pty Ltd designed the mechanical parts.

A race to capture a major share of the world market for the system is now on. According to Interscan Australia's managing director, Mr John Drennan, Australian-US partnership is already in the forefront of the competition, being the first to develop and place in the field a complete Interscan landing system. Later this year the partnership plans to bid for a $50 million US Federal Aviation Authority (FAA) contract to supply 100 microwave landing systems for large American airports.

*An Australian-made elevation antenna, under test in the US.*

**The basis of the INTERSCAN microwave landing system**




**The sub-system functions**

| | |
|---|---|
| Azimuth A | Approach guidance in the horizontal plane. |
| Azimuth B | Missed approach guidance. |
| Elevation A | Approach guidance in the vertical plane. |
| Elevation B | Missed approach guidance. |
| DME | Distance information throughout the coverage volume. |

## Public access television

A new form of television went over the air in Sydney and Melbourne in February.

Australia's first "public television" transmissions, made possible by the assistance of the Special Broadcasting Service, were previewed in the two cities using the facilities of Channel 0/28.

In October 1980, the Federal Government pledged to introduce public television to supplement and complement established "mainstream" TV. Open Channel, an independent television company, wants to present television programs which reflect and respond to community needs, and which are open to anyone who has something to say of value to the community.

## Chinese technology

Semiconductor technology in the People's Republic of China is roughly equivalent to that of the United States in 1972, according to recent reports by US consultants who have toured China. In some areas, the Chinese developments are equivalent to US levels of 1976.

Mel H. Eklund, vice president of Integrated Circuit Engineering Corporation of Arizona, says "What is most incredible is that China has bootstrapped itself into its present position with Chinese-built equipment and Western technology".

The 1972-level estimate of Chinese semiconductor development is particularly significant. It was in 1972 that Intel Corporation began sales of the 8008, the first general purpose microprocessor to be widely used.

## Unleashing the giants: Anti-trust cases against IBM, AT&T withdrawn

The ripples are still spreading from the December decisions of the United States Justice Department to drop the 13-year-old anti-trust case against IBM, and to allow American Telephone and Telegraph Co to compete in the commercial marketplace. US observers are predicting much stronger competition in the two areas both companies excel in: computers and communications,

Until the settlement of the case against AT&T, the giant telephone company was restricted to providing communication services only, as a common carrier, and forbidden to enter the booming market for terminals and communications equipment. Under the agreement with the Federal Communications Commission, AT&T is to divest itself of 22 local operating companies, which will provide local communication services.

The core of AT&T will provide long distance communications services, but will also be free to sell communications and computer equipment. With one of the largest research centres in the world, Bell Laboratories, the new company will be a fierce competitor in the marketplace.

listing on the London stock exchange, becoming in effect a multi-national, and is likely to aggressively sell its products overseas. There are even rumours of a personal computer from the revitalised company.

Freed of the uncertainties caused by the anti-trust suit, IBM seems certain to push into communications. The new freedom for the company is also likely to mean stiffer competition for other computer manufacturers, which over the years have been steadily eating into IBM's share of the market.

Reports from the United States concentrate on the new competitiveness which the decisions are likely to spark off, and warding off the challenge of the Japanese. Said Michael Killen, president of market research firm Strategies Inc: "this decision will enable IBM to keep the Japanese with their fifth-generation computer program from doing to the computer and communications industry what they have done to the automobile industry".

Certainly the Japanese have not troubled to hide their moves to establish a 10 year research and development plan dedicated to overtaking US computer technology and capturing the leading position in the world market. The United States is responding by lifting legal restraints on its two biggest companies in the field.

## Learn electronics by correspondence

The Australian School of Electronics Pty Ltd is off offering a new correspondence course in basic electronics. Average time for completion of the "Lerna-Kit" course is six months, although students are encouraged to learn at their own rate.

The first part of the course familiarises the student with solid-state components and circuit diagrams. Detailed instructions and all components are supplied to build a simple oscilloscope at this stage.

Practical training continues to be emphasised in the second part of the course, which also introduces electronic theory.

There is no enrollment fee or deposit for the course. A student can commence for less than $30, with other payments as the course progresses.

Both hobbyists and those with no prior knowledge of electronics can take the course. For more information write to the School Registrar, PO Box 108, Glen Iris, Vic 3146.

## New robot has "eyes" — responds to voice commands

Vision systems for robots are one of the most challenging areas of robotics research at the moment. Imitating even partially the functions of the human eye is still beyond researchers, but a new robot from Britain points the way.

Scientists at London's Queen Mary College have developed a robot which is designed to detect and handle specific objects and to carry out pre-programmed functions either automatically or under remote control. The robot is equipped with a main computer and three microcomputers for motorised control and sensory processing, including speech processing.

The mobile robot is equipped with ultrasonic and infrared sensors for recognising objects. The sensors are mounted on crab-like arms and grippers, with distance measurement provided by two television cameras mounted on the superstructure.

Controlled by an operator using a console with a speech command system, TV monitor video monitors, a keyboard and joysticks, the robot will eventually be used for remote manipulation in hazardous environments, such as nuclear power stations and reprocessing plants.

## British "Information Technology Year"

This year in Britain is "Information Technology Year" — a round of government-sponsored exhibitions, lectures, publicity campaigns and demonstrations — even a play and a ballet — aimed at informing industry and the public about the latest in computer and communication services.

Launching the campaign, Prime Minister Margaret Thatcher declared "the future prosperity of Britain depends on our being bang up to date in the latest technology, and preferably one step ahead of other countries".

# NEWS HIGHLIGHTS

## Computer-linked videodisc for education

The video disc may revolutionise our use of television, but it is in the training and educational fields that its biggest impact will occur.

The reason for this is that a video disc is not just a half hour recording of a television program. A disc also contains around 54,000 television pictures, any one of which can be called up and displayed as a "still". Alternatively, a combination of still images and short film clips can be shown, or single frames stepped at any speed.

When combined with computer control of the disc player, a half hour disc can provide audio-visual material for a three hour lesson or training sequence. The linear progression of the "film" can be replaced by a stop and start sequence of images controlled by the viewer's interest, or progress in a computer generated question and answer session.

When software is made available so that computer-assisted instruction sessions can be readily produced on any subject and computer text and graphics combined on the same display as the video disc material, the result is an entirely new approach to education, with far-reaching implications.

A unique VideoDisc/computer combination was displayed recently by Bell and Howell Australia, for the first time outside the United States. Based on the work of Dr Carl Reuter, formerly head of the faculty of Computer Instruction at the University of Wisconsin, the computer-based video system is designed for use as a training and sales promotion aid.

The system puts an Apple II computer in control of a laser video disc player, and incorporates a software package called PASS – for Professional Authoring Software System. PASS enables people with little or no knowledge of computers to quickly develop effective training programs employing the techniques of Computer Assisted Instruction. (CAI).

With the interactive video disc, each individual can proceed at his or her own rate. The computer program can monitor the individual's progress by asking questions and waiting for responses typed in on the computer's keyboard. A correct answer means that the program continues, moving on to the next area.

If the answer is incorrect, the computer can call up from the disc the specific part of the lecture or demonstration which deals with that subject, and play it for the student, patiently reinforcing his knowledge until all questions are answered correctly.

Lessons are produced by an instructor using the computer to develop programs tailored to specific training objectives. Using English language prompts and questions, PASS allows the development of such progams by people without prior computer knowledge. The pre-defined format of PASS reduces the time taken to develop a training course, and a full-featured word processing system built into the software allows lessons to be created and changed quickly and easily.

Whether the training course is to teach new staff how to operate a fork lift truck, solder a printed circuit board or service air conditioning equipment, early results of the individual training program have demonstrated its ability to pass on information quickly and effectively. The result is often improved company performance and greater customer satisfaction.

## Sharp introduces talking calculator

A wallet-sized calculator that speaks out numbers and arithmetic symbols is the latest application of the Sharp Corporation's research in voice synthesis.

The EL-620 calculator announces results either digit by digit (eight-three-four-five) or by whole numbers (eight thousand, three hundred, forty five). The calculator includes a 40mm loudspeaker for clear, easily understandable voice output.

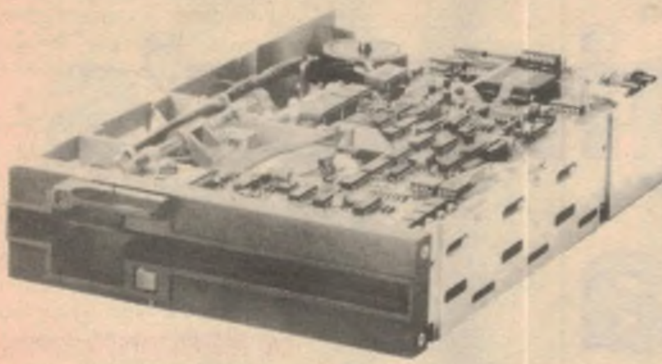
## Battery charge controller from WA

The Solar Energy Research Institute of Western Australia has developed a low-cost, compact charge/discharge controller for lead-acid batteries. Called Bemac (Battery Energy Meter and Controller), the device is designed specifically for solar electricity applications, although it can be used in a wide variety of equipment using lead-acid batteries.

Bemac gives a read-out of the state of charge of the battery, with 10 light emitting diodes providing a bar graph indication of battery state from fully discharged to fully charged.

The provision of a state of charge indicator in a battery charging regulator is particularly important in photovoltaic applications and in electric vehicles. For further information contact Product Engineer Mr Wal James, Solar Research Insitute, Box R1283, GPO Perth, WA, 6001.

# TANDON DISK DRIVES



## TANDON NEW EIGHT-INCH THINLINE DISK DRIVES

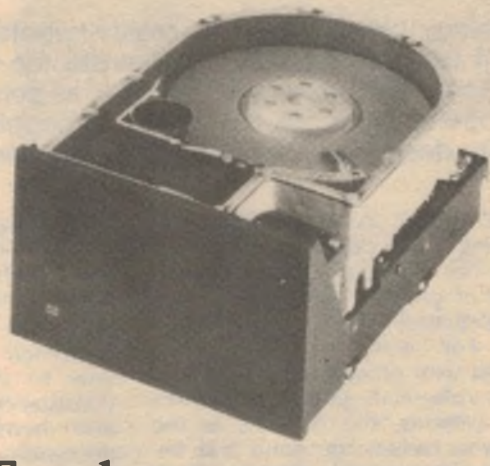
- Exactly one-half of the height of standard drives.
- Proprietary, high-resolution, read-write heads patented by Tandon.
- D.C. only operation — no A.C. required.
- Industry standard interface.
- Three millsecond track-to-track access time.

## TANDON MODEL TM600 SERIES MINI-WINCHESTER DISK DRIVES

Tandon's TM600 family of Mini-Winchesters offer unmatched storage capabilities in a 5¼" high-speed, random access disk drive. Available in two and three platter models, the TM600 series provides unformatted storage capacities of 6.4M bytes to an incredible 11.6M bytes of information.

Up to four Tandon TM600s can be daisy-chained on a single bus, which provides a capability of up to 46 megabytes of on-line storage (unformatted) in a single system.

Interface Flexibility. Tandon offers two industry-standard interfaces on the TM600 family of Mini-Winchesters. The "S" version is compatible with higher capacity drives (i.e.: SA1000). The "T" Version is compatible with the Tandon 5.25-floppy TM100 series — where except for data separation, the TM600 series can run in a daisy-chain with the TM100-4, a double sided, double density 96 TPI floppy disk drive, capable of one megabyte (unformatted). This permits 11.6 megabytes (unformatted) fixed disk in daisy-chain with 3 megabytes (unformatted) removable floppy disk capacity.



## Tandon Model TM-100 Mini-Floppy Disk Drives

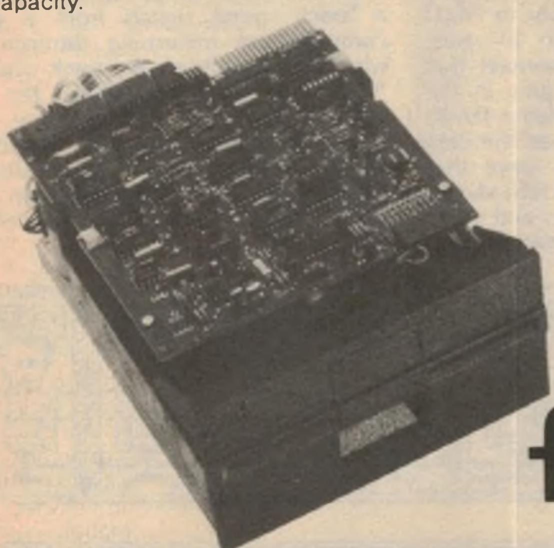
**Tandon's TM-100 family of mini-floppies offer the absolute highest storage capabilities of any 5¼" high-speed, random access disk drive available in two single head and two double head models, all double density.**

**Unsurpassed Storage Capacity** — Up to an incredible 1000K bytes information on 160 tracks. Recording density is 5877 BPI.

**Advanced Dual-Head Design** — Tandon Magnetics has for years been the leading designer and supplier of read/write heads to most major disk drive manufacturers.

**Increased Throughput** — Tandon's TM-100 have a track-to-track access time of only 5 milliseconds (an incredible 3 milliseconds double track density).

**Proven Reliability** — Designed for total reliability, as demonstrated by more than 50,000 production models in operation.



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Quantity of goods or quality of life?

# The engineer's dilemma

**by MEREDITH THRING**

Technology can be used to create robots and put people out of work; it can also be used to alleviate the suffering of the world's poor. Some engineers see their task as solving technical problems, while others focus on the needs of people. Here a noted British authority describes his changing perception of the engineer's role.

My 27 years as a professor of engineering have taught me that the engineer has a much greater effect on the lives of ordinary people than that more ubiquitous figure, the medical doctor. For while the doctor is concerned with providing remedies for people's physical (and sometimes mental) ailments, the engineer is the person who creates the good and the bad things that originally stemmed from the industrial revolution. The engineer's creations range from brain scanners to nuclear weapons, and from convenient materials to robots. So why, I wonder, have doctors had to take the Hippocratic oath for 2400 years, while engineers still work for money, with no real ethic other than giving their employer or client what he has paid for?

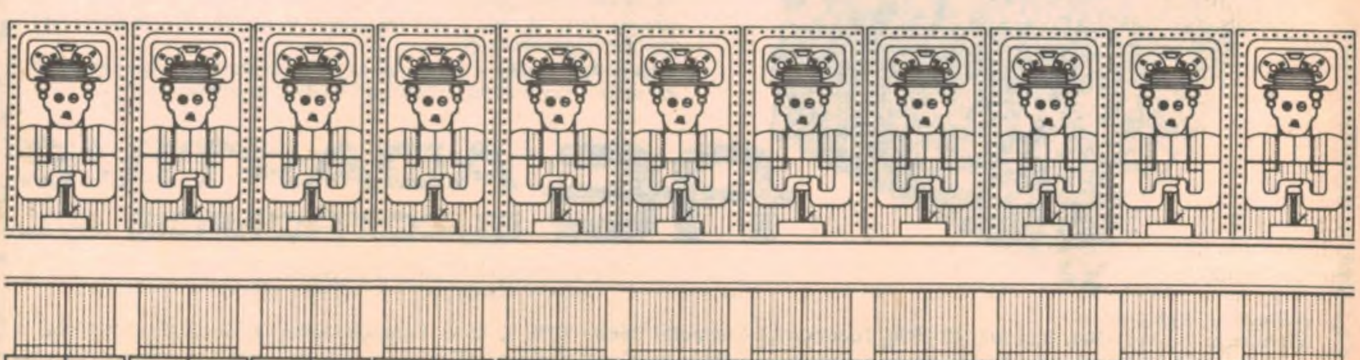
My experiences have had profound effects on my thoughts as to the humanity that engineers should embody in their approach to their work. Perhaps they should follow the line of thinking that I proposed in 1971 in an article in *New Scientist* entitled "A Hippocratic oath for applied scientists". The shortened version of the oath was, "I vow to strive to work towards the coexistence of all human beings in peace and human dignity with all the necessities for a self-fulfilling life and freedom from fear, stress, ugliness, pollution and noise."

*Professor Meredith Thring recently retired as professor of mechanical engineering at Queen Mary College, London. He has written a number of books, the latest being "The Engineer's Conscience".*

Perhaps the most striking consequence of my studies of engineering's effects on human life has been the change in my attitude to robots. From about 1955 to 1975 I was experimenting on the components of a sophisticated robot that would relieve humans of drudgery in the home, office and factory. In 1960 I suggested that we could, in 10 years, develop a mechanical housemaid that would do all the routine jobs in the house and cost no more than a family car. In April 1964, I developed the idea further, proposing a robot slave that could be programmed to scrub, sweep and dust, wash up, lay tables and make beds. It was to have a memory for instructions and a limited degree of intelligence so that it could adapt to some objects being out of their normal positions.

My students had already built the stair-climbing machine I had designed, and later a battery-operated prototype wheelchair for carrying handicapped people up kerbs and staircases. These designs resulted from the keen sympathy I felt over the frustration of highly educated women and their husbands having to spend so much time doing the daily chores necessitated by our wish to live in pleasant homes. The work culminated in our developing a table-clearing robot which we demonstrated in 1969 at the British Association for the Advancement of Science meeting in Dundee. The robot could work within the two horizontal dimensions of the table and could sense the diameter of the objects on a rectangular table.

We also built a fire-fighting robot in 1962. This robot navigated its way round a "track" using signals from a gyro compass and measuring distance by wheel-rotation. It left the track when it "saw" a fire and extinguished the fire when its "finger" sensed the flame. The idea was to develop a fully automatic night watchman that could travel around a warehouse and look out for a fire. We also studied a possible robot storekeeper.



The benefits of this work, we thought, would be:

- Avoiding drudgery and boring repetitive work.
- Eliminating danger and discomfort at work.
- Increasing available resources and reducing wastage (this is by no means an essential consequence of robot development: a skilled craftsman uses less power and is much more economical with materials, but a robot will spoil less products than a careless, tired or bored human).

> "Over the past 10 years I have become increasingly concerned about several dangerous consequences of concentrating research on robots. The primary gain from installing industrial robots is that they cut labour costs . . ."

However, over the past 10 years I have become increasingly concerned about several dangerous consequences of concentrating research on robots. The primary gain from installing industrial robots is that they cut labour costs; in other words they reduce the number of human employees.

We have reached the point in the developed countries where we must expect higher unemployment if we want to increase productivity. There are a number of reasons why this is so. One is that fossil fuels and other mineral resources are no longer considered to be infinite, and, therefore, it no longer makes sense to build obsolescence into industrial goods. Another reason is that people are no longer so easily satisfied. This leads to what I call the robot fallacy: "It is desirable to employ a robot rather than humans if it reduces production costs." The fallacy is apparent when one considers that each unemployed person costs the country on average $200 a week and most humans prefer to feel that they are doing something useful than to be paid for being idle.

For these reasons I have abandoned my work on industrial robots, where the primary aim is to displace human labour. I now work only on applications where the aim is to enable someone to do the job he does now without actually exposing his body to danger or discomfort; or where we need to amplify or diminish his skill and strength. A good example is "telechirics", the name for artefacts that allow people to work artificial hands and arms and to operate machines in hazardous or unpleasant environments as if they were there, while they are in fact in comfortable and safe conditions. Telechirics provides such good tactile, power and visual feedback that a person can apply his skill remotely. Curiously, telechirics was first developed when engineers thought that they could build nuclear-powered aircraft and wanted something that could go into one if it crashed. Later telechirics was used in space research. It can clearly also be of immense value in mining (especially of dangerous minerals such as asbestos or uranium), and for handling explosives, firefighting, bricklaying in hot furnaces and many other tasks including surgery.

It is 20 years since the first commercial non-adaptive robot was sold and there are still only 20,000 robots in the world, more than half of them in Japan. There are more than one thousand million workers in the world; that means one robot for every 50,000 people. As world unemployment rises, I believe that the robot population will climb to perhaps a few per 100,000 people and that they will be doing only dangerous and uncomfortable jobs (such as paint spraying), tasks that call for repetitive accuracy and manually demanding jobs such as sheep shearing.

Too great a concentration on developing robots also diverts skilled engineering effort from a vastly more important human problem — helping people in poorer nations. Sir Harold Hartley first drew my attention to this

# Robots—are they worth developing?

when he chaired a meeting at which I read a paper on the "domestic revolution". I talked about the domestic and the fire-fighting robots, among other things. He said to the meeting, "I felt a little doubtful about his saying that the objective is not raising the standard of life but creating more happiness, because after all he was thinking of was this country and the United States and there are so many other countries where the first duty of applied science is to try to raise the standard of living." This remark set me thinking. Three years later in my Cantor lecture of the Royal Society of Arts I said, "The more developed countries have a moral responsibility to find a technological way of aiding the less developed ones to achieve a satisfactory standard of living for all their peoples. The peace of the world depends on this." My feelings on this matter were enormously strengthened when I was a member of a UNESCO team of ten people who visited Bangladesh in 1979 and I walked through hospitals with hundreds of children suffering diseases resulting from malnutrition.

My work on robots that can sense something and respond, and on the way in which people do the enormous variety of tasks for which their hands are trained, has led me to conclude that an artefact cannot match the sophistication of the trained human system at a price that does not take away resources from vast numbers of people. It is of course possible (and indeed it has already been done in Japan) to make a robot with some limited sensory adaptiveness to do a small variety of fairly simple tasks. But imagine designing a robot with hands that could fold a sheet, thread a needle or cuddle a baby. That is how advanced a human's "system" is and it takes many years of practice and intelligent modification of behaviour to acquire these apparently simple skills.

I have therefore been forced to the conclusion that we will waste most of the inventiveness and skill now being devoted to developing robots. This is both because unemployment will inevitably rise to socially unacceptable levels in the developed countries, including the most successful ones as well as Britain, and because the only way to avoid world war is for the developed countries to devote a significant fraction of their engineering skill to solving the basic problems of the poor countries. Clearly, tensions in the world — caused by rising populations, increasing poverty and disasters, while the rich countries are consuming the world's oil — will lead to a greater danger of war if they are not checked within another generation. And no amount of the most sophisticated robots will help us in a nuclear holocaust.

Another theme to which I have given continual attention is the attitude in Britain towards industrial innovation and applied science. At first I was solely concerned by the tendency in this country to reject new things "until the foreigner had burnt his fingers first" and to spend most of our limited research funds on "big physics" rather than engineering. This led me to join in discussions about establishing a British society of top engineers with the task of making "far-sighted and wise decisions as to the direction in which invention and development should go". That was in 1966. Then in an article in *Nature* in 1967 I suggested there should be a British Academy of Engineering, much like the one set up in the US.

I was delighted some 10 years later when, in 1980, the Fellowship of Engineers was set up in this country.

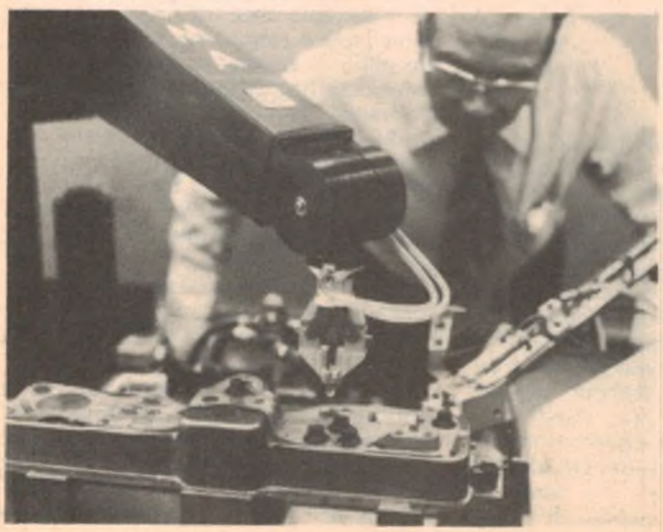
My views about what is the right long-term policy for engineering in Britain have steadily moved away from those of a blind follower of progress for its own sake. Originally, like almost everyone else, I believed in the continuing exponential increase in the speed of travel, output of steel and electricity, standard of living, and so on, although I was always keen on achieving the result with as little fuel as possible. In 1968 I expressed concern with our lack of young inventive engineers because of academic snobbery, bad career advice and the image of engineers as socially irresponsible ("Getting to grips with technology" *New Scientist,* vol 39, p 644). I criticised our tendency to say of a

**"I have come to feel that most of the dangers to our civilisation stem from decisions taken on a short-term basis"**

new idea that it would not work, or it would not be economic. And in 1969, I proposed a workshop in which inventions should be given as good a chance as new ideas are in pure science, provided they satisfied three criteria. These were: that the idea was not contrary to the known laws of science; it was not contrary to the interests of the individual human being; it appeared to be novel.

The second of these three criteria has become steadily more important to me. I have come to feel that most of the dangers to our civilisation stem from decisions taken on a short-term basis. We take avoiding action because a problem looms up — such as pollution, violence, rising oil costs, unemployment or inflation — but by being short-term, the actions rapidly worsen other problems.

A society that bases its measurements of success solely on the acquisition of status symbols must be self-destructive because there are not enough resources to last for ever. But I remain an optimist because, where lecturing to many thousands of young people, I have found them prepared to take a long-term view and to accept that standards of living will level off while creative self-fulfilment will improve the quality of life.



*Work on robots aims to match skills of trained human beings. In this laboratory demonstration a PUMA robot inserts a light bulb in a dashboard panel.*

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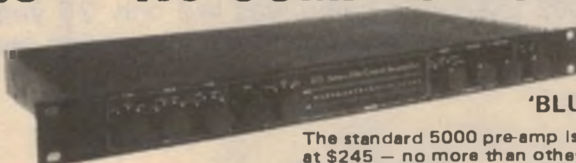

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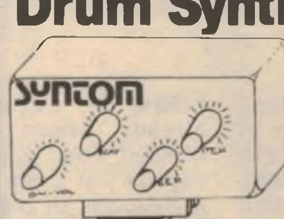


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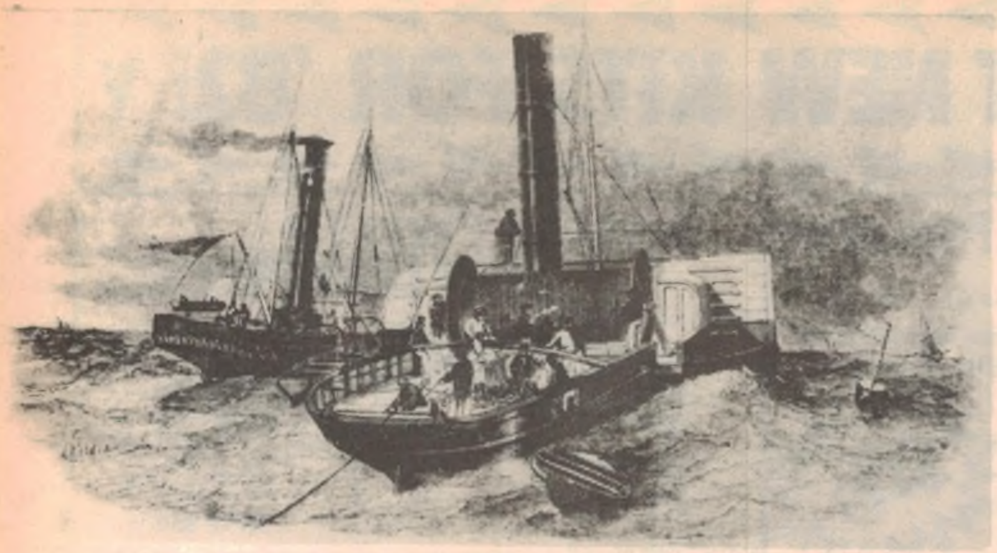

*First underwater telegraph cable between England and France, shown here being laid by the tug Goliath, August 28, 1850.*

**Nowadays we take for granted the ease with which we can pick up a telephone and in moments talk to a friend overseas. Usually the process is simple and trouble-free, and we rarely spare a thought for the thousands of kilometres of cable and the feats of engineering which make our conversation possible. Yet the idea of undersea cables is just a little over a hundred years old, and the first undersea telephone cable was laid only 25 years ago. The history of modern communication is a fascinating story.**

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# The story of

When Captain Arthur Phillip RN, chose the wooded shores of Sydney Cove as the site for the first British settlement in Australia, he knew that he and his party had no hope of communicating with home for years to come. The voyage out had taken eight months. The first ship to reach the colony after its establishment, the Lady Juliana, arrived two-and-a-half years later, having taken 11 months from Plymouth. The mail it carried was already a year or more old and the recipients had not been in touch with the writers for more than three years.

This fixed relationship between distance and communication had existed since time immemorial. It was one of life's constants, like the daily rising of the sun. The thought could not have occurred to Phillip, or the politicians in Westminster who had sent him, that within 50 years this relationship would have been shattered – or that within a little more than 80 years, people at Sydney Cove would be in daily communication with people in London.

Amid the 18th century courtliness and rustic torpor of the England they had left behind the Industrial Revolution had already begun. Their predictable ordered world of sailing ships and sealing wax was about to be swept away on a great tide of change. The skilled iron workers of Birmingham had already started manufacturing James Watt's steam engine. John Wilkinson had built the first iron boat in 1787. The character of the English countryside was undergoing metamorphosis as villages grew into industrial towns, their skylines dominated by tall factory chimneys, as iron bridges leapt across river gorges, as canals and paved roads cut through the green meadows. And a few far-seeing individuals were already seeking ways of harnessing the magical "fluid" electricity, and utilising it for communication.

The first published suggestion for a system of electric telegraphy had appeared in the Scots Magazine 35 years before, on February, 17, 1753. The author, Charles Marshall, proposed a system using 26 wires "extended horizontally between two given places, parallel to one another and each of them about an inch distant from the next." A ball hanging from the end of each wire at the receiving end would attract a piece of paper placed beneath it when energised with electricity, this being achieved by connecting the other end of the wire to a hand-operated frictional machine. If each piece of paper were inscribed with a particular letter of the alphabet, messages could be sent.

Telegraphic messages were actually sent experimentally in 1787, by means of a system using static electricity, over wires stretched between Madrid and Aranjuez, in Spain. The Spanish showed great interest in this new technology, setting up another line over the same 42km route in 1798 for the private use of the Royal Family.

During the early years of the 19th century the nations of Europe, plagued by the ambitious Napoleon, found themselves continuously preoccupied with the war. Yet a number of scientifically minded gentlemen continued to entertain themselves and their friends by experimenting with home-made systems of electrical telegraphy. One of these, S. T. von Sommering, demonstrated an electro-chemical telegraph to the Munich Academy of Science in 1809. His contribution to the art is worthy of note because his demonstrations inspired a Russian nobleman, Baron Schilling, to take a lifelong interest in the subject. The work of Schilling, in turn, prompted William Cooke 27 years later to stake everything on turning electrical telegraphy into a commercial system.

Schilling had, by then, refined his receiving equipment so as to utilise the ability of an electric current to deflect a compass needle, a property first observed by Professor Oersted, of the University of Copenhagen, in 1820. Schilling had also developed a signalling code based on combinations of black and white, the needle swinging so as to point to either a black or a white card. This technique removed the need to have as many wires as letters in the alphabet, and foreshadowed the more celebrated Morse Code, A being represented by

*Far left, the Cooke and Wheatstone telegraph instrument as used on the London railway, 1845. At left, bringing the Australian end of the Trans-Tasman cable ashore, Bondi Beach, 1975.*

# undersea cables

black-white, B by black-black-black, C by black-white-white, and so on.

William Fothergill Cooke was just 30 years old when, in March 1836, he saw a copy of Schilling's telegraph. Recently invalided out of the East Indian Army, he had gone to Heidelberg to study medicine. He seems to have realised immediately the potential value of Schilling's idea. (The Baron himself died in that same year.) Within a month, the young Englishman had abandoned his medical studies and returned to England to devote himself to the development of electric telegraphy.

The story of Cooke's success is a story of a need and the technology to satisfy that need arriving together. England was ripe for the development. The first railway, between Stockton and Darlington, had opened in 1825. Stephenson's engine, *The Rocket*, had amazed the world by reaching 60km/h when hauling a 13 tonne train. Capitalists were eager to subscribe to new railway ventures. And railway company directors were anxious to have some reliable high-speed system of sending messages between railway stations ahead of the trains.

Cooke, encountering technical difficulties, formed a partnership with Charles Wheatstone, a man of four years his senior, who was Professor of Natural Philosophy at King's College, London. In June 1837 they were granted their first patent. Soon afterwards they demonstrated their 5-needle electromagnetic telegraph system to the directors of the new London-Birmingham Railway. Although this test, conducted between Euston and Camden Town stations, proved the effectiveness of the system, the company chose not to place an order. However, the directors of the Great Western Railway were impressed and invited the partners to install a telegraph between Paddington, their London terminus, and West Drayton, 21km away. This, the world's first commercial electric telegraph, came into operation on July 9, 1839.

The wires of Cooke and Wheatstone's telegraph spread rapidly throughout Britain along with the railways. Improvements in the system reduced the number of needles on each receiving instrument first to two, later to just one. By 1845 the partners were well on the way to becoming wealthy men through royalties received from railway companies.

While the telegraph flourished in England through private enterprise, the American inventor, Samuel Morse, spent several frustrating years striving in vain to obtain financial backing from the US Government for his own proposed system. Morse, a portrait painter, had first sketched his ideas for an electric telegraph whilst on a voyage home from Europe in 1832. The distinctive feature of his concept was that it used the deflections of a magnet to move a pen across a moving strip of paper. After his appointment as Professor of the Literature of Arts and Design at the newly founded University of New York, in 1835, Morse devoted his spare time to perfecting his idea. In 1837, he took on a partner, Alfred Vail. In the following January he gave the first demonstration, in his studio at the University, of the transmis-

sion and reception of messages in the code of dots and dashes which he and his partner had devised.

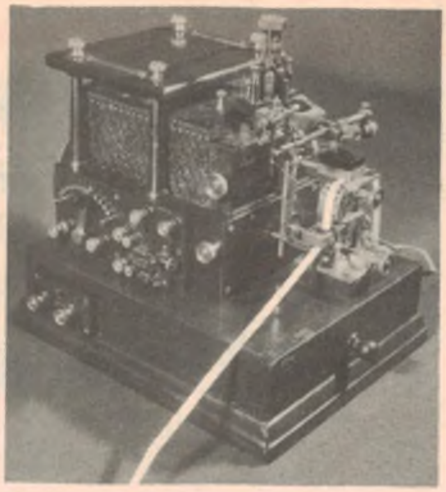
Morse's contribution to the new art was immense. His system needed only one wire, the return circuit being provided by the earth. Transmission of the signals was effected simply by tapping a key so as to make and break the connection. The pen and moving strip of paper were later discarded, for it was found in practice that operators could read the messages at the receiving end by listening to the long and short buzzing sounds made by the instruments. Key transmission and the code of dots and dashes survive to this day, especially in the sphere of ship/shore radio communication — as you could observe if you were to visit any one of OTC'S Coast Radio Stations.

The other great innovation introduced by Morse was the automatic relay, a device which enabled the telegraph to transmit messages over great distances without the need for reception and retransmission by operators at intermediate stations. This device played a vital part in the development of telegraphy, especially in its spread across the American continent. The relay functioned by using the current in one section of line to operate a make-and-break device in another section of the line powered by a separate set of batteries, thus causing the same sequence of long and short pulses of current to be sent down the distant line.

Australia got its first telegraph line, between Melbourne and Williamstown, in 1854, the year of the Eureka Stockade revolt. Victoria, only recently granted independent colonial status, was then experiencing a gold rush. The new colony's population had been expanded by a great influx of fortune seekers from many parts of the world and Melbourne had become Australia's most important city. Within four years the telegraph wires reached all the way to Sydney and westward as far as Adelaide, to enable the three capitals to keep in touch by Morse Code.

## International telegrams

The idea of linking the nations of the world by running telegraph wires beneath the sea had excited imaginative minds ever since the first discussions of electric telegraphy. By 1850, there seemed to be no great obstacle to be overcome. All that was needed, surely, was effective insulation of the wire. But the pioneers were to discover — as pioneers usually do — that there were more difficulties in the way of progress than they could have dreamed. Samuel Morse, having experimentally laid a rubber-insulated cable across a section of New York Harbour in 1842, found himself the butt of public derision when the line



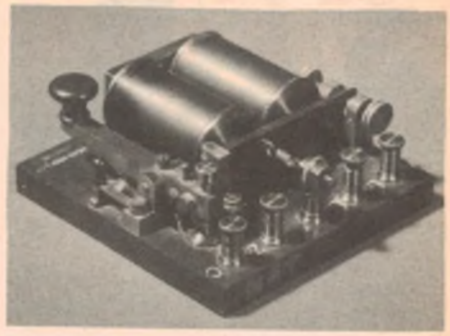
went dead even before the official opening ceremony. A fisherman, finding the cable fouling his anchor, had angrily chopped through it, letting the severed ends drop back to the bottom of the harbour.

Despite this experience, Morse remained optimistic about the prospects for submarine telegraph. He expressed the conviction, in 1843, that "telegraph communication may with certainty be established across the Atlantic Ocean."

In England, Professor Wheatstone had put forward a proposal for a cross-Channel telegraph as early as 1840 in a submission to a House of Commons Committee. The first actual attempt to lay a telegraph cable across the Channel came 10 years later. It was a private commercial venture. It failed.

The man behind this scheme to link Britain to Europe by wire was a 45-year-old retired antique dealer, John Watkins Brett. He formed a company with his younger brother Jacob, calling it the General Oceanic and Subterranean Electric Printing Telegraph Company. The cable, manufactured by the Gutta-Percha Company, consisted of a single copper wire surrounded by a 5mm thickness of gutta-percha insulation.

A small steam tug, the *Goliath*, paid out the 25 miles of cable from a huge drum on its after-deck throughout the day of August 28, 1850. The end was safely landed at Cape Gris Nez that evening and connected to the Brett's automatic printer. John Brett, in England,



*At left, a long-distance cable code recorder, used at Australian cable stations last century. Above is a telegraph key as used on the Overland Telegraph, Darwin to Port Augusta, 1872.*

attempted to send a message of greeting to Prince Louis Napoleon Bonaparte, but the receiving equipment recorded only an unintelligible jumble of characters.

Efforts to send messages in both directions continued for some hours but only a few words got through. By the next morning the line was lifeless. A French fisherman had hauled the cable inboard and cut a section from it, believing it to be some strange kind of seaweed with a gold core.

The Bretts tried again, this time with the support and guidance of a railway engineer, Thomas Crampton, who subscribed half the £15,000 capital for the project. Crampton also designed a new cable consisting of four conductors, each insulated with gutta-percha, contained in a protective sheath of tarred hemp and galvanised iron wires. Laid on September 25, 1851, this second Channel cable proved successful. For the first time, two countries separated by sea could correspond by means of the electric telegraph.

A boom in the production and laying of submarine cables now followed. Over the next few years, cables went into operation across the Irish Sea, the North Sea, the Mediterranean and even the Black Sea. In 1857, India and Ceylon were linked. And in 1859 a cable across Bass Strait joined the telegraph systems of Tasmania and the Australian mainland colonies.

*Next month: the story of the first Atlantic cable and events in Australia.*

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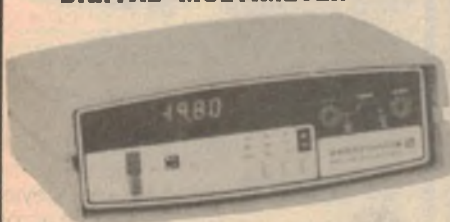

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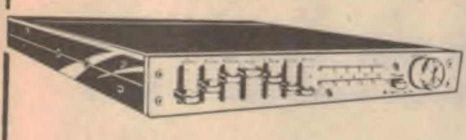

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*The Radio Super was very popular in the 1920s, chiefly because it needed no outside antenna.*

**The late 1920s to World War II proved to be the golden era of radio experimentation and home construction in Australia. In this, the final article of our four part series, the author looks at this era, and discusses the audio revolution that took place during this period and the introduction of stereo sound reproduction and experimental television.**

**by PHILIP GEEVES O.A.M.**
Fellow of the Royal Australian Historical Society.

# Australia's radio pioneers — 4

Most Australian families of the 1920s heard their first broadcasts on a crystal set. It was a modest investment and needed no batteries, yet it opened the door to a new wonderland. More affluent, or trendy, people often began with a valve set, perhaps even a multivalve receiver capable of driving a loudspeaker. These sets, with tuned RF stages on breadboard layouts mounted in coffin-like cabinets, enabled their owners to demonstrate the occult art of "tuning" for the benefit of wide-eyed friends. A large outdoor antenna was the distinctive hallmark of a radio home, at least until the first prosecutions of unlicensed listeners, when "there was a rush, not towards the licence counter of the GPO, but to get the backyard aerial down before the postman appeared the next morning."

One of the chief disabilities of early broadcasting was poor reproduction of recorded music. Because small synchronous or induction motors and electro-magnetic pickups had not been perfected, a spring-driven gramophone did duty as a studio record player: The vibrations of the heavy tone-arm were magnified by the gramophone horn and picked up by a carbon microphone. Discs were still made by the original acoustic process, their restricted dynamic range suggesting that all vocalists were singing at the end of a tunnel. The complex tonal patterns of keyboard instruments defied faithful reproduction from acoustic recordings. Consequently many broadcasters relied on the pianola as a musical reproducer, which anyone with two feet could play like a virtuoso.

The invention of electrical recording changed all that. The vastly improved frequency response of the new discs turned the gramophone into something of a vogue, prompting a noted Australian composer to comment on "the disconcerting popularity of music". The new process coincided with the introduction of dynamic cone speakers, so it was only a short step to electronic reproduction, with the output of a pickup feeding into an audio amplifier.

The first pickups used in Australia were heavy devices, with magnets and armatures in full view. To avoid distortion, announcers changed needles after each record. Although this was an exciting period, it meant endless frustrations for professional radio men. Improvements in valve performance and amplifier design caused broadcasters to invest substantial capital in new audio equipment, but listeners with outmoded receivers could not enjoy the enhanced sound, or even notice it.

The new breed of "wireless addicts" preferred to build their own receivers. Radio magazines were largely responsible for the home construction craze, which gained momentum during the 1920s. They printed illustrated articles showing how to build receivers of every genre, explained circuit diagrams and even ran courses in simplified electrical theory. When technical editors published constructional details of popular models, radio dealers offered kits to home hobbyists. Regular radio exhibitions and amateur displays allowed laymen to study receiver layout and wiring techniques at close quarters. Most sets were battery operated until 1928, but increasing availability of domestic electricity produced the battery eliminator, which freed experimenters from the replacement of expensive B batteries and culminated in the triumph of the 1920s: the all-electric receiver.

The development of radio owed much to engineers who never lost the lively enthusiasms of their amateur days and, in fact, a number of professionals devoted their spare time to ham radio, thus enjoying the best of both worlds. Ray Allsop, who in 1925 became chief engineer of 2BL, was one of them. He relished the challenge of DX communication and allowed the general public to hear the results. In February 1925 Allsop's experimental station, 2YG, was heard in Europe on 80 metres. That same month he intercepted a shortwave test transmission from KDKA, Pittsburgh, the world's first broadcasting station, and relayed the program over 2BL.

In 1927 Allsop organised a similar rebroadcast of PCJJ, Hilversum, and the public response to this novelty gave him an even more ambitious idea. The BBC had not yet begun its overseas service so Ray Allsop arranged, through the Netherlands Consul in Sydney, for 2LO, London, to be relayed from Hilversum on 30 metres for rebroadcast over 2BL. This triple transmission proved enormously successful – the first time that Big Ben and the voices of London announcers were heard in Australian homes. It was not until May 1928 that the BBC was heard here somewhat more directly, when the Marconi Company relayed to 2LO through its own shortwave outlet, 5SW at Chelmsford.

Red-blooded Australians felt an intense involvement with Kingsford Smith's epic trans-Pacific flight from Oakland to Brisbane in 1928 and, because the "Southern Cross" carried radio equipment, it became possible to follow the aircraft's progress. Sydney Newman transmitted continuous Morse homing signals from AWA's radio centre, Pennant Hills, while Ray Allsop and Tom McNeil shared a long listening vigil, interpreting the cryptic messages from the "Southern Cross" and keeping 2BL's audience aware of every development. An American, Jim Warner, was the plane's radio operator and his gear was built by Heintz and Kaufman of San Francisco. The original transmitter may be seen in the National Library, Canberra.

Looking back, it seems that 1929 was a watershed year for Australian electronics. Overseas, the development of efficient audio amplifers and loudspeaker systems had hastened the introduction of sound films – "talkies". In Australia, Ray Allsop took up the challenge. As early as 1921 he had succeeded in synchronising a wax cylinder recording with motion picture film; now he perfected his own Raycophone system which, despite bitter opposition from American interests, supplied the sound in almost half Australia's cinemas at a fraction of the cost of imported equipment. 1929 was also the year that AWA introduced its first domestic radiogram, the "Duoforte". Coinciding with the debut of sound films, the radiogram enjoyed widespread popularity as an exciting home entertainment package.

*Spark transmitters were widely used in Australian merchant ships. Pictured above is the radio cabin of S.S. "Burwah", fitted with an AWA ½kW quenched spark set.*

*Marconi's research chief, H. M. Dowsett (centre) operates an early TV receiver at La Perouse during his 1934 visit.*

Many improvements in components and circuitry date from that time. One veteran remembers it as a stimulating epoch . . . "every week the radio papers printed a new circuit, so we would rush home to build it. Screen grid valves and power pentodes gave radio new horizons and, of course, the superheterodyne was a winner." Housed in splendid, handcrafted cabinets, console receivers of the 1930s were often the most impressive pieces of furniture in average homes and became the focal point of the family circle.

Public fascination with sound films soon generated a belief that television would not be long in coming and, it must be admitted, a few local visionaries were not averse to suggesting that television was just around the corner.

An experimental TV station, using Baird's techniques, was built in Brisbane by T. M. Elliott and limited work was done by other experimenters. Three commercial radio stations, 3UZ, 3DB and 2UE, toyed briefly with the novelty of transmitting still pictures, but their enthusiasm outstripped the state of the art and public demand. A Melbourne firm, Television & Radio Laboratories Pty Ltd fostered the idea of Radiovision, which reproduced simple geometric figures on a special receiver. Experimental transmissions over Melbourne stations were soon abandoned. 2UE's interest centred on the Fultograph system, canvassed ardently by its British representative who, however, was realistic enough to

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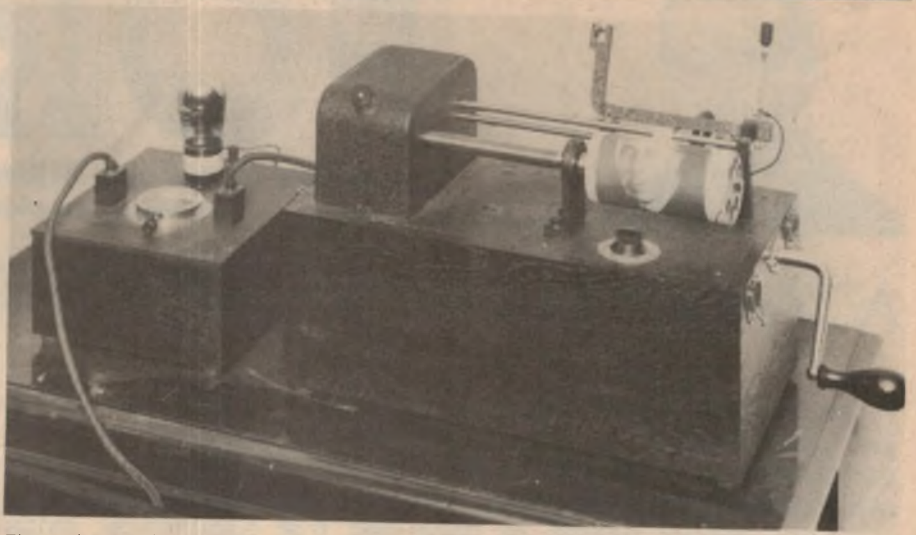
concede that "transmissions will be of no value until the Fultograph receivers are distributed." And all this in a time of worldwide depression!

Some unusual hookups were adopted to carry film soundtracks to remote places, but few captured the public imagination so completely as the 1930 transmission from VK2ME which enabled Admiral Byrd's expedition in Antarctica to hear Chevalier's film "The Love Parade" direct from the projection box of Sydney's Prince Edward Theatre. Spectacular achievements of this kind served to remind "John Citizen" that the unfolding science of radio was capable of infinitely more than simply producing agreeable sounds in his living room "wireless". And although Marconi never found time to visit Australia, the very association of his name touched any occasion with magic. It is impossible to convey the feeling of wonderment which engulfed Sydney in March 1930 when, from his yacht "Elettra" in Genoa harbour, Marconi switched on 2800 lights in the Town Hall to inaugurate that year's radio exhibition.



*The Fultograph experimental picture transmission equipment of 1929.*

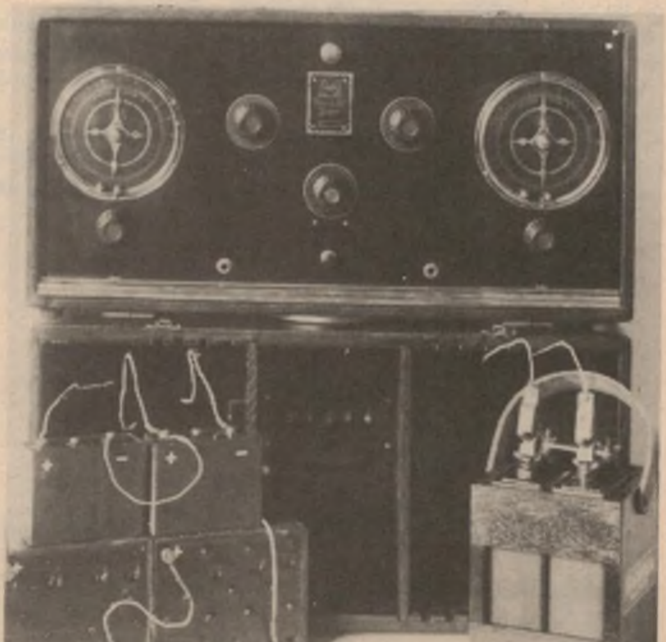
Dual wave receivers of the 1930s gave Australians a window on the world at a time when European dictators were exploiting the power of radio propaganda. Short-wave broadcasts became commonplace and, through the crackle of atmospherics, that generation listened to history in the making. In Australia, too, short-wave techniques were given some imaginative tests, such as the great Southern Seas broadcast on Empire Day 1933, the first major hookup in this part of the world. One report mentioned . . . "Nauru transmitted a word picture of natives listening with expressions of awe to the strange voices that came from the air. In New Guinea, miners on the goldfields were sitting around expensive receivers, bought with their newly-acquired wealth, listening to the flashing Empire messages. The minds of many went back to 1914 when intercommunication in the south seas depended on a few strands of cable."

The Wireless Institute of Australia was the sole active national body of its kind until 1932. Each State had a separate Division and the members' prime interest was amateur radio. However, industry leaders, immersed in the rapidly developing science of electronics, felt the need of a more professional organisation. As a result, the Institute's membership began crystallising at two different levels. As early as 1924 Fisk, Mingay and other professionals had the foresight to register the Institution of Radio Engineers, Australia, but the planned organisation remained dormant for eight years when, by common consent, the IRE hived off from the NSW Division of the Wireless Institute.

The new body quickly established an enviable reputation by snaring some of the front runners of electronics as lecturers. In May 1934 Marconi's research manager, H. M. Dowsett, delivered a paper on "Television and its possibilities in Australia" and four years later the IRE had attained the requisite stature to host the first world radio convention ever held in the British Empire.

That prestigious conclave, which was part of Australia's 150th anniversary celebrations, attracted to Sydney many international figures, including General James Harbord, Chairman of RCA, and TV inventor John Logie Baird. More than sixty papers were read, a goodly proportion being contributed by Australian engineers.

*continued on p117*



*AWA engineer Harry De Dassel making frequency measurements in a 1925 laboratory. At right is a battery model Radiola receiver, 1927 vintage, without loudspeaker.*

# FORUM

Conducted by Neville Williams

# A TANGLE IN TAPE COMPENSATION . . .

**If you're looking for a way to get yourself thoroughly confused, just get involved in a discussion about the recording and playback compensation in an audio tape recorder including, of course, references to time constants and turnover frequencies. More than one reader seems to have had that experience, since publication of our November issue.**

In that month, from page 31, we recounted a discussion with Mr Bill Andriesson of BASF, Germany, under the heading "Definitive answers about CRO2 cassettes". In it, he expressed dissatisfaction with the choice of 70µs as the compensation time constant for chromium dioxide tape, saying that it would have been better left at 120µs, as for ferric oxide.

He felt that the decision had been taken because engineers, at the time, did not accept that the tape hiss problem would yield – as it ultimately had – to the use of Dolby-B noise reduction. Dolby NR had made it not only unnecessary but unwise to change the time constant of the equalising networks to 70µs.

By retaining 120µs for chromium, he maintained, the full potential headroom of the new coating would be realised rather than compromised, yielding a better and more usable dynamic window.

Following publication of the article, I received a call from a reader, P.C. of Surry Hills, NSW, who said he could not follow the reasoning at all. It seemed upside-down to what he understood the facts to be.

Indeed, he had referred the matter to a number of technical acquaintances and they were equally puzzled. They felt that we had got our facts mixed up.

Subsequently, I received a letter from him that reflects that puzzlement and I reproduce it below:

*Dear Sir,*

*I must confess to total confusion over your article in the November issue about chromium tapes and equalisation. I would have thought that, where you wrote 120µs, you meant 70µs and vice versa.*

*1. As I understand it, tape saturates in the upper treble frequencies first, as levels are raised. Therefore, the less treble boost needed, the better the headroom.*

*2. As I understand it, 120µs is a treble boost (during record) of 6dB/octave that starts to rise at a lower frequency than does 70µs.*

*3. I therefore conclude that, for instance, 10kHz gets more treble boost on "normal" 120µs, and not as much boost on "chrome" 70µs.*

*4. I further conclude that, on replay, 120µs would cut more noise out than would 70µs.*

*Therefore I cannot understand how you have reached the opposite conclusion on page 33. Even after our telephone conversation, in which you mentioned the matter of recording head current, I am still confused. Would it be possible for you to publish a more complete explanation.*

*P. C. (Surry Hills, NSW).*

On the back of his letter, P. C. has sketched some ordinary boost and cut curves but then confesses that his convictions don't align with practice. He has noted that switching to the CRO2 position does indeed reduce the upper treble response on playback, thereby confirming what Bill Andriesson had said!

His confusion was therefore complete!

Rather than try to untangle his letter, the most helpful approach will probably be to follow through the recording and replay systems and, hopefully, let the facts speak for themselves.

To avoid unnessary complication, let's just talk about the cassette system, although the same principles apply to open reel recorders and to other tape speeds.

If one were to feed a magnetic record head directly from an amplifier with a flat voltage/frequency response, it would be found that the current through the head

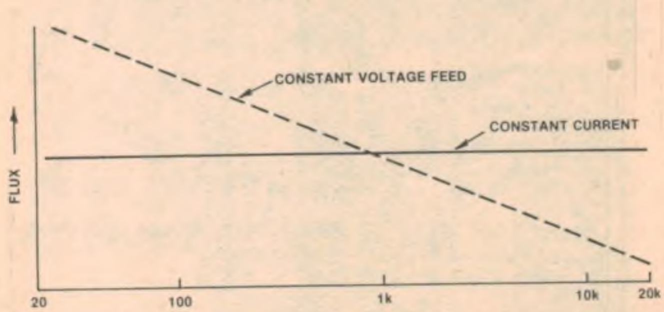



FIG. 1

*To ensure a more uniform flux on the tape at all frequencies, the recording head is fed from a "constant current" source – where the current remains constant with frequency.*

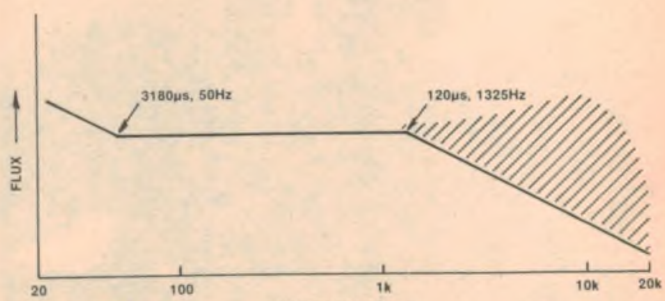



FIG. 2

*To match the flux curve more accurately to normal ferric tape, the recording amplifier includes bass boost and treble cut to produce the overall flux curve (idealised) as above.*

would diminish with rising frequency, because of the rising impedance of the head winding. In short, with a flat voltage/frequency input to the head ("constant voltage" drive) the remanent flux on the tape would diminish with rising frequency at something like 6dB/octave. (Fig. 1).

In practice, it is desirable that the remanent flux be substantially constant at all frequencies and, to approximate this situation, it is normal to feed the record head from a "constant current" source or one that has a flat current/frequency characteristic. (Solid line in Fig. 1).

Constant current feed can be approximated by using a driving amplifier stage with an intrinsically high output impedance, or by simply feeding the head through a suitably large series resistor.

But here's where some of the confusion arises. In voltage terms (head voltage/input voltage) constant current feed does seemingly produce a huge treble boost. But the rising voltage is solely the result of rising head impedance and, in terms of what really matters — remanent flux on the tape — constant current feed more closely approximates a flat frequency response.

## VITAL DISTINCTION

It is important to distinguish between constant current head feed (and the reasons for it) and recording compensation. So let's now talk about this second subject:

It was realised from the outset that signal/noise ratio would be a problem with the cassette format, considering its low tape speed and narrow tracks. There was therefore good reason to get as large a signal as possible on to the tape, so as not to rely any more than necessary on playback gain. Constant-current feed to the record head was a step in the right direction but not a cure-all in itself.

The further objective was to frequency-contour the signal so as to fully utilise the potential of the tape.

For example, a close study of tape characteristics and the energy content of low frequency audio led to the conclusion that some bass boost could be tolerated during record. This would permit equivalent attenuation during playback, minimising possible problems with low frequency hum and noise.

Originally, boost was applied below 100Hz but present-day practice is to employ a time constant of 3180μs, giving a nominal turnover point of 50Hz and boosting at the rate of 6dB/octave below that.

At the other end of the spectrum, it was apparent that the tape could not accommodate the same flux as at mid frequencies. Rather than lower the whole recording level to match the high frequency capability of the tape, the decision was taken to maximise the recording level between 50Hz and 1000Hz or more, and design for deliberate treble cut beyond that. The loss would have to be made good by equivalent boost during playback.

The solid line in Fig. 2 shows the standard (and idealised) flux/frequency curve which was settled upon for ferric oxide cassettes — flat between 50Hz and 1325Hz, 6dB/octave boost below 50Hz and 6dB/octave cut above 1325Hz.

If there were no other considerations, the recording amplifier would be compensated according to this same curve but things are not as simple as that.

In a practical deck, limitations of the head and drive circuitry and

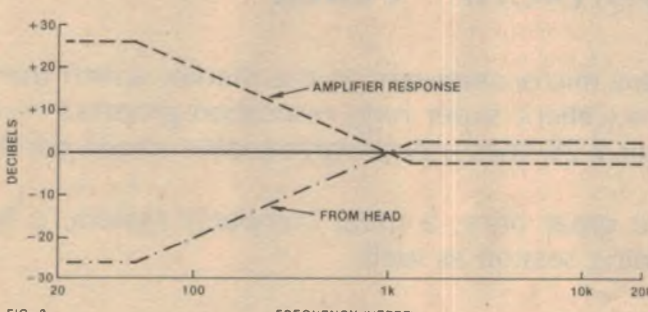



FIG. 3

*When replaying a flux curve like Fig. 2, an idealised head would produce the response shown. For a flat overall response, a compensation curve as shown dashed would be necessary.*

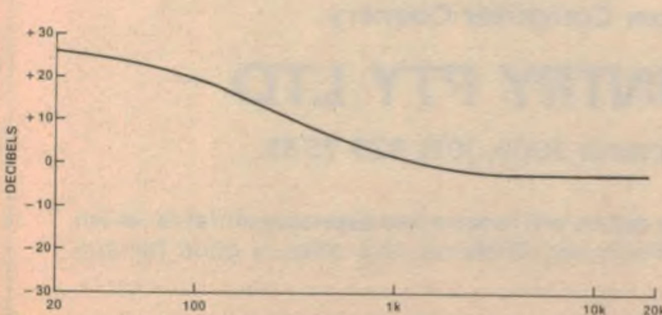



FIG. 4

*With rounded rather than abrupt turnover regions, a practical cassette replay compensation curve is as shown at left.*

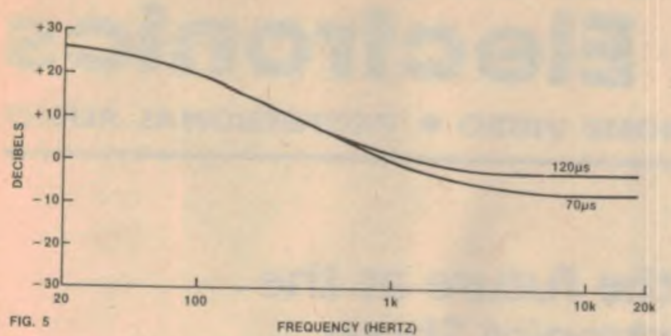



FIG. 5

*The compensation curves for 120µs (Fe) tape and 70µs (CrO2) tape. Reduced treble gain for the latter tends to minimise high frequency tape hiss.*

demagnetisation in the tape itself impose their own losses in the high frequency region and make it neither necessary nor desirable to roll off the recording amplifer as shown.

Instead, the high frequency response of a recording amplifier is normally "tailored" in individual models (shaded area, Fig. 2) to ensure that the signal on the tape approximates the standard flux/frequency law (solid line). In short, that it will produce a "flat" signal from a properly compensated replay amplifier.

## PLAYBACK RESPONSE

Which, of course, brings us to the subject of playback and, here again, we are faced with a two-tier requirement.

Fundamentally, the output voltage from a magnetic playback head tends to be proportional to the rate of change of the flux in the gap. A rapid change, due to a high frequency signal, will induce a much higher terminal voltage than a slow change, due to a low frequency signal.

In practical terms, the output from a magnetic playback head tends to rise with frequency at the rate of 6dB/octave. When this upward tilt is combined with the flux curve of Fig. 2, the overall response which results looks like the dot-dash curve in Fig. 3. Indeed, this is the frequency characteristic of the signal presented by the head to the playback amplifier.

To translate this into a level response, the playback compensation circuitry must produce a reciprocal curve, involving the same two time constants: 3180µs (50Hz) and 120µs (1325Hz). The idealised response, shown as the dashed line in Fig. 3, is level below 50Hz, falls at 6dB/octave from 50Hz to 1325Hz, and remains flat above 1325Hz.

Ideally the combination of the two — the signal from the head and the amplifier compensation — will produce an overall flat response (solid line).

A practical, as distinct from an idealised, playback response has smooth rather than abrupt "corners" and looks more like Fig. 4. Again, in a practical deck, the desired response may be achieved by "fiddling" the compensation circuitry to make up for possible deficiencies in the head performance, particularly in the upper treble region.

And this brings us to the point where our correspondent stumbled — the relationship between the compensation for ferric and chromium tape — between 120µs and 70µs.

Fig. 5 repeats the ferric response curve of Fig. 4 but, in addition, it shows the 70µs curve for chromium tape, with a "corner" frequency of 2270Hz. Clearly, the amplifier gain beyond 1325Hz is lower for chromium that it is for ferric tape, which accounts for the greater attenuation of high frequency noise, referred to by Mr Andriesson, and noted in practice by our correspondent.

So everything checks, as far as the basic theory is concerned.

What doesn't check are the abbreviated explanations that are sometimes offered for tape recording and playback compensation and the failure to clarify the vital role of head response in both modes. It is little wonder the confusion results.

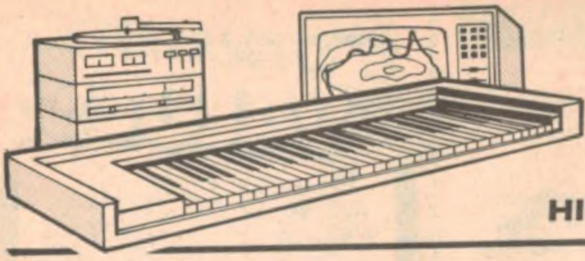
We trust that our correspondent and his friends will be better able to sort the matter out for themselves. But here's a tip for what it's worth. Think purely in terms of tape; don't try to construct parallels with, or borrow phrases from, disc or other technology.

You'll get all tangled up again!

## Another cassette problem . . .

Why, asks a reader, is the tape in some cassettes passed around corner pillars, as well as guide rollers? It must surely increase friction.

We put this one to a cassette designer. "Yes", he said, "It does increase friction and it is meant to do so. The aim is to increase tape tension by a controlled amount, to ensure smoother flow, better alignment and better winding.



# Audio-video Electronics

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## LAS VEGAS: A glimpse of the future at the Consumer Electronics Show

With more than 900 exhibitors and a trade-only attendance of more than 67,000 visitors, the recent Winter Les Vegas CES (Consumer Electronics Show) has more than ever established its place alongside the older Chicago Summer Show. Video was strongly represented but there was still plenty of interest in audio-hifi.

**by GEORGE TILLETT**

At the Last Winter Show, CBS caused a sensation by announcing that future records would involve a compander system to increase the dynamic range. As the system was claimed to be compatible (the records could be played without an encoder) it was called CX or Compatible Expander. It is intended to be a standard system for all record companies and the idea has been endorsed by Warner, Atlantic and RCA among others. But, so far, only about 24 CX records have been released, although there is no lack of decoders. It is in strong contrast to the early days of stereo when we had records but no suitable phono cartridges!

Opposition to CX comes from recording engineers, who feel that they would lose some control over the sonic quality. Then again, some of us have doubts about its compatibility. Be that as it may, CX licensees now include Nakamichi, Kenwood, Pioneer, Yamaha, Marantz, Hitachi and Toshiba.

**George Tillett is correspondent in the USA for "Electronics Australia" and "VideoMag'.**

The dbx noise reduction system is gaining in popularity and both Yamaha and Teac were showing cassette recorders incorporating it. Teac's V-95RX has both Dolby-B and dbx, giving a dynamic range of 69 and 92dB, respectively. Other features include bi-directional recording and playback; also Up and Down pushbuttons for level and a fader control.

Akai have one of the lowest price models with Dolby-C, the CS-F13, which is only $199.95.

Several decks feature auto-reverse and some, like Toshiba's PC-G6R, use an infrared sensor for switching. Instead of changing direction at the extreme end of the tape, the sensor detects the non-metallic leader and switches immediately, thus avoiding the usual 15-second blank spot which often comes just at the wrong time.

Most of the higher priced decks feature some kind of "Music Search System" for quick access to chosen selections on the tape and each manufacturer has his own acronym describing it. For example, there's Sansui's AMPS (Automatic Music Program Selection), JVC's MMS (Multiple Music Selection and Teac's CPS or (Computomatic Program Selection).

Some of the systems depend on blank spaces between recorded selections for sensor operation but the Akai Intro-Scan is a little different, as it plays back the first 10 seconds of a selection for easy identification.

Cassette designers must have real headaches trying to figure out new ideas and it is interesting to look out for the latest innovations. This year, I think, it is "push-button head demagnetisation" — so far provided by two models, one from Aiwa and one from B&O. I'll be surprised if there are not more decks with this feature at the June show.

Open-reel recorders are still popular among serious audiophiles, although the estimated sales of 150,000 last year are way below the figure for cassette decks. A number of new models were seen at the Show, most of them having provision for the new Extra Efficiency (EE) tapes.

Teac's X-1000R is a good example of modern design. It has a built-in dbx system, provision for 267mm reels, dual capstan closed-loop drive, variable pitch control and bi-directional recording facilities.

At 19cm/sec, the frequency response extends to 34kHz (−3 dB) with a signal-to-noise of 65dB. Switching in the dbx system extends it to 100dB. It is claimed — with some justification — that the performance

*Sansui are still pushing their "super feedforward" circuitry, as evidenced by this new AU-D33 integrated amplifier, rated at 50W per channel and a total harmonic distortion figure of less than 0.004%. Denon were also showing three integrated amplifiers which, from the description, would appear to be using a similar system.*

with EE tapes at 9.5cm/sec is equal to that obtained from "ordinary" tapes at 19cm/sec.

Turntables are still coming down in price and there is now quite a selection of direct-drive models costing less than $200. Small models termed "album size" are becoming very popular for packaged component systems. Sansui's PM-7, for instance, measures about 35cm square and offers programming of up to 7 musical selections on a record for playback in any order. Incidentally, this model is Sansui's first SLT (Straight Line Tracking) entry.

Another Sansui model is the XR-Q7 which uses two motors to reduce rumble. The second motor is mounted coaxially with the main (direct-drive) motor, but rotates in the opposite direction to cancel out fluctuations. Well, that's the theory anyway, but the rumble figure of −80dB (DIN-B) would indicate that the idea works! The ingenious design is called the "Synchrotor". Among the other features of the XR-Q7 is a low-mass straight arm and a "Repeat" function, which enables a record to be played continuously.

## SLT TURNTABLES

Straight line (SLT) turntables use an optical or other kind of sensor which is activated when the arm deviates from its tangential position. A pulse is sent to the arm drive motor and the arm duly moves forward one groove. Critics have said that this one-groove-at-a-time movement means that there must be a tracking error for most of the time. This is perfectly true but it amounts to a fraction of a degree at the worst position — at most one-tenth that of pivoted arms.

One model, the Sony PS-800 even reduces this microscopic error by applying a constant drive to the arm in addition to the correction pulses. Another feature of this model is a "bionic" arm which is completely electronically controlled.

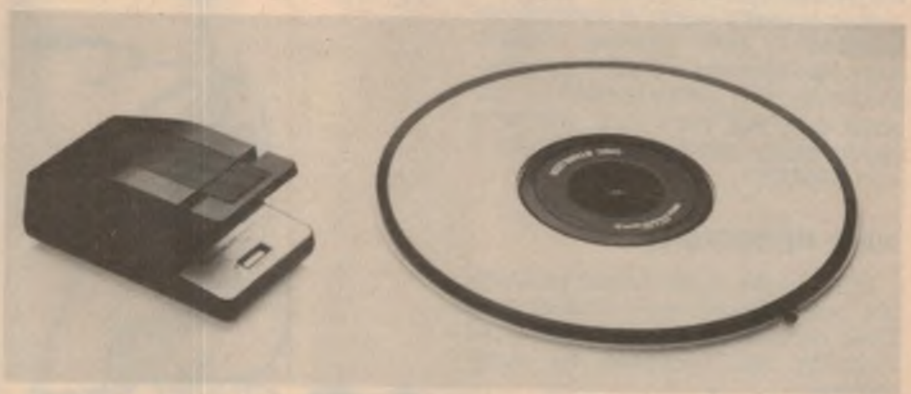
A velocity feedback circuit provides the tracking force, and a knob on the front panel enables this force to be varied while a record is playing — a feature which I have found useful when testing phono cartridges.

Now Denon have come up with another model with an "electronic tone arm" that "senses dynamic record conditions and then adjusts its tracking and anti-skating forces accordingly". This model is not an SLT design: it employs a low-mass straight pivoted arm.

United Audio (DUAL) were using a spectrum analyser to show the superiority of their arm, which uses a tuned counterweight. A special record containing eight 1mm warps plus a 300Hz signal was employed and the turntable was fitted with a standard arm as well as a Dual ULM model. Quite an impressive demonstration.

## On display at the Las Vegas CES

*Mattel's electronic "Synsonic Drums" unit takes up a lot less space than a conventional acoustic drum set and doesn't have to make as much noise. It also offers another advantage: an in-built memory which makes it possible to compose, play, record and replay drum routines at will.*



*This Audio Technica "Disc Stabiliser" takes the place of the usual turntable mat. When the space between the disc and the stabiliser is evacuated by means of the hand pump (left) air pressure holds the disc firmly in place during replay.*

## VACUUM BONDING

About two years ago, Luxman introduced an elaborate turntable which has a built-in vacuum pump to bond the record tightly to the platter. The platter has two vent holes in it and the outside rim is raised slightly to form an airtight seal. The pump operated for a few seconds before the stylus landed in the first groove and the vacuum was sufficient to last during play: in fact an automatic release circuit is operated as the arm swings back to its rest — otherwise you just couldn't pry the record from the platter!

Luxman introduced a lower priced version at the Show and another vacuum pump model was shown by the Swiss company of Thorens. This model has two tonearms so it could be classified as a professional unit. The advantages claimed for vacuum bonding include reduced distortion, elimination of record resonances, improved tracking, and the flattening out of warped records.

If you want to fit a vacuum system to your own turntable, Audio Technica have just the job: the Model AT 666 Disc Stabiliser. This consists of a small manual pump and a precision duralumin platter which replaces the turntable mat. A tube connects the pump to the platter valve and a few strokes on the pump creates enough vacuum to hold

## AUDIO-VIDEO ELECTRONICS—cont.

the record securely — even if it is warped.

Some three years ago, if I remember correctly, Threshold introduced an amplifier using no negative feedback. Distortion was balanced out by using a voltage amplifier and a null circuit. Sansui uses a similar concept in their "feed-forward" amplifiers. Recently, they have added two more models to the range, one rated at 50 watts per channel and one rated at 35 watts — both with a THD of less than 0.005%.

Now Denon have introduced three integrated amplifiers which appear to use the same kind of circuit. I quote from the specifications, ". . . a localised error detection system is used to cancel distortion without any negative feedback". Power ratings are 60, 80 and 100 watts per channel.

Yamaha's new A-1060 uses what they call an X-power supply which is something like Soundcraftsmen's Class-H configuration. Low level signals are handled by a low current supply but a more powerful supply is automatically switched in when required. Yamaha were also showing a Class-A amplifier, the Model BX-1 which is rated at 100 watts each unit: that's right, you need two for stereo and it will set you back a cool $4000!

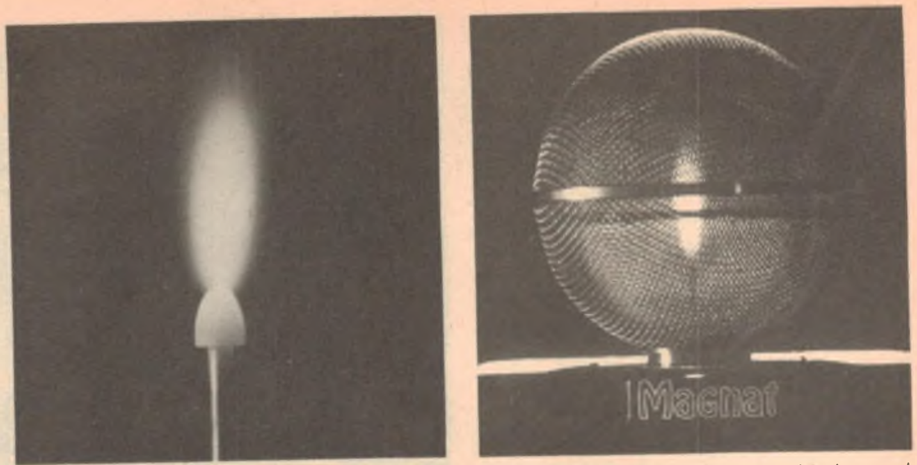
### NEW RECEIVERS

Many of the higher priced receivers are now featuring some kind of electronic controls with no rotaries at all. All functions are controlled by push-buttons.

Kenwood's KR-1000 is a good example. Everything is controlled by "push-pads" or touch controls and various displays indicate operating mode, power output, time, station frequency, speakers in use, relative volume level and graphic equaliser positions. Other features of this prestigious receiver include presets for 12 stations, synthesiser tuning, mic mixing, low and high filters and wide-narrow band IF filters.

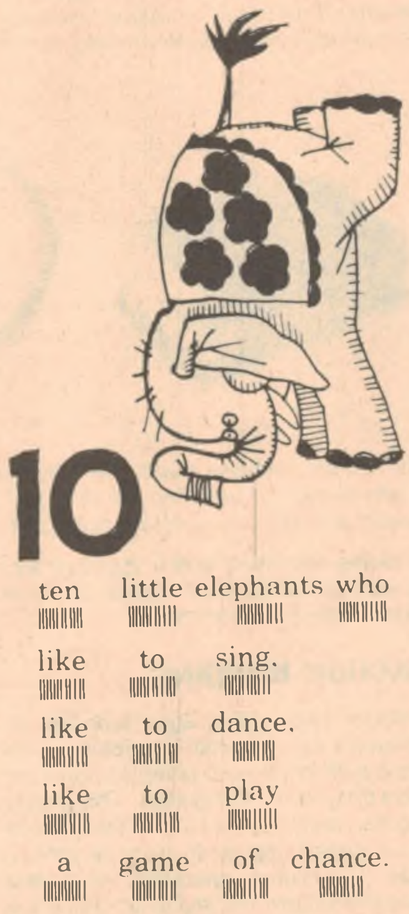
Kenwood were also showing their second cassette-receiver, a combination that is becoming more common here, although I doubt whether it will be as popular as in Japan.

On the other hand, we have experienced an equivalent boom in tiny portable radio-tape players such as Sony's Walkman and the Koss Music Box, plus many others with names like the Road Runner, Hip Pocket Stereo, Sound Partner Music Mate and so on. All use lightweight headphones. Those from Koss fold up to "fit in the palm of your hand" but prize for the smallest must go to Denon whose AH-P5's are housed in a cassette tape box!




*In the latest version of the Ionophone tweeter loudspeaker, the ion cloud is formed at the tip of an electrode, as shown on the left. Modulation applied to the sustaining voltage produces sound waves in the range 4kHz and upwards. The sound source is enclosed in a metal mesh ball, as at right.*

Space will not permit a description of anything like the number of loudspeakers at the Show but I will pick out a few of the more interesting.




*The latest in nursery novelties. Turn the pages of the book, pass an electronic wand over the bar graphs and a speech synthesiser speaks the words "in a warm and friendly voice"!*

The Quad Electrostatic ESL-63, which I had heard when I visited the plant in England a few months ago, was not on show. I imagine the company has more orders than they can handle at the moment.

However, a full range ESL called the Audiostatic was attracting a lot of attention. It comes from Holland and is in the form of five panels standing about 130cm high and 115cm wide. Because the panels are hinged, it is possible to obtain quite good dispersion, although best results are obtained in large rooms. The systems can be obtained with built-in 100W Class-A amplifiers if desired.

The Acoustat company claims to be, "The World's largest manufacturer of electrostatic speaker systems" and their top model is the "four", which measures 150 x 90 x 10cm. Coupling is via a method called Magne-Kinetic Interface, which involves the use of two special transformers. Efficiency is said to be higher than average, with an impedance of around 4 ohms.

### LEAD CYLINDER!

The GNP company were demonstrating a system called "The Lead Cylinder" which turned out to be a three-way design with the treble and midrange units housed in separate enclosures, mounted on top of the cabinet containing a 25cm woofer. The midrange driver was a 11.5cm cone type, housed in a 18cm cylinder lined with a sandwich of lead sheeting and some corrugated cellulose material. The object was to reduce colouration and it certainly seemed quite effective.

B&W, as always, were giving a fine demonstration: this time with their Model 801 which has a new midrange enclosure made from a glass reinforced concrete mix, with an outer skin of

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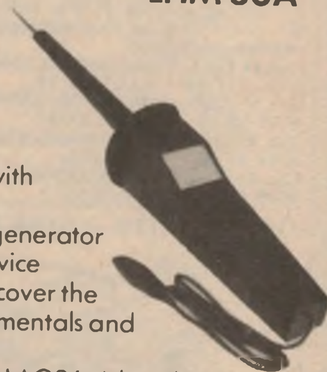

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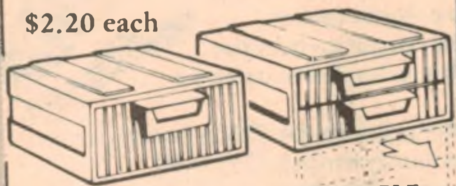

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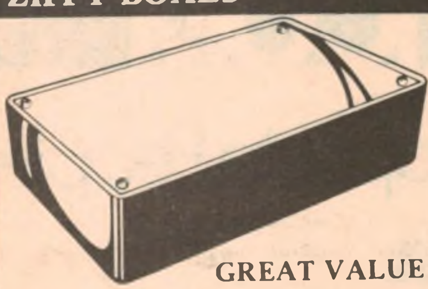

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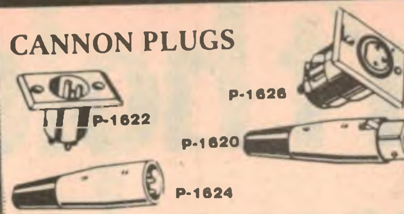


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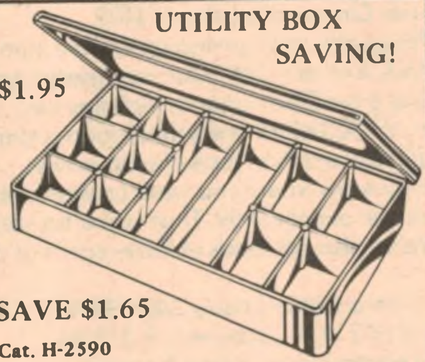

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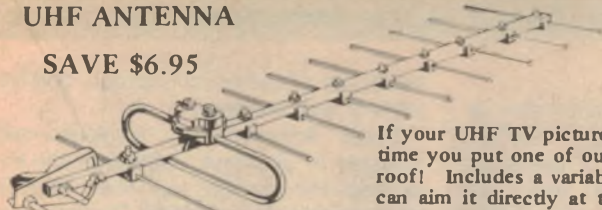

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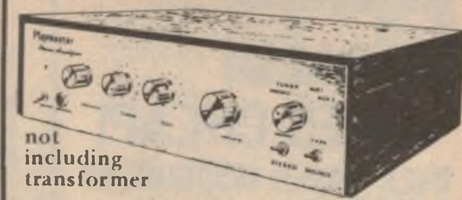


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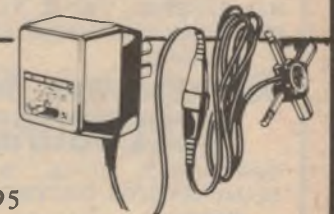

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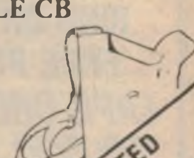

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moulded polystyrene.

The Hill Plasmatronic system also attracted many discriminating listeners and I noticed that a pair of these impressive systems were used by Threshold to show off their new Stasis (non-feedback) amplifiers. As I am sure most readers will remember, the Hill system uses a modulated plasma discharge for the high frequencies.

## IONOPHONE SPEAKER

Which brings me to the latest version of the Ionophone, being demonstrated by Magnat from W. Germany. The Ionophone was invented about 30 years ago by a French physicist, Dr Klein. It was a corona discharge system using high voltage generated by a 27MHz oscillator. The corona tip was in a small quartz cell and was coupled to the air by a short horn. Audio signals were fed to a transformer coupled modulator, and the crossover frequency was 1kHz.

In the late 1950's I was considering using these units in some Decca loudspeakers but found too many problems. Throat distortion was too high and radiation from the 27MHz oscillator was significant up to the third and fourth harmonics, causing the TV test department to shut down until I changed the lab hours!

Efficient shielding solved that problem and I designed a new horn which was a lot better. But the corona cell proved to be altogether too erratic, and the project was dropped.

Fane Acoustics in England and Ducane in America subsequently improved the design but now Magnat have gone a stage further. The horn has been eliminated, along with the quartz cell, so the corona is coupled directly to the air. It is about 38mm long and contained in a perforated metal ball. Inside the ball is a silver-plated sphere which inhibits the cooling of the enclosed air mass. The crossover frequency has been increased to 4kHz. As the ion cloud is virtually massless, the transient response is superb.

The most interesting exhibit in AR's room was not a loudspeaker at all. It was something called the "ADSP" which translates as Adaptive Digital Sound Processor. According to AR, this is a computer, "which listens to a test signal, analyses it and then automatically designs a filter-equaliser to compensate for the room-loudspeaker characteristics."

In operation, a test signal is picked up by a microphone placed near the listener's position and the information passed to a 16-bit NMOS processor which is the "heart" of the ADSP (They had better come up with a name for the thing before it is on the market!) Texas Instruments helped with the development work and it is hoped that units will be available by June.

Microcomputers are now used in almost everything from ovens to record

## Servicing aids from Ralmar Agencies


*Of natural interest to "Electronics Australia" readers are the three pressurised products from Ralmar shown above. "Dust Off Spray" (left) can be used to blow dust or debris from vulnerable surfaces (electronic, photographic, etc) without risk of leaving behind moisture droplets. "Zero Freeze" can reduce the temperature of electronic components, while operating normally, and show up possible intermittent faults. "Contact Cleaner" provides an anti-fouling, anti-moisture treatment for electro-mechanical components like switches, fuses, potentiometers, etc. The above items are stocked by electronic component stores around Australia but, where a supplier cannot be located, readers may write to Ralmar Agencies Pty Ltd, at 4 Carlotta St, Artarmon, NSW 2064. Phone (02) 439 6566.*

# A BATTERY POWERED STYLUS CLEANER

*While a normal phono stylus brush may get rid of loose dust and fluff, it will not necessarily be effective against particles or deposits which tend to adhere to the stylus surface.*

Goldring Products Ltd, of England, have come up with an interesting answer to this potential problem – a battery powered oscillator, which drives a small vibrating pad on which the stylus can rest. Measuring about 8mm in diameter, and vibrating at a few hundred Hertz, it is intended to dislodge surface fouling, without risk to the stylus or cartridge.

In use, the unit is first switched on and then placed on the stationary turntable within the pickup's normal arc of travel. The stylus is then lowered gently on to the vibrating pad and left there for about 5-10 seconds. The amplifier should, of course, be switched off in the meantime.

The local distributors say that experience to date has confirmed the effectiveness of the unit and there have been no reports of malfunction or damage to phono cartridges. They stress, however, that the pickup must be handled carefully and not subjected to any stress beyond what it would encounter in everyday use.

A member of E.A. staff who used the device for a trial period on his own equipment, reported no difficulties and a stylus which looked very clean under the microscope.

The Electronic Stylus Cleaner is distributed in Australia by Soundring Distributors Pty Ltd and has a recommended retail price of $29.95. It is available through specialty hifi dealers but, in case of difficulty, Soundring can be contacted through PO Box 154, Cammerary, NSW 2062. Phone (02) 92 1990.

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players and toys to trashgrinders but here's a new one: the Audiovox Corporation were demonstrating a handheld unit which sends out signals to start a car. The system is called "Computer Start" and the idea is that the car will be nice and warm in the winter or cool in the summer, before you put your fragile body into it. A luxury no one should be without, says the leaflet!

**In brief . . .**

Digital Audio Disc (DAD) players were shown by Fisher, Pioneer, JVC, Denon, Sony and Hitachi . . . Solarex were demonstrating a variety of sun-powered items including a power pack producing 9V at 50mA for portable radios, a higher powered battery charger, display turntables and a "Solar Sunflower" with 23cm spinning petals . . . Western Publishing, "Connects the World of Books to Electronics" with a mini-computer. The device is intended for young children who learn words by passing a wand over them in a special book, thus activating a "warm friendly voice". Price of the battery operated unit, which "can even say hippopotamus", will be between $60 and $80 . . . Accutime were showing a "Melody Alarm Clock" with a built-in electronic game — but who wants to play electronic games in bed?

☆ ☆ ☆

**"TELEVISION" magazine** in the UK suggests to its readers that they encase electrical connections to the dipole of a TV antenna, plus other screws, nuts, washers, &c in Plasticine, before erecting the antenna. They say that the Plasticine will gradually harden with exposure but it is easily broken away at a later date. The claim is that it will protect fittings and threads and make things easier to service or disassemble if necessary.

**TOSHIBA,** who developed the Adres system of noise reduction, have come up with a new IC which can reportedly cope both with Adres and the new Dolby-C, under playback conditions. It may even cover dbx-II as well. Toshiba are reportedly negotiating with Dolby and dbx interests in the hope of finding common ground and a way out of the present NR confusion. Toshiba are in a fairly good position to take such initiative because their Adres system ranks number 2, behind Dolby-B, in terms of units in the field.

**THE CAD (Compact Audio Disc)** system developed by Philips has picked up another three major supporters in Mitsubishi Electric, Trio-Kenwood and Sharp, all of whom have signed the appropriate licensing agreement. Toshiba has also reached a similar decision and will sign soon. They will join other major Japanese manufacturers such as Sony, Denon, Pioneer and Sanyo. The giant Matsushita has decided to back both the CAD Philips/optical style audio disc, and their AHD capacitance style audio disc based on their existing VHD (Video High Density) technology.

# Mitsubishi LT-5V linear tracking turntable

While there are quite a few turntables on the market which have linear tracking arms, there are only a few which are designed to play in the vertical mode. One such is the Mitsubishi LT-5V which we review this month. It has the advantage of having a standard headshell with the conventional EIA locking collar, so cartridges can be easily interchanged.

In the past, many hifi enthusiasts have probably been attracted to the concept of a vertically operated turntable but it is not until you are faced with an actual model that you realise the problems the designer has had to consider. The Mitsubishi LT-5V is a good example of this. It is not just a conventional player "stood on its edge" but is a completely new design.

While the LT-5V could logically be hung on a wall it does not have provision for this. Instead, it has two mounting "legs" with compliant rubber feet so it can be placed on a shelf. If this is done it will require shelf space 470mm wide by 200mm deep with 490mm clearance above it.

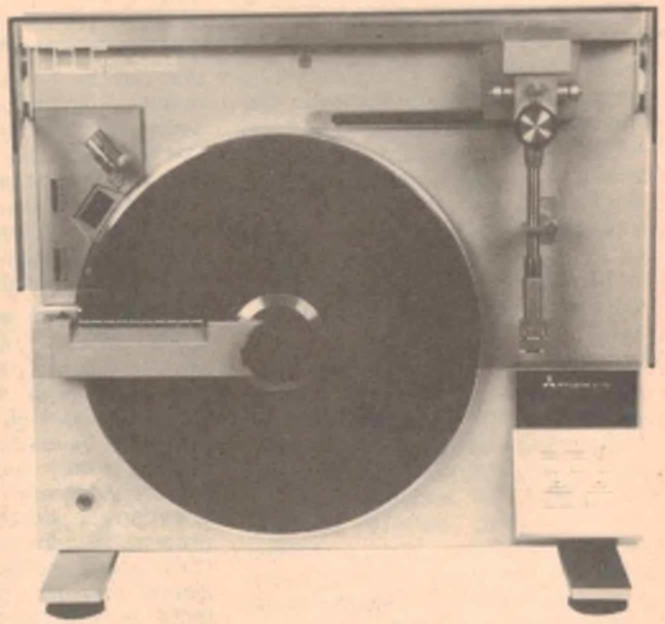
To keep the record on the turntable while it is spinning, the LT-5V has a "swing out clamper" which clips over the spindle. The arm is dynamically balanced but the counterweights are arranged to apply the tracking force "into" the turntable rather than down, in the normal case. The arm headshell has the standard locking collar so any cartridge/headshell combination with a mass of between 10 and 20 grams can be used.

This is an advantage compared with other turntables with linear tracking arms which can generally only be used with their own unique cartridge.

On the lower righthand corner of the turntable base plate is the control panel accommodating five buttons with microswitch action plus a number of indicators which show speed, mode and arm tracking error, if any. On the top left hand corner is another panel with two speed adjust controls, a light emitting prism for disc size selection and the window for the illuminated strobe.

Because of the positioning of the various controls, the designer of the LT-5V has opted for a half-cover of smoked perspex rather than a full cover which would be more unwieldly but would probably provide better dust protection for records when they are on the platter. While we are not altogether happy with the half-cover compromise, it is difficult to suggest a better one without redesigning other features.

Three motors drive the LT-5V. Belt-drive is provided to the turntable hub of about 180mm diameter from a small motor running at around 1200rpm and controlled by phase locked loop circuitry. Just what the reference is for the PLL we are not sure but it is an internal oscillator rather then the incoming mains.



*The Mitsubishi LT-5V has a "half cover" for ease of access to the disc clamper and control buttons.*

Strangely, in spite of the fact there apparently is a precisely set internal reference oscillator, there are no detent positions on the speed control knobs which would give precise speeds of 33 and 45rpm. Instead, the user has to rely on the less precise ±2% accuracy of the incoming mains which powers the illuminated strobe markings on the turntable hub and set the speeds for a stationary strobe pattern.

In fact, we went through the exercise of powering the turntable from a free-running 240VAC inverter. Varying the "mains" frequency then had the effect of making the strobe patterns vary while the platter speed remained constant. Interesting!

We should interpose at this stage and state the LT-5V owner's manual gives no technical description of the unit and no circuit diagram.

The other two motors involved in the LT-5V are the optically controlled servomotor for the belt-driven linear tracking mechanism and the motor for the cam-driven lift/cue mechanism. All of these operate smoothly and quietly, although we did find the traverse speed of the arm painfully slow, which made curing operations somewhat tedious. Added to this was the difficulty in estimating where the stylus was in relation to a particular track.

Sure, there are reference markings on the record clamper arm and the top of the deck underneath the arm counterweight but they only give an approximate guide. We found it sorely tempting to lift the headshell and manually cue it instead. Actually, this reviewer succumbed to the temptation although the supplied headshell does not have a finger lift.

Mitsubishi state that moving the tone arm by hand is taboo and that damage may result if it is attempted. We agree that while ever the tone arm is traversing or in the lift/cue modes it certainly is not

(Continued on page 116)

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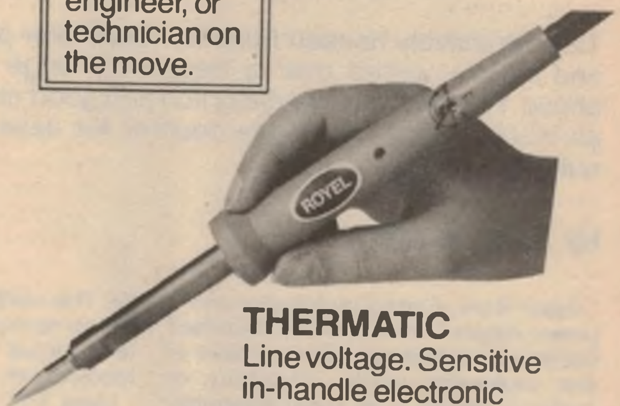


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*For stable, low distortion audio signals*

# Function Generator with digital readout

This attractively housed Function Generator produces sine, triangle and square waves over a frequency range from below 20Hz to above 160kHz with low distortion and good envelope stability. It has an inbuilt 4-digit frequency counter for ease and accuracy of frequency setting.

**by JOHN CLARKE**

Apart from a good multimeter and a power supply such as the one described last month, the next most useful piece of test equipment in the laboratory or home workshop is an audio generator. In the past 15 years or so, this would normally be a solid-state Wien bridge oscillator but more recently the function generator has come into its own, particularly where the potentially very low distortion of the former circuit is not required.

The particular advantage of a function generator is that it has good envelope stability. This means that the output level stays constant regardless of small or large changes in the frequency setting. This is not the case with typical solid state Wien bridge oscillators which are stabilised with a thermistor. These Wien bridge oscillators can fluctuate violently in output level when the frequency is changed and take several seconds to settle. This can be very frustrating when trying to measure the frequency response of a circuit or component such as a loudspeaker.

Using that attractive, low profile case for the Function Generator meant that a different approach was required to the conventional dial scale. If this was used it would have to be of small diameter and, in any case, it would be subject to the normal drawbacks of calibration accuracy, and considerable cramping at the high end of the scale.

This problem has been solved at one stroke by incorporating a 4-digit counter. This eliminates the need for any dial scale or any calibration procedure. The frequency counter uses the 50Hz mains as a timebase to give an accuracy of about ±2%.

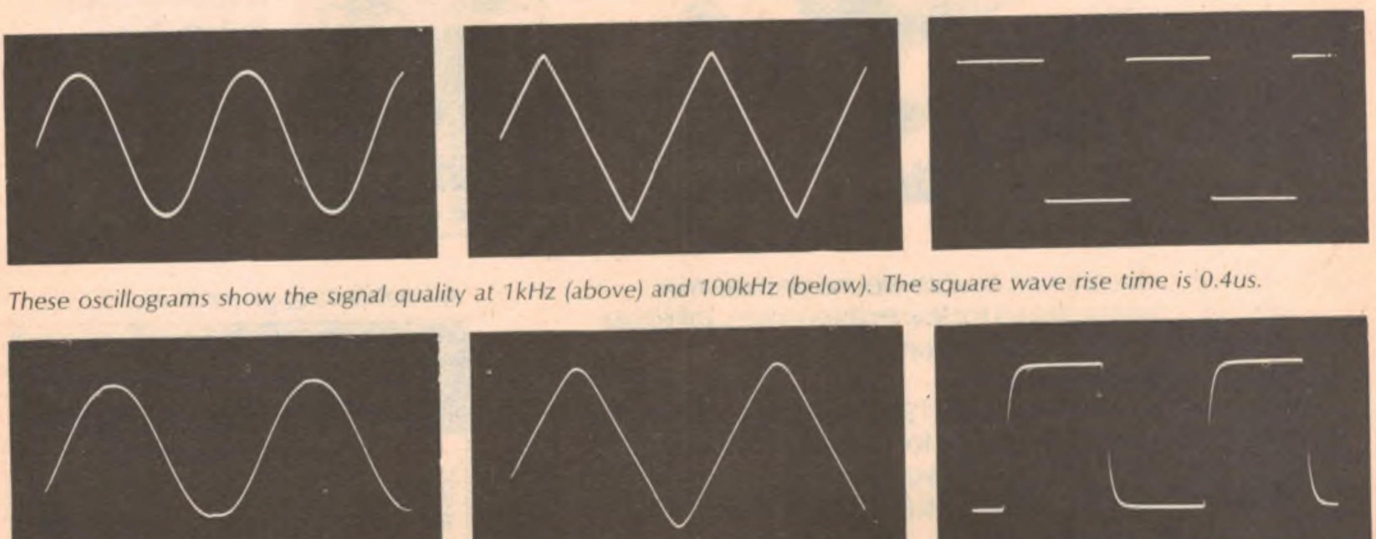
We used an XR-2206 IC from EXAR to generate the waveforms for our Function Generator. The operation of the IC can be described in four blocks: a voltage controlled oscillator (VCO), an analog multiplier and sine wave shaper, a unity gain buffer and a set of current switches.

## Block Diagrams

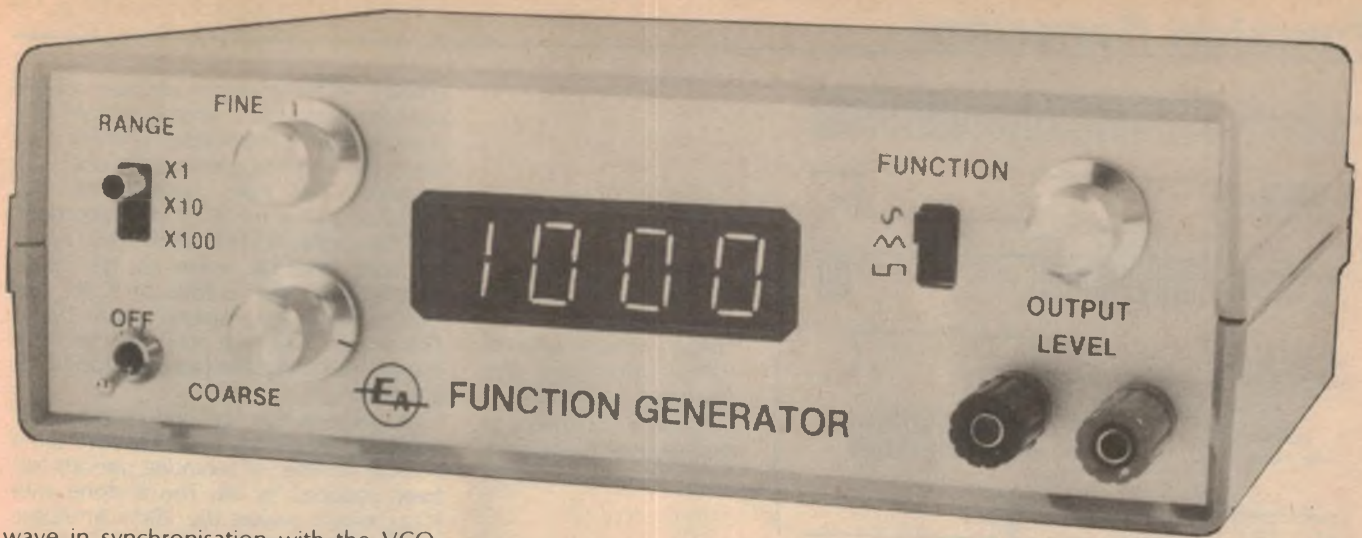
As can be seen in Fig. 1, the IC is capable of many operations including amplitude modulation (AM), frequency shift keying (FSK), and frequency modulation, via the current switches. The VCO is the major function block of the circuit, which generates the triangle and square waveforms at a frequency controlled by the current switches. Resistors tied from pins 7 and 8 are used to program the current switches and determine the VCO frequency.

The multiplier and sine wave shaper performs several tasks. It accepts the triangular waveform from the VCO and reshapes this to a sine wave. In addition, the output level of these two waveforms is controlled by a resistor at pin 3 to ground and with the voltage at pin 1. Either sine or triangle is selected with a resistor across the waveform adjust pins (13, 14), or open circuit, respectively, while the unity gain amplifier buffers the sine or triangle waveform.

The sync output at pin 11 is an open collector output that provides a square



*These oscillograms show the signal quality at 1kHz (above) and 100kHz (below). The square wave rise time is 0.4us.*




wave in synchronisation with the VCO frequency.

Fig. 2 shows a simplified block diagram of the frequency meter. This can be divided into three parts: counter and display, latch and reset and timebase. The timebase gives three counter update times: 20ms, 200ms and 2s. Let us look at the counter operation in the 2s update situation.

The 50Hz mains signal is squared by a Schmitt trigger and then fed to two decade dividers for an overall division of 100, giving a waveform with a period of two seconds. This waveform is fed to the latch and reset circuitry so that the input signal to be counted (from the function generator) is gated into the counter in one-second bursts, every two seconds. At the end of each one-second count period, the value of the count is latched (stored in 16 flipflops, four for each digit) and displayed. The counter is then reset, ready for the next count.

When the update time is two seconds, as discussed above, the display indicates the frequency directly in Hertz. For the 0.2 second update time, the reading must be multiplied by 10 and for the .02 second (20ms) update time, multiplied by 100.

Having discussed the circuit in block form, let us now look at the complete circuit diagram in detail.

IC1, the XR-2206 monolithic function generator, is connected to provide both the sine and triangle wave signals. R2 and R3 are trimpot resistors which are used to preset the level of the sine and triangle waves. When switch S1 is in position 2, a triangle wave is produced at pin 2 and the output level of this wave is determined by R2 since R3 is short circuited with S1c. When S1b is in position 1, a sine wave is produced and the output level of this is determined by R2 and R3. R3 is adjusted so that the sine wave level is the same as the triangle wave level.

In the sine wave mode, the sine wave shaper is brought into play to "round off" the peaks of the triangle wave. Critical adjustment of R4, between pins 13 and 14 of IC1, gives minimum distortion of the sine wave. R1, the symmetry adjustment between pins 15 and 16, is adjusted for equal positive and negative swings of the sine and triangle waveforms. Adjustment of these trimpots will be discussed later in this article.

S2a is used to select the three frequency ranges by switching separate timing capacitors across pins 5 and 6. Frequency adjustment is with the fine and coarse variable resistors and the 4.7kΩ resistor sets the maximum frequency for each range. The frequency of the generated signal is a function of the capacitor value between pins 5 and 6 and the frequency adjust resistors. The actual formula is F = 1/RC. Since C is a constant for each range, the frequency is proportional to 1/R.

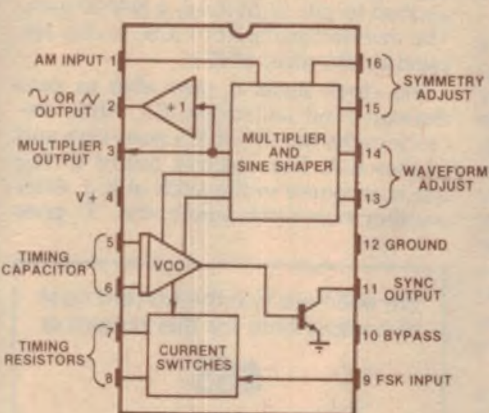



FIG. 1

With this 1/R relationship, the actual change in frequency with respect to the change with resistance is hardly linear especially when the resistance is small. This tends to give an unusable control at the low resistance end if only the coarse control were available. With the addition of a low value fine control, frequency changes are easily accomplished at the low end of the resistance range. The fine control has little effect at the high resistance end of the coarse control since, at this end, large changes in resistance are required for a small change in frequency.

The open-collector square wave output of ICl1, pin 11, is provided with an external 2.2kΩ pullup resistor to drive the input of IC7a, a Schmitt trigger which provides buffering and further squaring of the waveform. IC7c acts as a further buffer to drive an attenuator and then the transistor output stage. The attenuator (voltage divider) consists of 1.8kΩ and 2.2kΩ resistors, to adjust the level of the square wave to the same peak-to-peak level.

S1a selects the sine, triangle or square wave and the signal is attenuated with the 22kΩ level potentiometer. The resulting signal from the wiper of the pot is fed to the input of the emitter follower output stage.

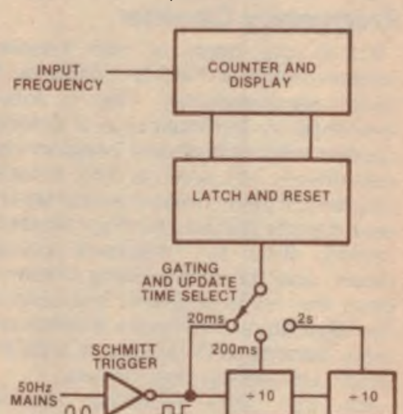



FIG. 2

The emitter follower stage consisting of the NPN BD139 and PNP BD140 transistors is a complementary symmetry arrangement. The NPN transistor drives the output for positive input signals and the PNP transistor drives for the negative input signal. To prevent crossover distortion at the transition when one transistor takes over the signal from the other, the transistors are biased on so that a quiescent current flows through both transistors. 2.2kΩ and 1kΩ base bias resistors set this current at around 40mA.

Heavy supply decoupling, consisting of the 100Ω resistors and 47μF capacitors across each supply rail, ensures good rip-

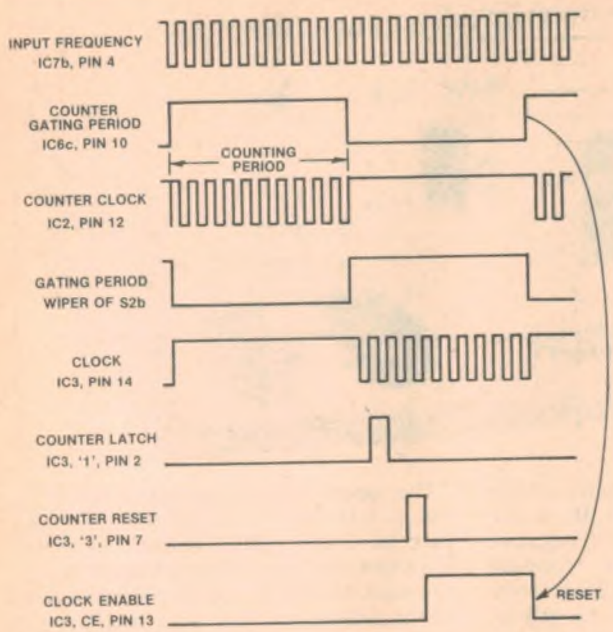


FIG. 3

*These timing waveforms illustrate the operation of the inbuilt frequency counter in the Function Generator.*

ple rejection. This allows the output signals to be attenuated, to millivolt levels without hum and noise swamping the signal.

Output impedance of the stage is a nominal 600Ω for all output levels.

## Frequency Counter

IC2 is the heart of the frequency counter and is a 74C926, made by National Semiconductor. This is loosely described by the makers as a 4-decade counter with multiplexed 7-segment output drivers. As well as the 4-decade counters, it also contains a 4-bit latch for each decade (the four flipflops alluded to earlier), BCD to 7-segment decoder drivers and the multiplexing circuitry to drive the seven segment lines and the four digit driver transistors. It drives common cathode LED displays via BC337's which are used as digit drivers.

For the 50Hz timebase reference signal, a connection is made to the transformer secondary via a 10kΩ resistor. This is clipped by diodes connected to the positive and negative 5V supplies and then fed to the input of IC7d, another Schmitt trigger, to be squared up. This signal is then fed to two 4017 decade dividers in cascade (IC4 and IC5) to produce a 0.5Hz signal (2-second pulses) which gates the 4-digit counter, as described previously.

The timing operation of the circuit is best explained with the waveform diagrams of Fig. 3. Firstly we will assume S2b to be in position 1 for the purposes of explanation. When the waveform at the wiper of S2b is low, the output of IC6c, connected as an inverter, is high and the input frequency from IC7b is allowed to pass to the output of IC6a and to the clock input of IC2. IC2 then counts the number of clock pulses. When the wiper of S2b goes high, the output of IC6c goes low and the clock signal to IC2 is prevented from passing to IC6a and further clocking IC2. IC2 then stops counting the clock signal.

When switch S2b is in position 1, the 50Hz is divided by 100 and this signal is applied to pin 12 of IC6d, a NAND gate. The inverted signal from IC6c is also applied to the reset of IC3.

The clock signal is now able to pass through IC6d and clock IC3. After one clock cycle, the "1" of IC3 goes high and latches IC2. The counted pulses of IC2 are now stored in the latch of IC2. After another two clock pulses, the "3" goes high and IC2 is reset, ready to count the next set of clock pulses. When the "4" output goes high at the next clock cycle, the CE or clock enable is disabled (high) and remains high until reset with pin 10 of IC6c going high.

So the complete cycle of events in counting the clock pulses occurs in this sequence. The cleared counter of IC2 begins to count the clock pulses and is stopped counting when half the timebase period has completed. One clock cycle after this, the counter is latched and the latched count is displayed on the display. The counter is then reset with IC3 and IC3 waits for the end of the timebase cycle when it is reset.

With S2b in position 1, the displayed count is in Hz since the counter counts over the period of 1 second. When S2b is in position 2, the display is in Hz x 10 since the counter counts only over 0.1 seconds. The third position of S2b provides a .01s or 10ms counting time and the display is in Hz x 100. If the signal for this timebase were to be taken directly from the output of IC7d, the display would be updated every 20ms. This would lead to a very fast changing display and make the last digit appear as a flickering 8.

> We estimate that the current cost of components for this project is
>
> **$85**
>
> This includes sale tax.

To alleviate the fast update time, the counting period has been kept the same but the number of counting periods has been reduced by 10. This is done with IC6b, which passes the 20ms timebase signal only when pin 10, the "4" output of IC4 goes high or once in every ten 20ms cycles.

Note that S2 selects both the gating time of the frequency meter section and the capacitor of the function generator, IC1.

Power for the circuit is derived from a full-wave centre tapped supply, providing positive and negative supply rails. Filtering is provided with 1000μF capacitors connected from each supply rail to ground.

There are three 5V regulators, one positive and two negative. One −5V regulator supplies IC1 and IC7 while the other supplies IC2 and the associated logic ICs. The reason for this unusual arrangement is to isolate the severe multiplexing noise generated by IC2, from the function generator, IC1. This results in an output waveform free from the noise generated on the other negative supply line.

The 1μF and 10μF capacitors connected at the input and output of each regulator prevent instability in the regulators and provide transient and ripple rejection at the regulated output.

It should be noted that while IC2 is powered from the negative 5V rail, its CK, LE and R inputs are driven from IC6 and IC3 which are powered from ±5V rails. This means that these signals will swing above the Vcc line for IC2 by +5V. However, although IC2 can only be operated from a maximum supply voltage of 6V it can safely handle signal voltages up to 15V without damage.

## Construction

We constructed our Function Generator in a Pac-tec case measuring 207 x 64 x 159mm and mounted the components on two PC boards. The main PC board is coded 82ao3a and measures 169 x 126mm, and the display PC board is coded 82ao3b and measures 83 x 46mm. A Scotchcal front panel artwork has been produced for the front panel of the Pac-tec case and measures 199 x 61mm.

The larger of the two PC boards is

designed to be screwed to the base of the case and the smaller PC board soldered at right angles to the main PC board. Check that the copper runs right to the edge of the 82ao3a PC board. If not, file the PC board until the copper is flush to the edge.

Next the components can be soldered to the PC board. Use the overlay diagram to help you position the components. It is easier to place the low profile components on the PC board first, such as the links, resistors and diodes followed by the ICs. When soldering the CMOS ICs, solder the supply rails first with the barrel of the soldering iron earthed and then solder each pin quickly. Pay particular attention to orienting the ICs correctly.

When all the components have been positioned, check your work and make sure that all the polarised components such as the diodes, capacitors, transistors and ICs are correctly oriented. Now work can begin on the display PC board. Place the links in first and then the displays. The displays are oriented so that the ribs at the top edge of the display are at the top. When soldering the displays keep them all in line and butted close together.

Placing the PC boards aside for the moment, work can begin on the front panel. We used countersunk screws to support the slider switches so that the Scotchcal panel can be placed over the screws and provide a front panel finish unmarred with screws. In doing this, construction is more difficult, since the rectangular holes for the switches have to be shaped before the Scotchcal label is applied to the front panel, however, the final result is well worth the effort.

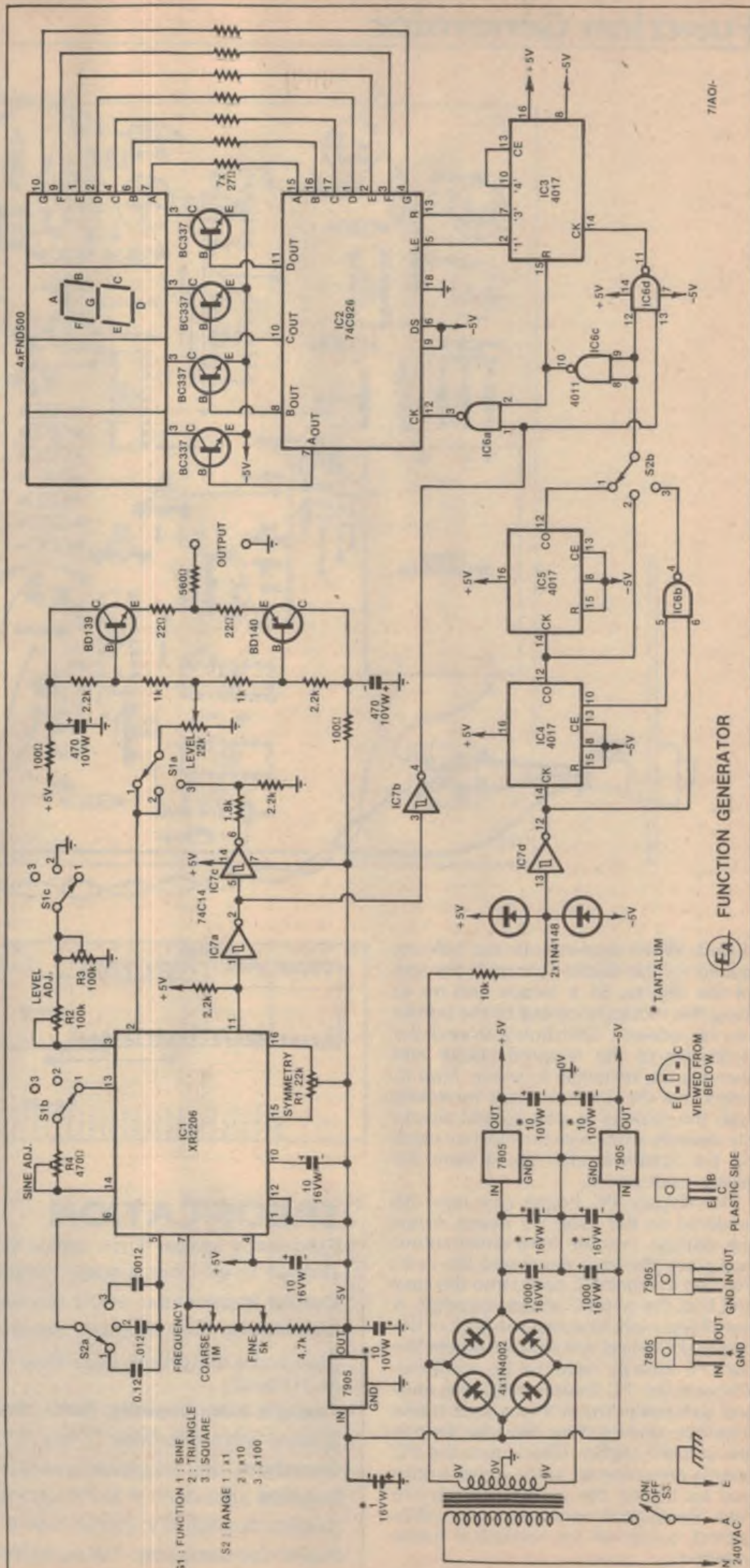
Our prototype used a 2-pole slider switch and a 3-pole slider switch, which agrees with the circuit and wiring diagram. However, these have different actuators, round for the 2-pole and square for the 3-pole. So for a better visual effect, it would be better to install two 3-pole sliders, with one pole unused on the Range switch.

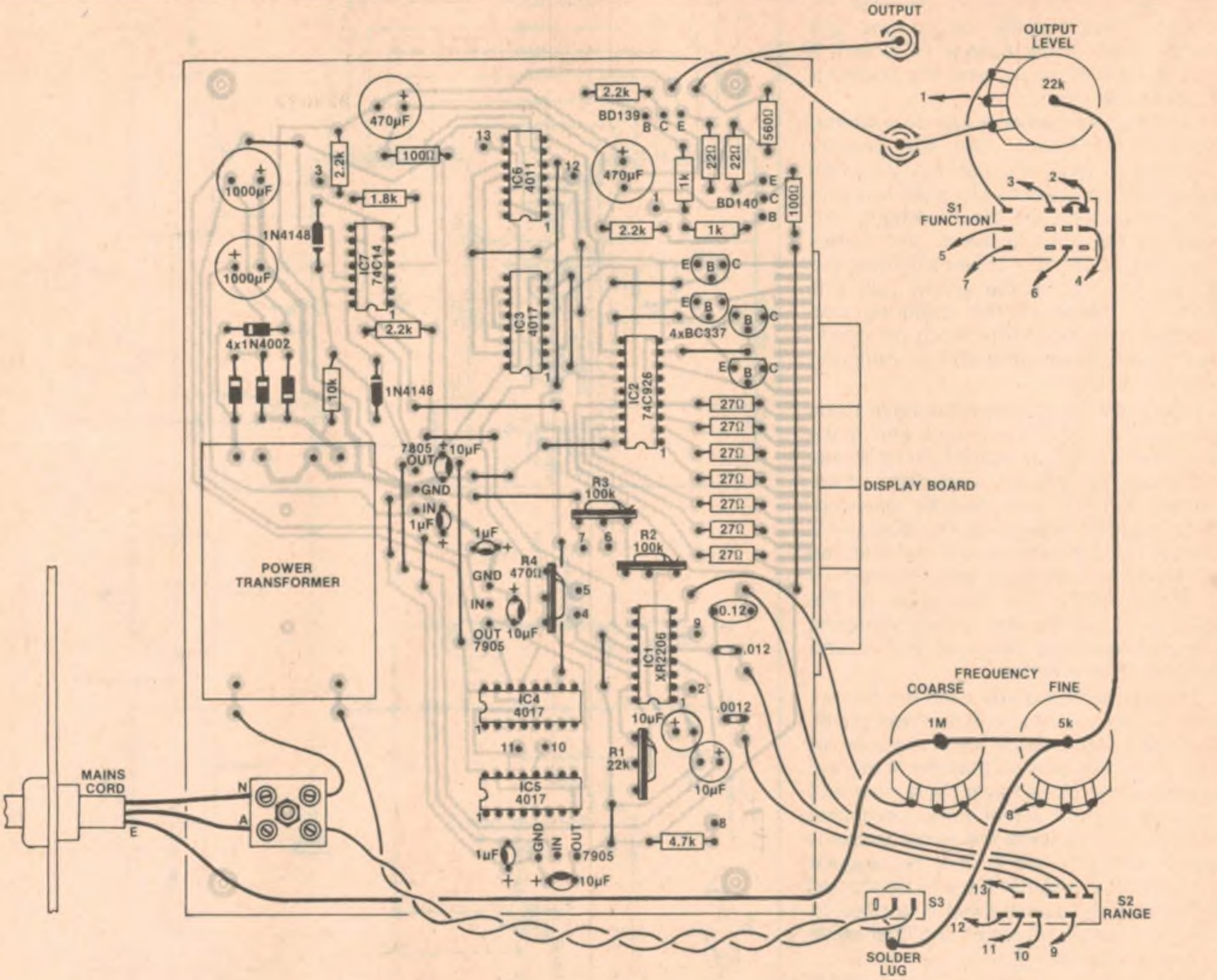
We have found that the Scotchcal will stick better to the smooth surface of the plastic panel rather than the stippled side. So use the smooth side of the plastic as the front face of the panel.

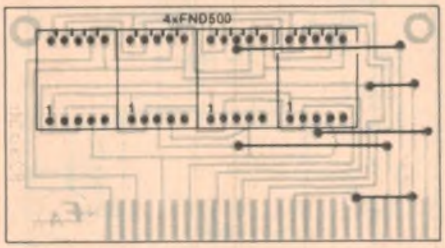
Using the Scotchcal art work as a guide, mark up the positions required for the slider switches. Drill and file the rectangular holes and drill the mounting holes and countersink them. Mount the slider switches and check that the rectangular hole is large enough not to affect the operation of the switch slider. The Scotchcal panel can now be positioned on the front panel.

Now cut the holes in the Scotchcal panel for the switches and use the slider switch actuators to guide the Scotchcal when placing it on the plastic front panel baseplate.

The holes for the on/off switch, terminals and potentiometers can now be






*These wiring diagrams show the PC boards from the component side. The display board (left) butts against the main board at right angles and is soldered to it via the edge connector strips. Use 250VAC-rated cable for all mains wiring.*

drilled. When marking out the hole required for the display, measure the size of the display, 61 x 16mm, and try to keep this rectangle central to the border on the artwork. Drill holes around the perimeter of the required cutout and then file the rectangle to shape. Stop to check that the size is to shape by testing with the displays as you go and always file inwards, otherwise the file may catch on the Scotchcal and tear it from the plastic front panel.

The display PC board can now be soldered to the main PC board. Insert the displays into the front panel cutout and place the front panel into the case. Position the main PC board into the case and butt the two PC boards together. A pencil line marked across the back of the display PC board will indicate where the two PC boards have to be soldered. Remove the PC boards from the case and tack solder two of the copper tracks together, making sure that the boards are at right angles. Check that the PC boards are soldered in the correct position by testing the construction in the case. Readjust if necessary, and, when correct, solder all the respective tracks together.

The internal wiring can now begin. Fit

## SPECIFICATION

**Frequency range:** From below 20Hz to 170kHz in three ranges.

**Output level:** Continuously variable from 3mV to 2.5V peak-peak.

**Output impedance:** 600Ω (nominal).

**Waveforms:** Sine, Triangle, Square.

**Sine wave distortion:** Less than 0.7% at 1kHz; 1% at 10kHz and 2% at 100kHz.

**Triangle wave linearity:** Better than 1% at 1kHz.

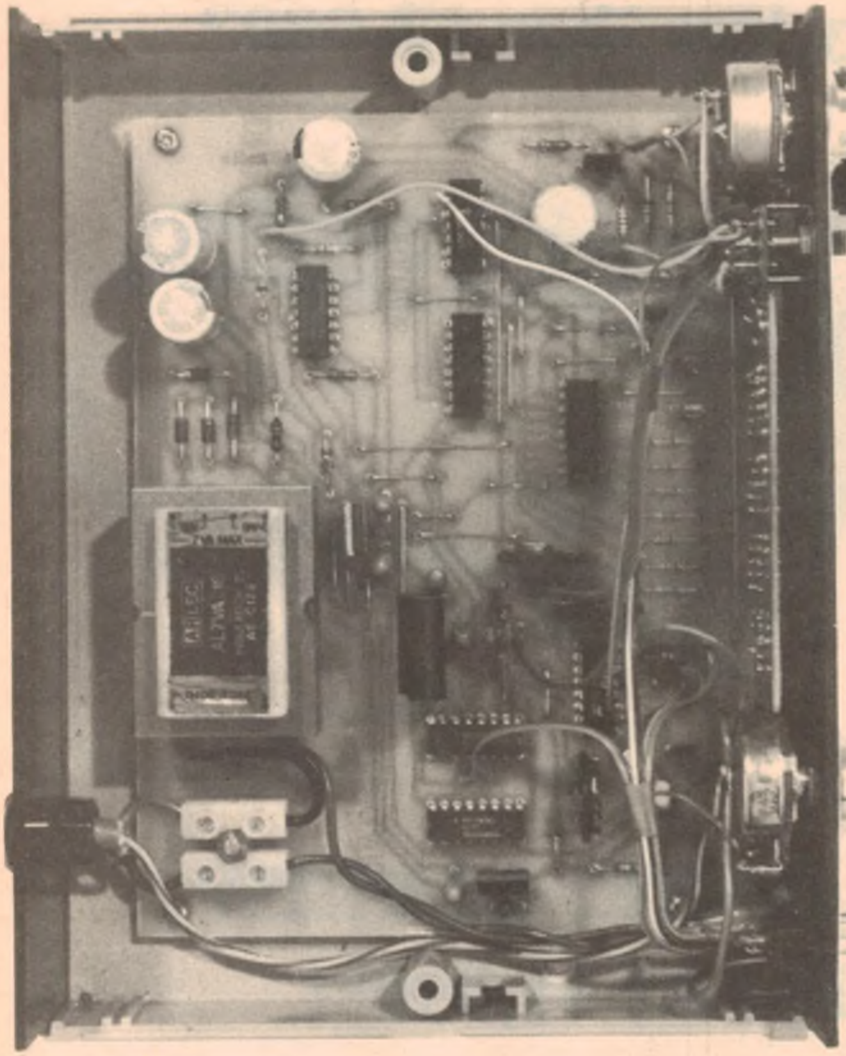
**Square wave rise-time:** 0.4us (6V/us at maximum output level).

**Overshoot, etc:** Negligible overshoot, droop or ringing.

**Readout accuracy:** ±2% + one digit.

**Amplitude stability:** Better than 0.1dB on all ranges.

**Power consumption:** 7W at 240VAC.



A view inside the prototype, showing the completed PC board assembly. Note the clip on heatsink for one of the negative regulators.

the potentiometers, mains switch and terminals to the front panel and wire them to the PC board with the aid of the wiring diagram. Several layers of insulation tape should be wrapped around the mains switch after the mains wires have been soldered to it. We also placed some layers of tape over the mains entry to the transformer under the PC board as a safety precaution. The terminal block mounts directly onto the PC board as shown. The earth is soldered to the rear of the potentiometers and to the on/off switch washer.

The mains cable is clamped to the rear of the case with a cord grip grommet. A small clip on heatsink is required for the negative regulator which supplies IC2.

When the wiring is complete, check your work against the wiring diagram and, if all is correct, the generator is ready to be switched on. Check that all the regulators supply the correct voltage and that the digital display is functioning. Different frequencies should be obtained when the coarse frequency control is adjusted. Try the control on all ranges.

## Setting up

Setting up the Function Generator can be achieved in one of two ways: by using an oscilloscope (if available), or by using a loudspeaker or headphones. For either method, the symmetry trimpot, R1, and the sine adjust trimpot, R4, should initially be adjusted for a midway setting. The level adjust trimpot should be set to the minimum resistance setting (toward the rear of the case) and setting up begun with these settings.

When using an oscilloscope, the maximum level of the sine wave can be determined before clipping by adjusting either R2 or R3. Then switch to the triangle waveform and adjust R2 to give a triangle wave level the same as the previous sine wave setting. Return to the sine wave and adjust the level with R3 only to a level just before clipping. The triangle wave and sine wave levels should now be the same.

## PARTS LIST

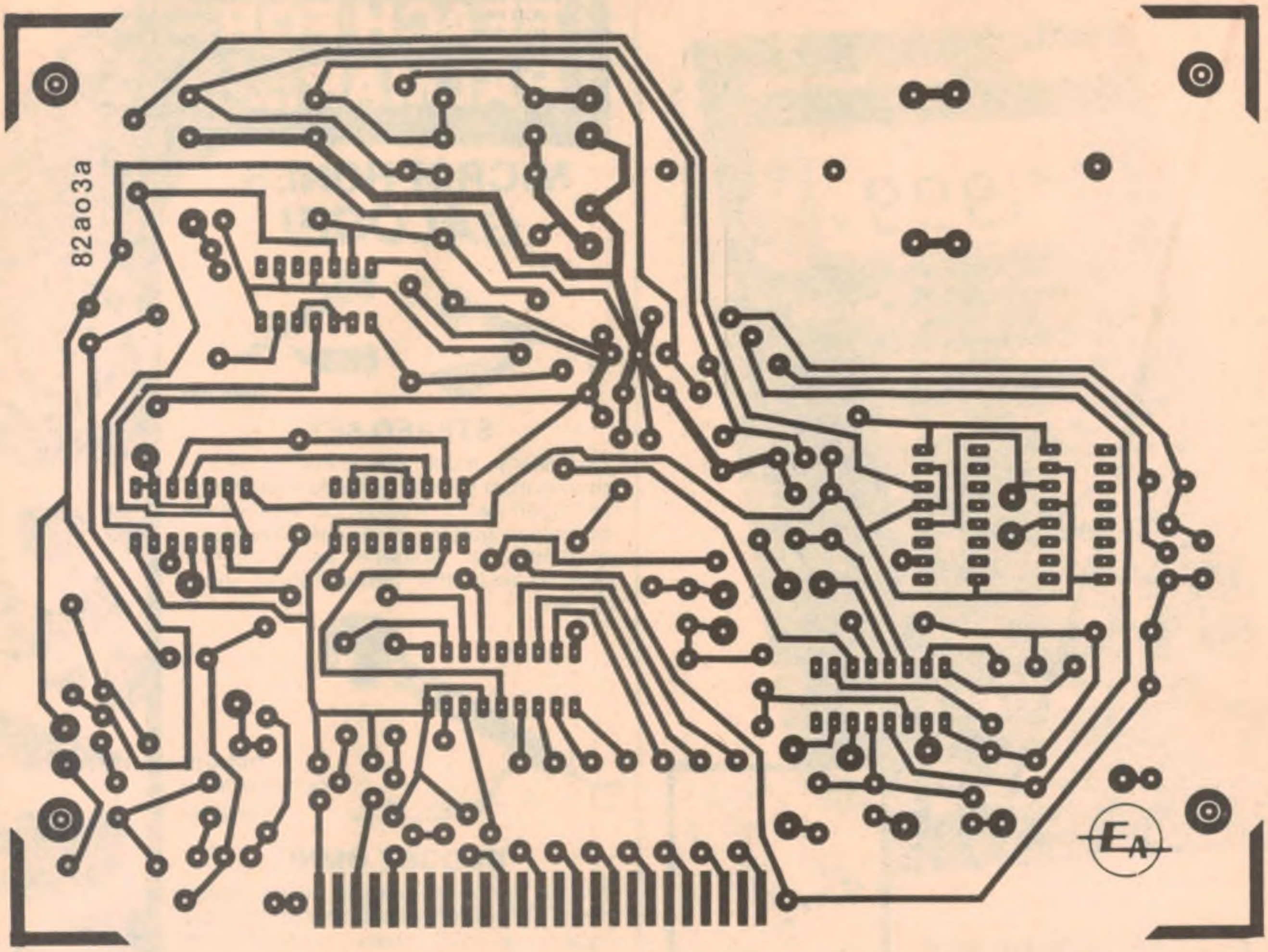
*1 printed circuit board, code 82ao3a, 169 x 126mm*
*1 printed circuit board, code 82ao3b, 83 x 46mm*
*1 Arlec AL7VA/18 or Ferguson PL18/5VA PC mounting transformer*
*1 Scotchcal front panel, 199 x 61mm*
*1 Pac-tec case, 207 x 64 x 159mm*
*1 clip-on T0-220 heatsink*
*1 SPDT switch*
*2 3-pole, 3-position slide switches (see text)*
*1 mains cord and plug*
*1 2-way insulated terminal block*
*1 cordgrip grommet*
*2 binding post terminals, one red, one black*
*3 knobs*

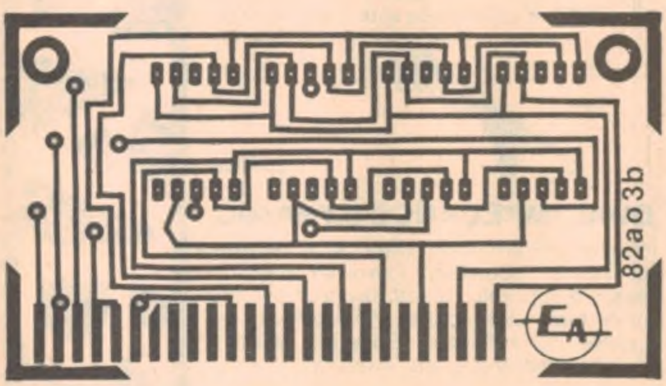
*SEMICONDUCTORS*
*1 XR-2206 monolithic function generator*
*1 74C926 4-digit counter*
*3 4017 decade counter/dividers*
*1 74C14 hex Schmitt trigger*
*1 4011 quad NAND gate*
*2 7905 three terminal 5V negative regulators*
*1 7805 three terminal 5V positive regulator*
*4 1N4002 rectifier diodes*
*2 1N914, 1N4148 small signal diodes*
*1 BD139 NPN transistor*
*1 BD140 PNP transistor*
*4 BC337 NPN transistors*
*4 FND500 common cathode LED displays*

*CAPACITORS*
*2 1000μF/16VW PC electrolytic*
*2 470μF/10VW PC electrolytic*
*2 10μF/16VW PC electrolytic*
*3 10μF/10VW tantalum*
*3 1μF/16VW tantalum*
*1 0.12μF metallised polyester*
*1 .012μF metallised polyester*
*1 .0012μF metallised polyester*

*RESISTORS (¼W 5%)*
*1 x 10kΩ, 1 x 4.7kΩ, 4 x 2.2kΩ, 1 x 1.8kΩ, 2 x 1kΩ, 1 x 560Ω, 2 x 100Ω, 7 x 27Ω, 2 x 22Ω.*
*2 x 100kΩ large vertical trimpot*
*1 x 22kΩ large vertical trimpot*
*1 x 470Ω large vertical trimpot*
*1 x 1MΩ (lin) potentiometer*
*1 x 5kΩ (lin) potentiometer*
*1 x 22kΩ (lin) potentiometer*

*NOTE: Components specified are those used in the prototype. Components with higher ratings may generally be used providing they are physically compatible.*




*Full size artwork for both of the PC boards.*

R4 can be adjusted for best visual sine wave output and the symmetry trimpot, R1, adjusted for a symmetrical waveform. The distortion trimming should be done at 1kHz.

If no oscilloscope is available, then satisfactory results can be achieved with either a loudspeaker or with headphones. Connect to the output terminals and increase R2 and R3 together when listening to the sine wave. Adjust the output level potentiometer to a suitable listening volume. The point at which the sine wave clips will be immediately obvious from the marked increase in distortion. Back the two trimpots off slightly from this point. If both the trimpots are set to the same resistance value, the sine and triangle wave should be of a similar output level.

Now disconnect the loudspeaker or headphones, switch to sine wave and connect a multimeter across the output. With multimeter set to read 200mV DC or less, adjust R1 for a zero reading. If no meter is available with reasonable sensitivity, set R1 to the centre of its range.

In adjusting the sine wave for symmetry, you are equalising the positive and negative swings of the waveform.

Now reconnect the loudspeaker and adjust R4 for minimum distortion on sine wave at 1kHz. This is done by listening closely for the purest tone. At one extreme (minimum resistance) odd harmonics will predominate while at the other extreme, even harmonics will predominate, so there is a definite setting in between where the tone is purest. With careful setting, it is possible to adjust the distortion by this method to less than 0.7%.

With both setting up methods, the clipping point of the sine wave should be readjusted after trimming the distortion. The maximum expected output level of the sine wave is around 6V peak to peak.

If you have access to a distortion analyser, it is possible to obtain a minimum harmonic distortion of around 0.5% by critical adjustment of R1, R3 and R4. This will result in distortion of less than 1% at 10kHz and around 2% at 100kHz. These figures will naturally be slightly higher if you have used the methods described above. Even so, for most audio work, this is entirely satisfactory.

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**by COLIN DAWSON**

Quite a few uses can be envisaged for this circuit, the most obvious as a VOX control for a transmitter. It avoids the need to use the press-to-talk switch on the microphone every time the operator wishes to speak.

Another use is to control a tape recorder when the material to be recorded is of a short and spasmodic nature. By fitting a VOX, the tape recorder will be activated only when there is something to be recorded. This eliminates tape wastage and ensures that there are no long gaps between recorded segments when the tape is played back.

You can also team the VOX with a stereo tape recorder to control your slide projector. The narration for the slide show is recorded on one channel, while cueing tones to control the VOX are recorded on the other. Each time a cueing tone triggers the VOX, the relay contacts close to activate the slide change mechanism.

Connecting the VOX to your slide projector is not difficult – the normally open relay contacts are simply wired in parallel with the slide change switch.

## Circuit description

The circuit consists of three parts: a microphone preamplifier, a Schmitt trigger and a relay driver. Input signals to the microphone preamplifier are amplified and fed to a threshold trimpot. When the selected threshold is exceeded, the output of the Schmitt trigger immediately oscillates at almost 9V peak-to-peak. This output is rectified and charges a capacitor to turn the relay driver on and thereby energise the device being controlled.

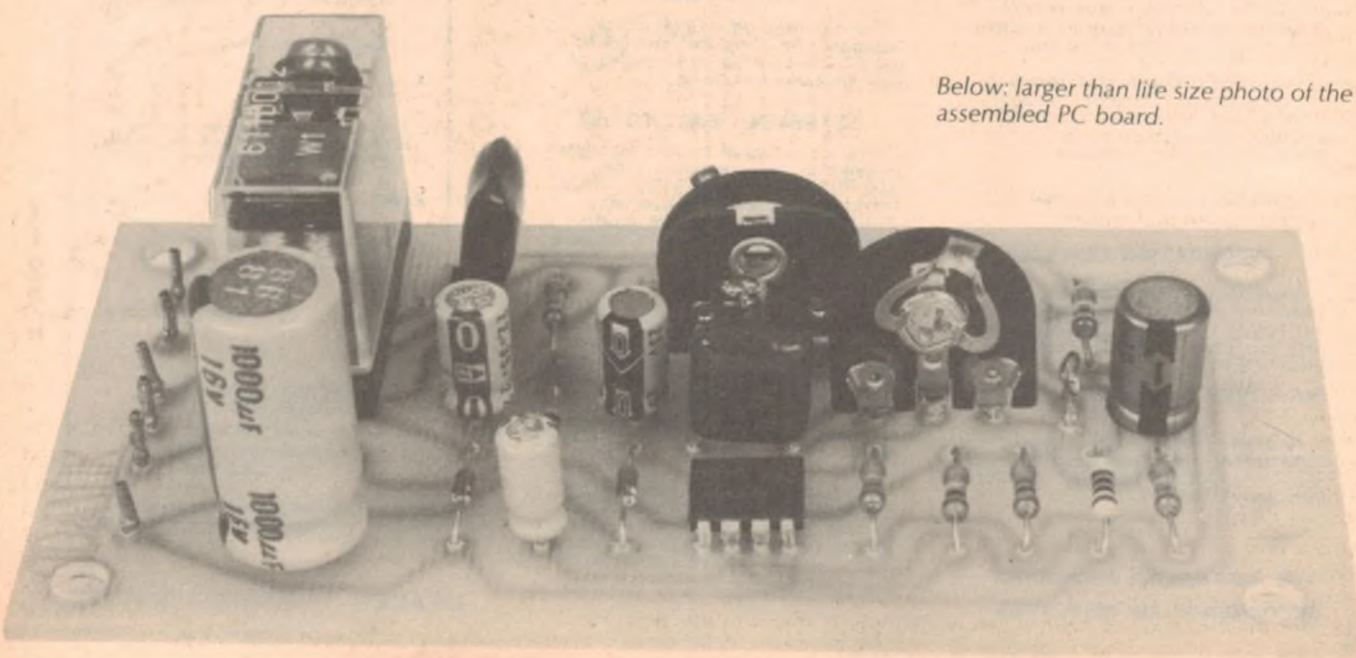
IC1 functions as the microphone preamplifier and is connected as an inverting amplifier with AC gain variable between 11 and 111 by means of RV1. Frequency roll-off below 20Hz is set by the 10μF electrolytic capacitor, which also sets DC gain at unity.

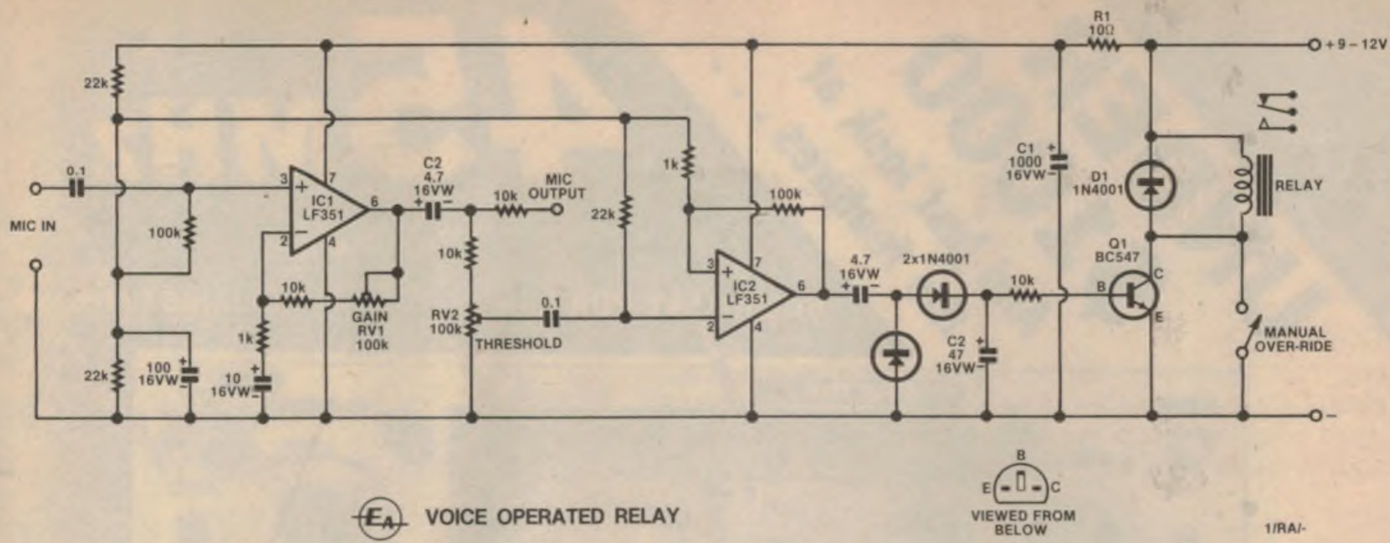
Input signals from the microphone are AC-coupled via a 0.1μF capacitor to the non-inverting input of IC1. A voltage divider consisting of two 22kΩ resistors sets the bias to the non-inverting input of IC1 and to both inputs of IC2 to half supply so that the two op amps can function from a single supply rail. The bias is applied to IC1 via a 100kΩ resistor, while heavy decoupling of the voltage divider is provided by a 100μF capacitor.

The output signal from the preamplifier is coupled by a 4.7μF electrolytic capacitor to a 10kΩ resistor and a 100kΩ trimpot (RV2) which feeds the op amp Schmitt trigger. In addition, the microphone output signal is made available by an additional 10kΩ isolating resistor, to drive a high level input on a tape recorder or transmitter etc.

Signals from the trimpot are coupled via a 0.1μF capacitor to the inverting input of the Schmitt trigger (IC2). Notice

*Below: larger than life size photo of the assembled PC board.*



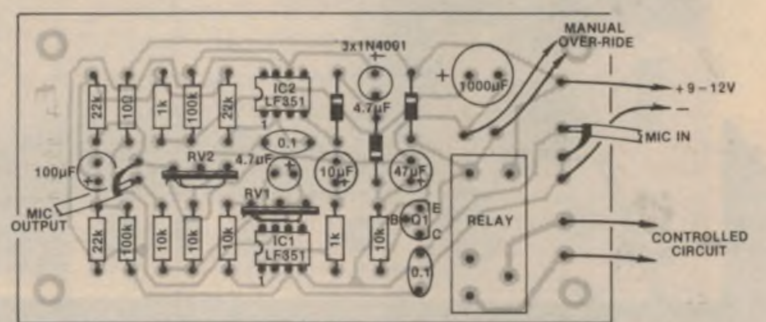



*The circuit suits 600Ω and 50kΩ microphones and may be operated from signals of 100mV RMS or more by omitting the preamp.*

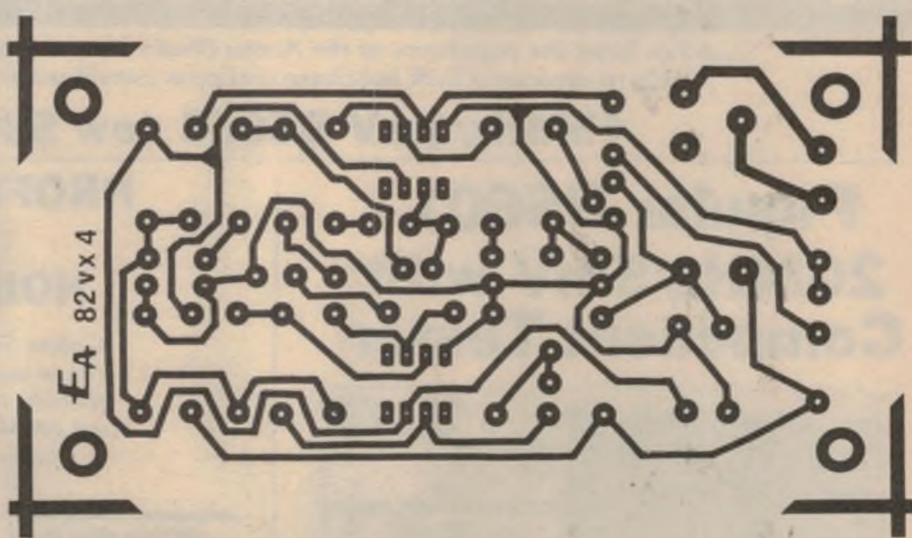
We estimate that the cost of parts for this project is approximately

**$15.00**

This includes sales tax




*Follow this wiring diagram carefully and use shielded cable for the microphone input and output connections. Below is the PC board artwork.*




that there is no negative feedback to the inverting input. Instead, there is positive feedback via a 100kΩ resistor to the non-inverting input, and this sets the hysteresis of the Schmitt trigger. For small signals to the inverting input there is no AC output and pin 6 will remain either high or low.

When the signal to the inverting input rises above about 65mV peak-to-peak (which is 23mV RMS for a sine wave), the output of the Schmitt trigger suddenly jumps to the limiting condition which is a square wave at the input frequency with amplitude just a little less than the full supply voltage, ie about 9V peak-to-peak.

So op amp IC2 suddenly changes from a zero gain condition to the limiting condition. This contributes to the fast attack time of the circuit.

Output from the Schmitt trigger is fed to a half-wave voltage doubler rectifier which charges a 47µF capacitor. This capacitor (when charged) provides base bias to relay driver transistor Q1 to enable it to energise the relay. A diode across the relay coil protects the driver transistor against inductive kickback from the relay.

Attack time of the circuit is inherently limited by the closing time of the relay and this is typically about 10ms. Delay time after the cessation of input signal is set by the size of the 47µF capacitor to about three seconds, which should be ample for most purposes. Optional manual override is provided by a SPDT switch wired in parallel with the relay driver transistor.

Power for the circuit can be derived from any plug pack supply capable of delivering 9-12V. Decoupling of the supply is provided by R1 (10Ω) and C1 (1000µF).

## Construction

All components, except the override switch, are accommodated on a printed circuit board (PCB) coded 82vx4 and measuring 113 x 60mm. Begin construction by installing and soldering the PC pins, followed by the resistors and diodes. The remaining components can then be fitted, and the board carefully checked for errors.

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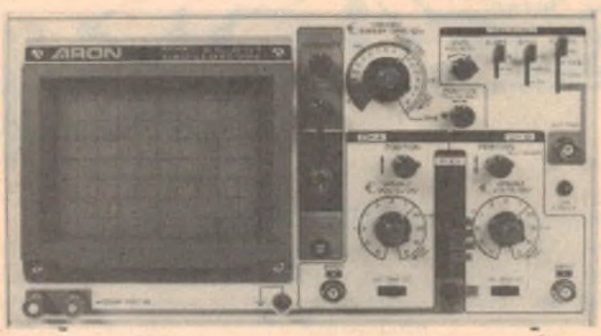


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In particular, check the polarity of the ICs, transistor, diodes and electrolytic capacitors.

If the circuit is to be controlled by signals with an amplitude of 100mV or more, the microphone preamplifier stage may be omitted. Just omit all the components to the left of C2 except for the two 22kΩ resistors and the 100μF bypass capacitor, and substitute a wire link for the 10kΩ resistor connected to the threshold trimpot. The input signal is then coupled in via C2.

The source impedance of the signal to drive C2 in this way must be less than 5kΩ. The outputs of many cassette and tape decks are quite suitable for this purpose.

The threshold trimpot may be replaced with a conventional potentiometer as a panel-mounting control, if you so desire.

To test the VOX, connect the microphone and power supply and set the RV2 threshold control to maximum sensitivity. RV1 is then set to provide the required signal level at the microphone output pin, while RV2 is adjusted to provide reliable triggering. If you do not intend to use the microphone output facility, set RV2 midway and adjust RV1 for reliable triggering.

Finally, if the microphone preamplifier is retained, the PCB should be housed in a metal box to keep hum and noise to a minimum. The circuit should be grounded only via the microphone input earth return.

## PARTS LIST

*2 LF351, TL071 FET-input op amps*
*1 BC547 NPN transistor*
*3 1N4001 diodes*
*1 printed circuit board, code 82vx4, 113 x 60mm*
*1 12V SPDT 180Ω relay*
*1 SPDT miniature toggle switch*
*10 PC stakes*

*CAPACITORS*
*1 1000μF 16VW electrolytic*
*1 100μF 16VW electrolytic*
*1 47μF 16VW electrolytic*
*1 10μF 16VW electrolytic*
*2 4.7μF 16VW electrolytic*
*2 0.1μF metallised polyester (greencap)*

*RESISTORS (¼W, 5%)*
*2 x 100kΩ, 3 x 22kΩ, 4 x 10kΩ, 2 x 1kΩ, 1 x 10kΩ, 2 x 100kΩ large vertical trimpots (see text).*

*NOTE: Components with higher ratings may be used provided they are physically compatible.*

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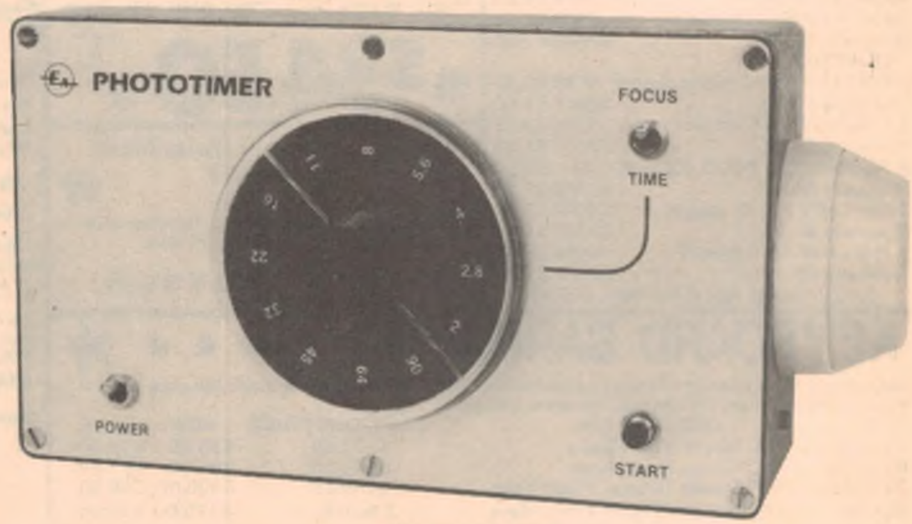
New design has 12 settings from 2 to 90 seconds

# An easy-to-build photographic timer

Want an easy-to-build photographic enlarger timer that won't cost an arm and a leg? This new Phototimer has 12 separate settings ranging from 2 to 90 seconds, and can handle enlargers rated up to 300 watts.

by GREG SWAIN and JEFF SKEEN




*Phototimer is housd in a metal case and uses a red neon lamp to backlight the dial setting. Unit can handle enlargers rated up to 300W.*

Anyone who has ever timed photographic enlargements by means of a stopwatch will know just how tedious the whole process can be. With this simple unit, your troubles are over. At the push of a button, the unit will energise a 240V AC mains socket and switch the power off after the required interval. What could be easier?

Simplicity of operation combined with ease of construction were our main goals in designing this new "Phototimer". As can be seen from the photographs, the unit is built into a metal diecast case with a three-pin mains socket at one end to power the enlarger. A large handspan dial on the front panel indicates the timer setting in seconds, while a pushbutton Start switch initiates the timing sequence.

The remaining front panel controls consist of two toggle switches: a Power on/off switch, and a Focus/Time switch which switches the timer in or out of circuit.

When the Focus/Time switch is in the Focus position, the enlarger stays on continuously so that the photographic image can be focused onto the enlarger baseboard. However, when the switch is in the Time position, the enlarger is controlled by the timer. Pressing the Start button in this mode turns the enlarger light on for a period determined by the setting of the handspan dial.

Note that the Focus position overrides the timer. This means that if the switch is moved to the Focus position during a timing cycle, the enlarger will remain on and will not extinguish at the end of the timing cycle.

Since the Phototimer is to be used in a darkroom, illumination of the dial setting is necessary and this is provided by backlighting the appropriate number with a small neon lamp. This means that only the selected setting will be visible under darkroom conditions, thus minimising any chance of error. A red filter in front of the neon lamp (ie, the plastic bezel) removes any violet emissions, which are "bad news" for photographic work.

To readers not involved in photography, the calibrations on the handspan dial may seem rather unusual. The calibrations actually increase as a geometric progression, with the square root of 2 as the multiplier rate. This gives a 1, 1.414, 2, 2.828, 4 . . . sequence and means that to double the exposure time, the dial must be "clicked up" two divisions. This is a more logical arrangement than a linear scale for photographic work, since each step on the scale is equivalent to a "half stop" on a camera lens.

(On a camera, the stops are an indication of the effective lens diameter. Increasing the setting by one full stop doubles the exposure value).

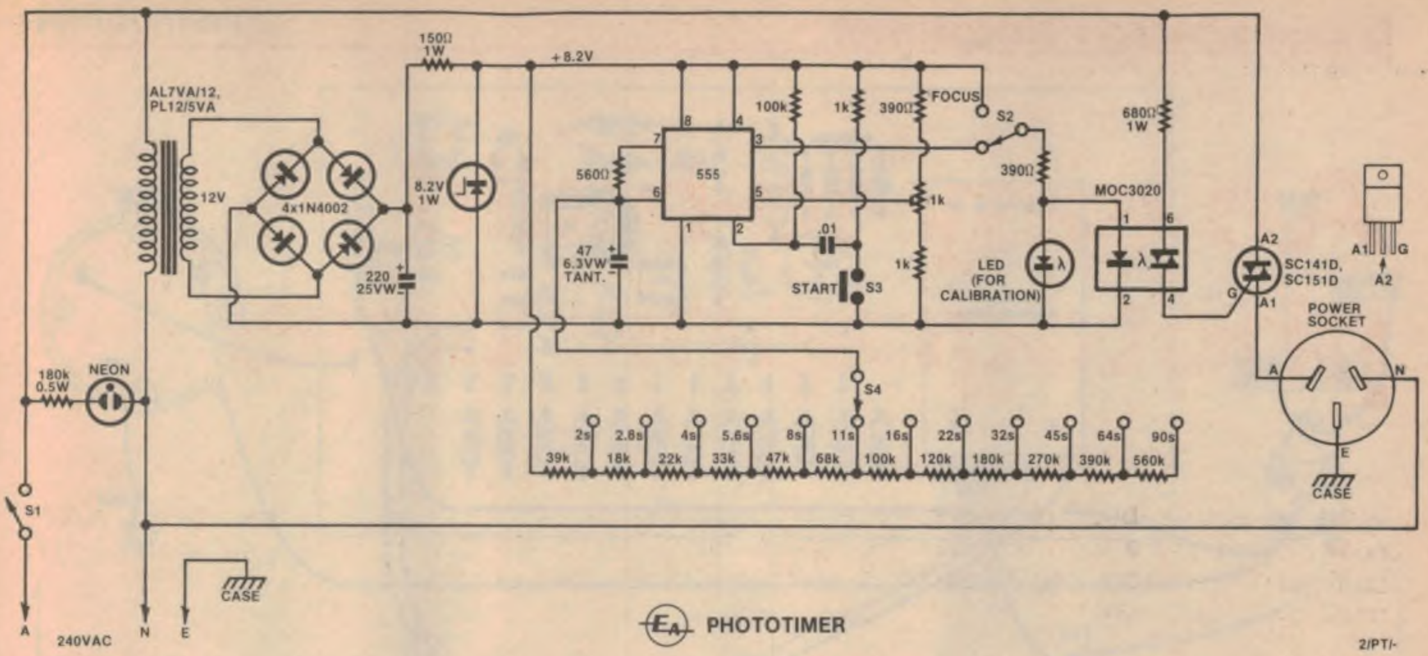
The circuit presented here is based on a design originally presented in May, 1973, but with some important modifications. In particular, our new unit uses a mains transformer and an opto-coupled Triac driver to provide full isolation between the low voltage and mains voltage parts of the circuit. The advantage here is that the unit does not have to be unplugged from the mains for calibration adjustments and, of course, is considerably safer to troubleshoot in the event of difficulties.

Other changes include an additional range to bring the minimum timer period down to two seconds, and a slight modification to the "start timer" circuitry to eliminate possible timer overrun if the Start button is held down.

## How it works

Refer now to the circuit. It may be split into four sections: a power supply, a 555 IC timer, a MOC3020 opto-coupled Triac driver, and a Triac to control the mains supply to the enlarger lamp.

At the heart of the circuit is the 555 IC timer, wired here as a one-shot monostable, ie it delivers a positive DC




PHOTOTIMER

2/PT/-

## PARTS LIST

*1 printed circuit board, code 82pt4, 174 x 92mm*
*1 diecast aluminium box, 190 x 60 x 110mm*
*1 12V transformer: Arlec AL7VA/12, Ferguson PL12/5VA, or 2851*
*1 Scotchcal front panel, 191 x 112mm*
*1 mains cable and plug*
*1 mains cable clamp*
*2 earth lugs*
*1 surface-mounting mains socket*
*1 2-way mains terminal strip*
*1 12-position (single pole) rotary switch*
*2 SPDT toggle switches*
*1 momentary contact pushbutton switch*
*1 neon lamp with red bezel*
*1 handspan dial*
*4 12mm tapped brass spacers*
*4 rubber feet*
*1 large rubber grommet*
*3 small rubber grommets*
*20cm ribbon cable, 16-way*
*50cm black mains rated hook-up wire*
*1.5m red mains rated hook-up wire*

*SEMICONDUCTORS*
*4 1N4002 diodes*
*1 8.2V 1W zener diode*
*1 red LED*
*1 MOC3020, MOC3021 opto-coupled Triac driver*
*1 SC141D or SC151D Triac*
*1 NE555 integrated circuit*

*CAPACITORS*
*1 220μF 25VW PC electrolytic*
*1 47μF 6.3VW tantalum*
*1 0.01μF metallised polyester*

*RESISTORS (¼W 5%, unless specified)*
*1 x 560kΩ, 1 x 390kΩ, 1 x 270kΩ, 1 x 180kΩ, 1 x 180kΩ ½W, 1 x 120kΩ, 2 x 100kΩ, 1 x 68kΩ, 1 x 47kΩ, 1 x 39kΩ, 1 x 33kΩ, 1 x 22kΩ, 1 x 18kΩ, 2 x 1kΩ, 1 x 680Ω 1W, 1 x 560Ω, 2 x 390Ω, 1 x 150Ω 1W, 1 x 1kΩ large, flat mounting trimpot.*

*MISCELLANEOUS*
*Machine screws and nuts, solder, 2mm spaghetti sleeving etc.*

pulse for a set time interval whenever a negative pulse appears on the trigger input (pin 2). The length of this pulse is determined by the external timing capacitor connected to pin 6 of the 555 (47μF) and the value of the timing resistors between pin 6 and the positive supply rail.

Here's how the circuit works. Initially, the 47μF timing capacitor is held discharged by a transistor inside the 555 IC. When a trigger pulse is applied to pin 2 (Start button pressed), the discharge transistor is turned off and the output (pin 3) of the 555 goes high. This output remains high while ever the voltage on the capacitor remains below a set threshold voltage (nominally ⅔ the supply voltage Vcc).

The 47μF capacitor now charges via the timing resistor(s) and, when it reaches the threshold voltage, the output at pin 3 goes low and the timing cycle ends. At the same time, the internal discharge transistor is turned on and discharges the 47μF capacitor via pin 7. A 560Ω resistor connected between pins 6 and 7 of the 555 limits the discharge current to a safe value.

Note that once this sequence of events has been started by the trigger pulse at pin 2, further trigger pulses have no effect until the output at pin 3 reverts to zero.

The length of the DC pulse delivered from pin 3 is a function of the time constant formed by the 47μF timing capacitor (C) and the timing resistance (R) selected by switch S4. Assuming that the threshold voltage of the 555 is set to ⅔Vcc, this is given by the equation

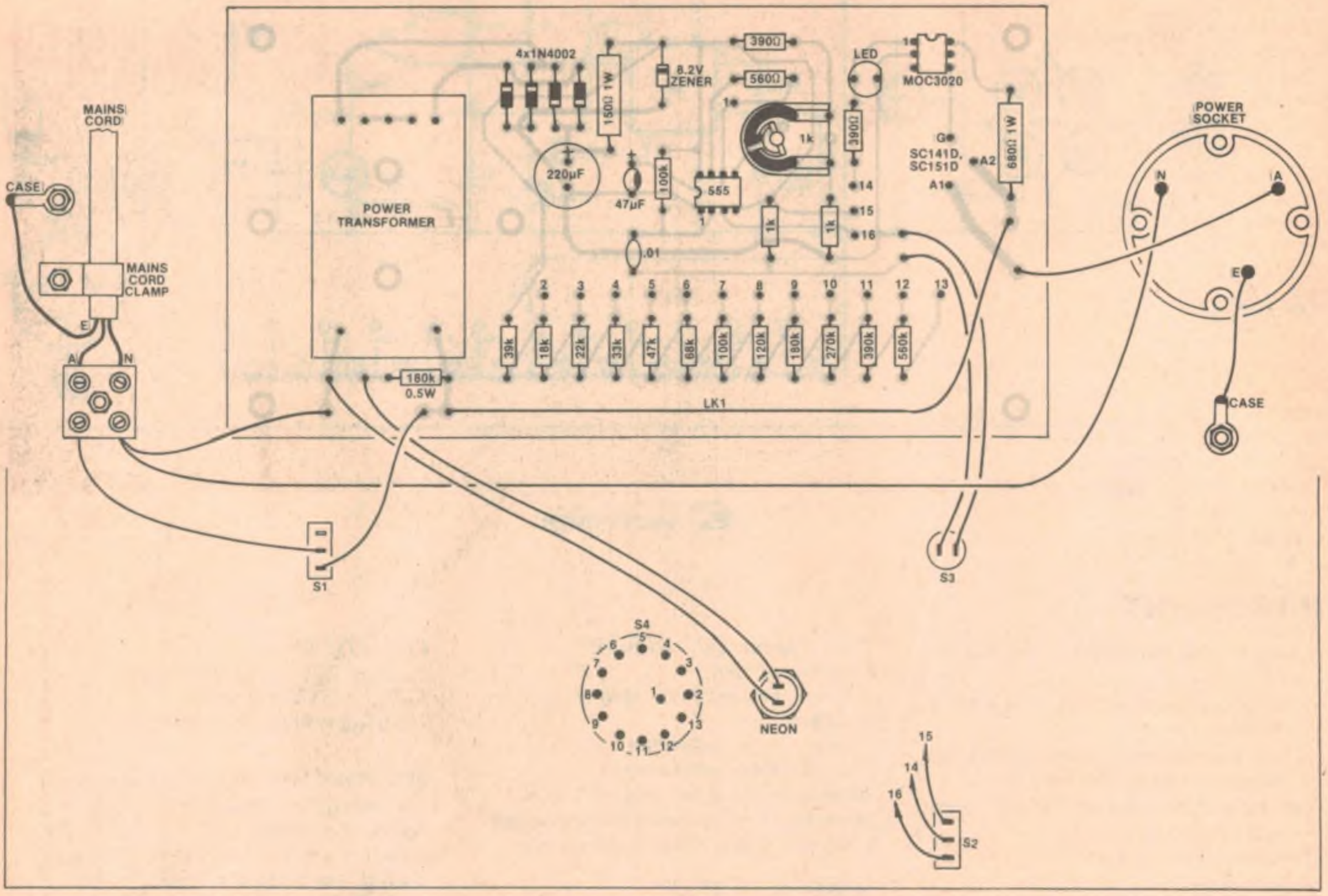
$$T(secs) = R.C \times 1.1$$

Where T is the length of the output pulse in seconds.

In this circuit, the threshold voltage (and hence the output pulse length) of the 555 is varied by applying a DC voltage to pin 5. This DC voltage is provided by a voltage divider network consisting of two fixed value resistors and a 1kΩ trimpot, and provides a means by which the circuit may be calibrated to compensate for component tolerances.

Negative-going trigger pulses to pin 2 of the 555 are provided by switch S3 and its associated RC network. Why the RC network? The reason is that if S3 directly shorted pin 2 to ground, timer operation could be affected by contact bounce. In other words, if S3 was held down for a period longer than the timer setting and then released, the timing cycle should accidentally be repeated.

The RC network prevents this from happening by restricting the trigger pulse to 1ms duration. It works like this: initially, both sides of the .01μF coupling capacitor are held high by the 100kΩ and 1kΩ resistors. When S3 is closed, both sides of the capacitor are pulled low to provide the trigger pulse to pin 2 of the 555. The 0.1μF capacitor then charges via the 100kΩ resistor and, after about 1ms, pulls pin 2 high again to end the trigger pulse.




*Follow this diagram when wiring up the Phototimer, but do not install Lk1 or the MOC3020 until after calibration.*

So keeping S3 depressed after the timing cycle has started has no effect on the circuit performance.

The output from the 555 is coupled via switch S2 and a 390Ω resistor to the MOC3020 opto-coupled Triac driver. When the pin 3 output of the 555 goes high, the LED inside the MOC3020 lights and triggers a photosensitive Triac output stage. This in turn causes current to flow to the gate of an SC141D power Triac, which turns on to activate the mains output socket.

The enlarger bulb will thus remain lit while ever the output of the 555 timer remains high and gate current is supplied to the power Triac by the opto-coupler. At the completion of the timing pulse, the opto-coupler turns off and the SC141D Triac switches off the enlarger at the end of the next mains half cycle, ie when the load current drops to zero.

The 680Ω resistor limits the repetitive surge current through the MOC3020 to a safe value of about 0.5A. Switch S2 switches the input to the MOC3020 between the output of the 555 timer and the positive supply rail. When the switch is in the Focus position, the LED in the MOC3020 is lit continuously and the enlarger lamp remains on.

Also shown on the circuit diagram is an external LED connected in parallel with the internal LED of the MOC3020 Triac driver. This LED is temporarily inserted into circuit during construction so that the unit can be safely calibrated before the mains active is connected to the output stage.

Power for the unit is obtained from a 12V transformer which feeds a bridge rectifier circuit and a 200μF filter capacitor. The resultant DC supply is then passed through a 150Ω current limiting resistor and regulated by an 8.2V zener diode. Backlighting for the dial is provided by a neon lamp wired in series with a 180kΩ resistor across the mains.

## Construction

Our new Phototimer is built into a standard metal diecast case measuring 190 x 60 x 110mm. A metal case is mandatory for this project so that it can be earthed to guard against electric shock.

Construction is easy, with most components mounted on a printed circuit board (PCB) coded 82pt4 and measuring 174 x 92mm. Begin construction by mounting components on the PCB according to the wiring diagram, but do not install the MOC3020 or link Lk1 at this stage. Fit the resistors and capacitors first, followed by the 555 IC and the diodes.

Make sure that all polarised components are correctly oriented, and don't forget to install the calibration LED in the position indicated on the wiring diagram. The power transformer can also be fitted at this stage, and the board has been designed to accommodate both PCB-mounting transformers and the more conventional 2851 type with flying leads.

The Triac is installed so that its body lies flat against the PCB, as shown in the photograph. Readers should note that the metal tab of the Triac will be at mains potential when the project is operating, so watch it!

Once the PCB has been completed, you can commence fitting the hardware

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

**$48**

This includes sales tax.

to the metal diecast case. Begin by temporarily positioning the various items in the case and mark and drill the necessary holes.

The mains cable enters through a grommeted hole and is securely clamped. Terminate the active (brown) and neutral (blue) leads in an insulated terminal block and connect the earth lead to a lug bolted to the chassis.

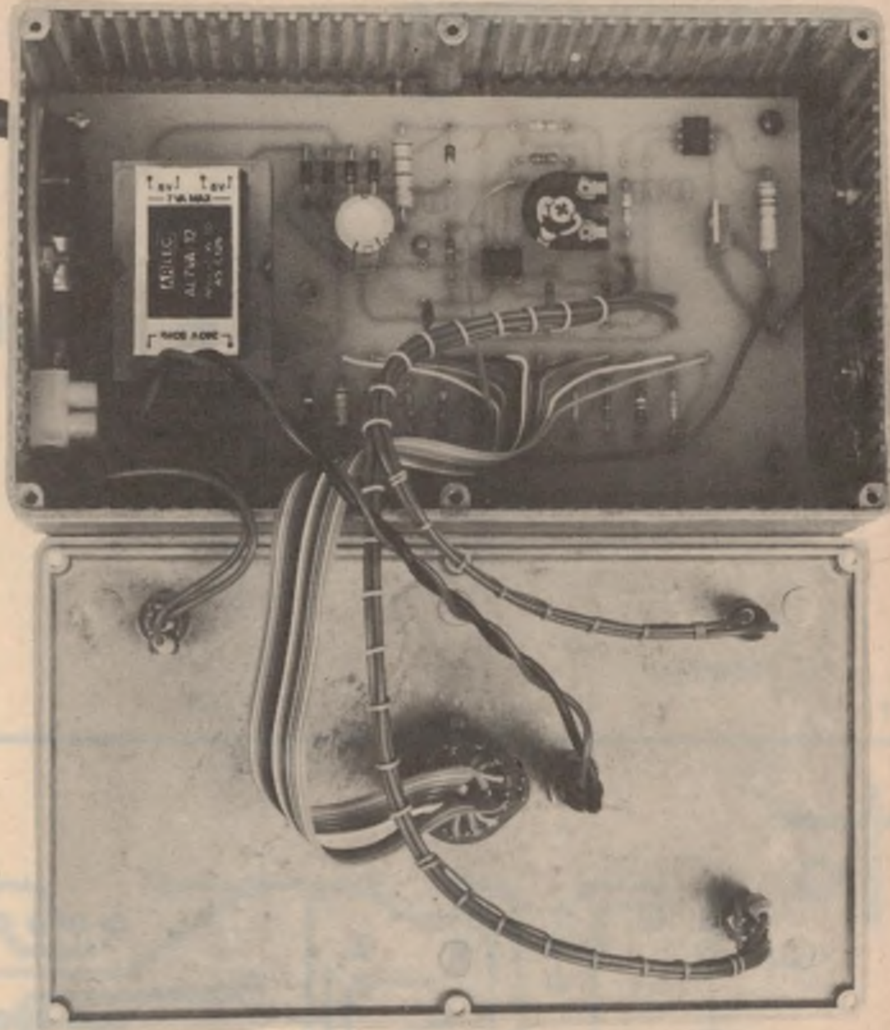
Wiring to the mains socket should also pass through grommeted holes to ensure safe operation. Make sure that you use mains-rated cable, and note the earth connection to the side of the case.

A Scotchcal adhesive label measuring 191 x 112mm provides an attractive finish to the Phototimer. Spray the label with a hard-setting lacquer (such as "Estapol") to prevent scratches and, when dry, affix it carefully to the lid of the case. Working from the Scotchcal side, drill holes in the lid and mount the front panel switches and the neon indicator lamp. Before mounting the 12-way rotary switch (S4), cut its shaft to a length of about 15mm.

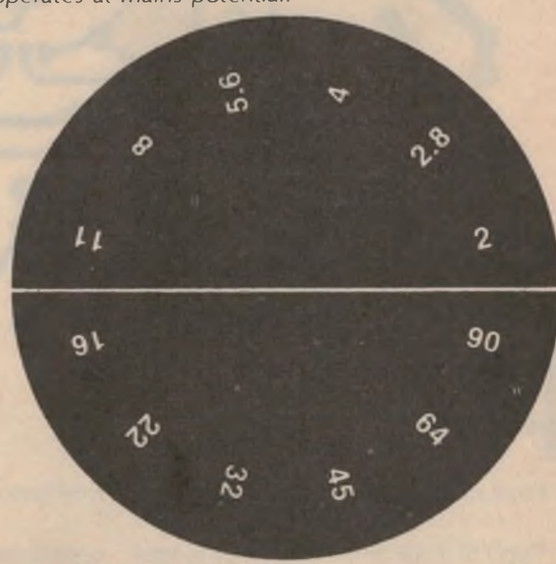
The wiring between the PCB and the front panel can now be completed, and the PCB mounted in the case using four 12mm standoffs. 13-way rainbow cable is used to make the connections to switch S4, but connections to S1, S2 and S3 and to the neon indicator must use mains rated cable. Lace the wiring to S2, S3 and S4 so that it cannot come into contact with any part of the circuit at mains potential if a wire should come adrift.

As an additional precautionary measure, plastic sleeving should be placed over the soldered connections to S1, S2 and S3 and on the neon indicator.

The handspan dial on the prototype was made using a film transparency. The best course for readers, however, is to photocopy the accompanying artwork and glue it to the back of the dial. This done, set the rotary switch (S4) to position 2 (ie select the 39kΩ resistor only) and press the dial onto the switch shaft with the "2" lined up against the calibration line.



*Use mains-rated cable for all wiring connections, except to switch S4. Note that the Triac and associated circuitry operates at mains potential.*



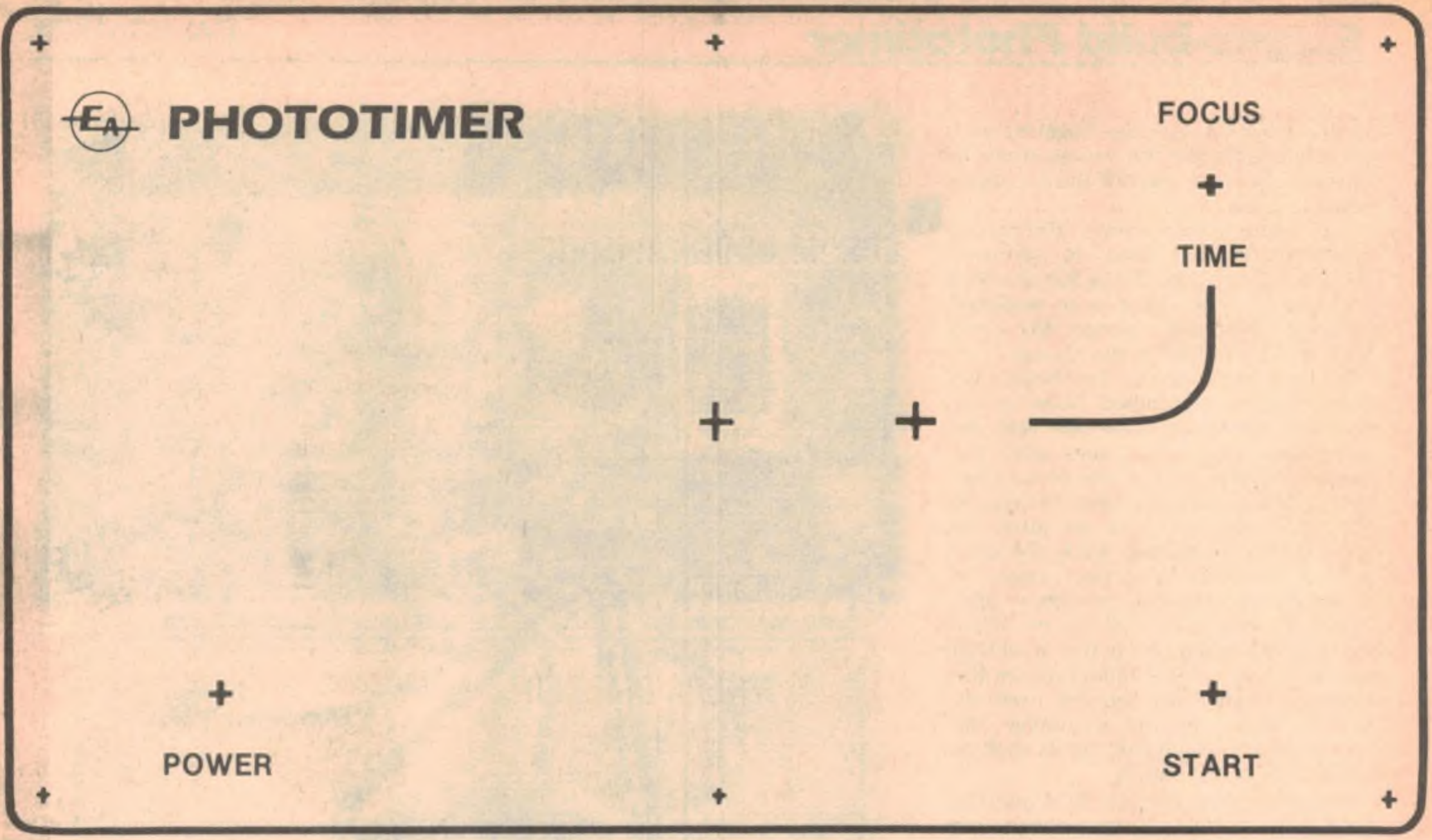

*Right: Actual size artwork for the handspan dial.*

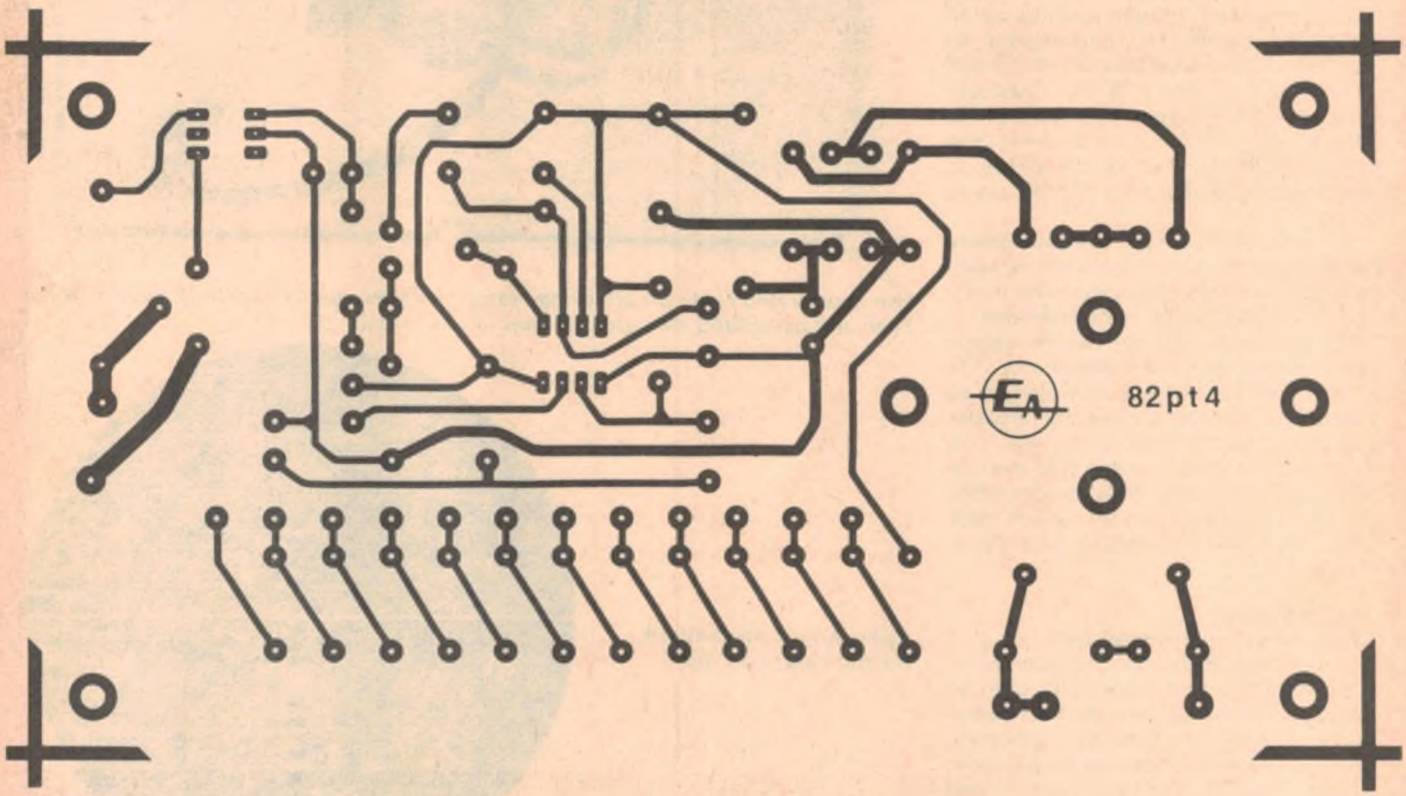
## Calibration

Calibration is performed with link Lk 1 and the MOC3020 opto-coupler omitted. Check your wiring carefully, then set the Focus/Time switch to the Focus position and switch on. Both the calibration LED and the neon indicator should light.

Now switch to the Time position and check that the calibration LED goes out. Press the Start switch, and the calibration LED should immediately come on again and remain on for a period approximately equal to the setting on the dial.

To calibrate the Phototimer, set the dial to an intermediate setting (eg 16s) and press the Start switch. The LED should remain on for 16s and then extinguish. If it doesn't remain on for exactly 16s (which is more than likely), adjust the 1kΩ trimpot until it does. Finally, check the performance on the remaining ranges. A difference of a few seconds between the dial indication and the actual time on the high ranges will be due mainly to the 5% tolerance resistors specified and should be of no consequence.




*Actual size artworks for the PCB and the front panel. Finished boards and panels are available from retailers.*

That's it! Your new Phototimer is now calibrated.

Switch the power to the Phototimer off, unplug it from the wall socket and remove the calibration LED. All you have to do now is insert the MOC3020 opto-coupler and mains-rated link Lk1, and re-assemble the unit. The rubber feet are attached by screwing the mounting screws into the PCB standoffs.

As a final test, connect the Phototimer up to your enlarger for a trial run. Check that the enlarger lamp remains on when the Focus/Time switch is in the Focus position, that it goes off in the Time position, and that the lamp turns on for the set time period when the Start button is pressed.

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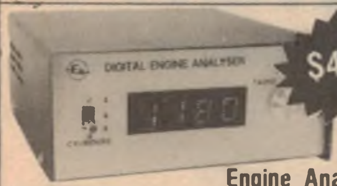


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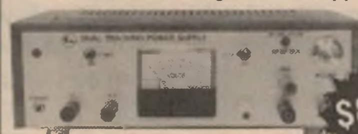

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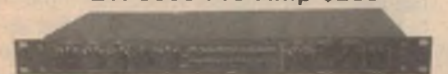

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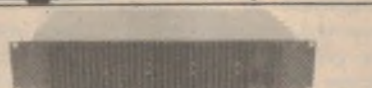
| 81SG9 | LED Sandglass | Spt 81 | 22.50 |
| 81CI9 | Digital Clock Thermometer | Spt 81 | 80.00 |



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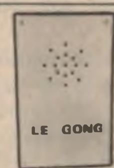


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# The Serviceman

## It never pays to be over-confident . . .

It never pays to be over-confident in the servicing game. Just when you reckon you know all the likely causes of a certain set of symptoms along will come a set with same symptoms, but a completely different fault.

In some respects this story is a follow-up on one I told in the January 1982 issue concerning varying brightness problems with a couple of National TC86A sets. It is a follow-up in the sense that it involved the same symptoms in the same make and model of set, but not the same actual set.

Having tracked down two such faults in this model – one of them the hard way – I felt reasonably confident that I now knew this circuit, and most of its tricks, pretty well. Alas my confidence was about to be rudely shattered.

As before, the brightness varied with the temperature of the set. If the brightness was adjusted after the set had been running for 30 minutes or so it would remain stable from then on, until the set was switched off. But when the set was switched on again, after having cooled, the picture would be much too bright.

Naturally, my prime suspect was the edge connectors on the relevant boards, as in the January story, and particularly TNP65113. So these were all given a thorough cleaning and the set put through the warm-up/cool-down cycle again. And this was where my confidence suffered its set-back; results appeared to be exactly the same.

While it was just possible that the edge connectors were at fault, and I had simply failed to fix them, I found this hard to accept. It seemed far more likely that I was facing a completely different fault.

### A NASTY SETBACK

This was a nasty set-back. As I explained in January the video chain in this set is long and direct coupled throughout. Finding the cause of a brightness shift in such a network threatened to be an equally long and involved process. As I also explained in the January notes, it needs only a small voltage change at the beginning of the video chain to build up to very substantial change at the end.

And so began a lengthy series of voltage measurements along the chain, while observing the changes in brightness as the chassis was either warmed or cooled. My first check was at the collectors of the three output transistors (TR351, 352, 353), the collectors of which connect directly to the picture tube cathodes, and I wasn't really surprised to find significant voltage changes here.

The circuit shows these collector voltages to be around 140V, although my experience is that it is often somewhat lower at around 130V. In this case, with the set cold, the voltages were down to around 82V, rising steadily to about 123V, as the set warmed-up. At the same time the base voltages were varying from 10.9V when cold to 9.7V when hot. Not only was this a substantial base voltage swing, but neither these voltages, nor the collector voltages, approached the values on the circuit.


*"I got it! I got it!"*

Well, that was a start, but I still had to find where the shift was actually occurring. According to Murphy's Law, in a case like this it doesn't matter at which end of the chain you start – it will be the wrong end! But I had to start somewhere and, for a number of reasons, I went back to the beginning of the video amplifier chain.

My first checks were around the video processing IC, AN331, and the second video amplifier, TR301, on board TNP65113BZ. One suspect was a 12V regulator network, involving zener diode D301. After all the problems I have experienced with regulated supplies recently, it wouldn't have surprised me to find a serious voltage drift here.

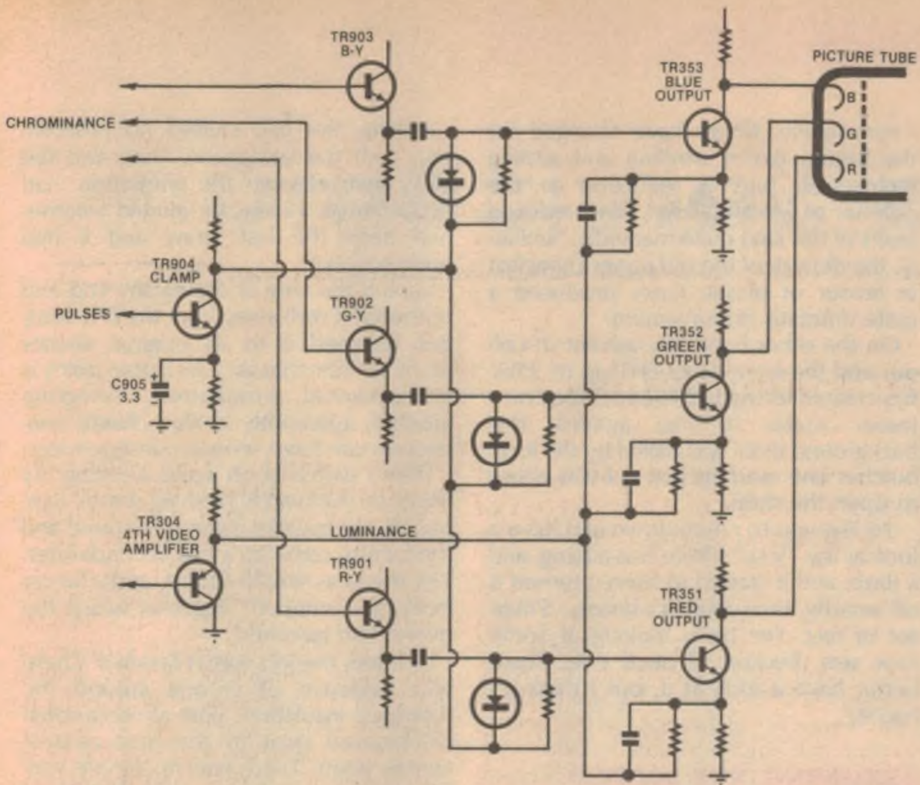
Unfortunately, it wasn't going to be that easy. The rail measured almost exactly 12V and, more importantly, appeared to be rock steady. It was much the same story concerning the relevant voltages on AN331 and TR301; such differences as there were infinitisimal, even for this part of the circuit.

I moved on to the next board, TNP65427, on which are the third and fourth video amplifiers (TR303, 304) and made a series of hot/cold voltage checks here. Again I drew a blank; no significant voltage changes to be found. It was all getting a bit frustrating by now, as the tests had to be spread over several days to provide the necessary temperature changes.

### WHAT NOW

I sat back and took stock of what I had established so far, and also spent some time studying this part of the circuit diagram in detail. It is surprising how often one tends to skim over a circuit, absorbing the general configuration, while missing important details which can be vital in cases like this.

The situation so far was that there were significant changes, plus a basic error, in the collector voltages of the three output transistors driving the picture tube cathodes. These changes, and the basic error, were repeated, appropriately scal-




*The video output stage of the National TC86A colour receiver. A faulty emitter bypass capacitor (C905) on TR904 proved to be the culprit.*

ed down, at the bases of these transistors.

On the other hand, I had been unable to find any significant corresponding changes in the video amplifier chain up to the fourth video amplifier (TR304). This suggested that the fault was somewhere in between these two sections but, unfortunately, the "between" involved some rather complex circuitry.

I went back to the bases of the three output transistors, where I had last observed the voltage changes. These three bases were driven from three emitter followers as R-Y, G-Y, and B-Y amplifiers (TR901, 902, 903), driven in turn by three more amplifiers following the colour decoding circuitry.

The point about the coupling to the emitter followers is that it is not direct, but via three capacitors (C902, 903, 904), which seemed to rule out any suggestion that the drift was coming from these stages, or anything ahead of them in the chrominance chain.

But, as I mentioned earlier, the main video (luminance) circuit is direct coupled. The fourth video amplifier is direct coupled to the three output transistors, but via the emitters, rather than the bases. In fact this is where the matrixing of the luminance and chrominance signals takes place, the composite signal appearing at the collectors and then applied to the picture tube cathodes.

So where was the drift coming from? I took another close look at the circuit. With the DC path blocked by the coupling capacitors just mentioned there appeared to be only one remaining DC path; all three bases were connected via a network of resistors and diodes to the collectors of a black level clamp transistor (TR904).

The operation of this clamp is quite complex and need not be dealt with here. Suffice to say that its base is fed with horizontal pulses which gate it in such a way that the black level is established during the horizontal flyback period, which is constant regardless of the video content.

Of more immediate importance was the fact that it appeared to be the only remaining part of the circuit where the fault could lie, in spite of the tests which I had already made. One of my routine voltage checks had included the clamp collector voltage, and the changes seemed quite insignificant. In fact, it had amounted to only 0.1V, from 20.9V to 21V from cold to hot.

## A CLUE AT LAST

I went over the circuit again, measuring the base and emitter voltages as well as the collector voltage. The base voltage varied from 2.2V when cold to 2.5V when hot. Over the same temperature range the emitter varied from 4.1V to 4.6V. Both these latter voltages were lower than those given on the circuit.

But if these voltages held a clue, it wasn't immediately obvious, except to reinforce my conviction that the fault was in this stage.

I looked at the clamp circuit again. Apart from the transistor there were only a half dozen or so components, mostly resistors. If necessary, I could change all the components in this circuit until I found the culprit. But the most likely suspect was C905, a 3.3μF (not 33μF as shown in the circuit) electrolytic as an emitter bypass. Imported low value electrolytics have proved to be notoriously unreliable in recent years, as I have mentioned in previous notes.

I let the set run until it was thoroughly warm, set the brightness to normal, or a little on the low side, then hit this capacitor with a blast from a freezer spray can. And this time I had beaten Murphy at his own game; the picture brightness shot up to what I would have expected had the set been standing overnight. I had hit it in one!

A new electrolytic cured the fault and, incidently, brought the various voltages back to values a lot closer to those shown on the circuit. I ran the set for several days before returning it to the customer. The brightness remained rock steady the whole time.

As a matter of interest I salvaged the faulty capacitor and checked it on the bridge. Even when it was warm its capacitance was below its rated value, being only a little over 2μF, and a blast of freezer would drop this value dramatically.

As for the mechanism by which it caused the symptoms it did, it is obvious (now!) that the fault was a dynamic one, involving the gain of the clamp transistor, rather than a static one, even though the end result was a DC shift.

So that makes three separate faults in this make of set, all having the same symptoms, which I have encountered over a period of a few weeks; the faulty edge connectors, a gassy picture tube, and now the faulty clamp circuit due to a temperature sensitive capacitor.

## HUMIDITY AND EHT

To finish off this month, here is a short story on a quite different theme. The last few weeks have been hot and humid, and these conditions invariably bring forth their quota of faults.

The truth is, humidity and electronic devices have never learned to live together. Years ago it was paper capacitors and, before the makers learned how to seal them, speaker transformers were a prime target. And in the early days of monochrome TV, a bout of humid weather would always bring forth a crop of vertical output transformer failures in one particular model.

Fortunately, things have changed for the better. Better winding and sealing techniques, plus a reduction in the number of windings used, have reduced faults of this kind quite markedly. Similarly, the demise of the old paper capacitor in favour of plastic types produced a quite dramatic improvement.

On the other hand, the advent of colour and the increase of EHT up to 25kV has created its own problems, albeit on a lesser scale. It was against this background that I was hailed by the local butcher one morning just as I was about to open the shop.

"I'd like you to come down and have a look at my TV set. There was a bang, and a flash, and it started to burn. I turned it off smartly, but I think it's history. S'matter of fact, I've been looking at some new sets. Reckon I'll need one. You'd better have a look at it, but I think it's had it."

## ASSUMING THE WORST

It never ceases to amaze me that so many customers always assume the worst. And even more surprising is the way they leave themselves open for a smart salesman to make a killing. I've known more than one sharp operator who would have needed much less excuse than that to condemn a set as a write-off and sign the "sucker" up for a brand new set.

In this case I advised the customer not to do anything hasty, and that I'd be down as soon as I could. I was familiar with the set, a Pye T-29, and I tipped that something had gone over in the EHT section. Hopefully, it might not be serious, particularly as he had switched it off smartly.

So, later that day, I was in the lounge room pulling the back off the set. A quick visual inspection failed to reveal any signs of burning or other damage so, while watching the inside carefully, I gingerly switched on. There was an immediate splat and flash reflected from somewhere in the works, though I couldn't see exactly where. I switched off smartly.

There was now no doubt in my mind that it was an EHT flash-over, so I undid the clips and swung out the two sections of the chassis to give a better view of the EHT transformer, tripler, and power supply. Then I switched on again.

There was no doubt about it this time. The flash-over was clearly visible between the EHT lead, where it left the tripler, and an adjacent earthing wire from the picture tube aquadag. The wire had been allowed to drape against the EHT lead and was only lightly insulated.

Initially, this had caused no problem but, with the passage of time and the EHT environment, the insulation had deteriorated. Finally, the humid weather had been the last straw and it had broken down.

I undid the wire at the earthy end and re-routed it well away from the EHT lead, but returned it to its original anchor point on the chassis. This latter point is an essential precaution; selecting another, apparently similar, chassis connection can have serious consequences.

Then I switched on again, keeping my finger on the switch. Nothing drastic happened, the speaker gave forth sound and the picture came up a few seconds later. Yes, it was as simple as that, and a far cry from the "write-off" situation which the owner had assumed.

Granted, the job wasn't finished. There was evidence of corona around the damaged insulation, plus an occasional half-hearted splat to the next nearest chassis point. There was no simple way of replacing the damaged EHT lead without replacing the whole tripler, but this seemed to be an unnecessary waste and expense.

Instead I covered the damaged portion with a liberal coating of a silicone sealing compound. This is a Dow Corning product called Silastic Adhesive Sealant 732RTV. My main use for it is under ultor caps where there is evidence or risk of breakdown between the ultor clip and the aquadag. I have found that it is far superior to silicone grease, which deteriorates into a powder after some time.

There was some evidence of leakage around the ultor clip in this case, again probably aggravated by the humid conditions. I loaded the ultor cap with a small dose, then pressed it into place until a small quantity oozed out from under the edge.

This material takes about 24 hours to cure, so I advised the owner to leave the set off until the next day. After that, I assured him, he should have no further troubles from that source.

Naturally, he was very grateful. A set which he was ready to write off had been restored for the price of a service call, and without even having to buy a single component. The salesman at the local discount house must hate my guts!

If you have a factual and interesting story to tell about electronic servicing, write it in your own words and sent it to "The Serviceman", c/- "Electronics Australia", Box 163, Chippendale 2008. If the Serviceman uses it in his column, we will pay an appropriate fee.

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If you were interested in hi-fi a few years ago, you'll remember the name Fisher.

We made the first dynamic range expander back in 1939.

We introduced the transistorised preamplifier/equalizer in 1956.

In 1959 we gave the world the stereophonic AM/FM receiver.

In fact, we've notched up thirty hi-fi firsts.

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There is a 4 band stereo tuner.

So you can shape the sound to whatever room you're listening in, there is a 5 band graphic equaliser.

When you're travelling you'll appreciate the carry handle.

When you stop, you'll appreciate the detachable 2 way speakers.

We have also made a few other models. They come at varying prices.

They all offer varying degrees of technical sophistication.

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Of course they all come with the Fisher name.

Which means nearly 50 years of making the most out of music.

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Our name already sounds familiar. You'll soon agree that it also sounds fantastic.

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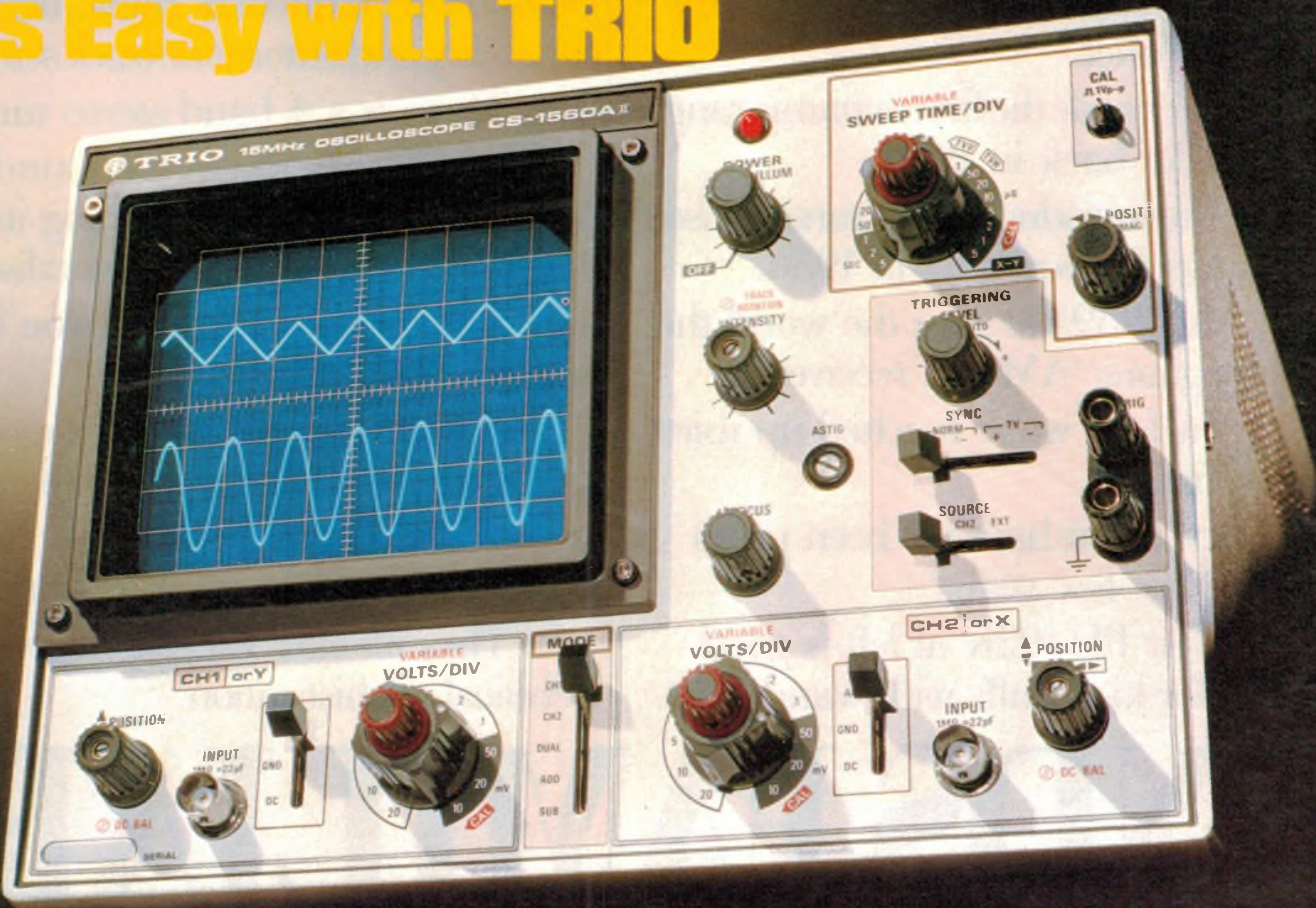
# Superb Performance with Economy is Easy with TRIO




# 15MHz

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*The CS-1560AII dual trace, triggered sweep oscilloscope incorporates a brilliant clarity 130mm diameter cathode ray tube. The solid state circuitry is designed for outstanding reliability and operational stability.*

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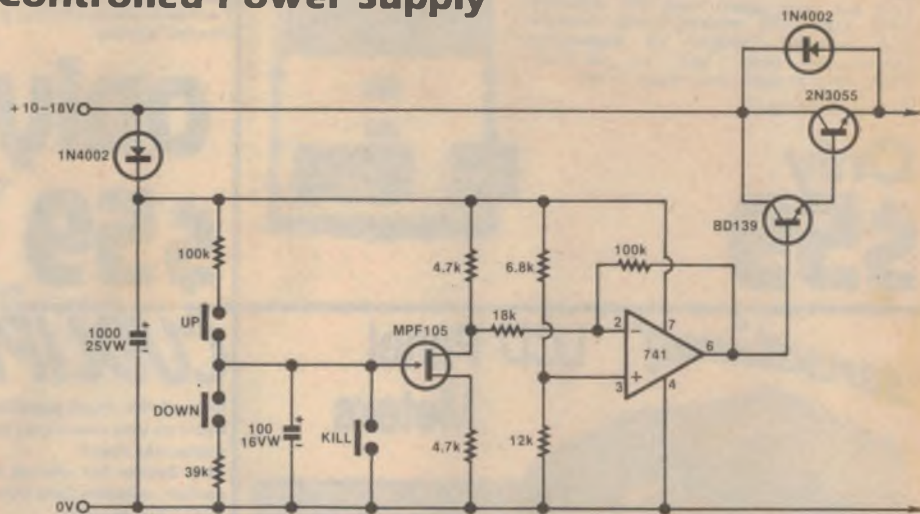
# Circuit & Design Ideas

Interesting circuit ideas from readers and technical literature. While this material has been checked as far as possible for feasibility, the circuits have not been built and tested by us. As a consequence, we cannot accept responsibility, enter into correspondence or provide constructional details.

## Up/down Pushbutton-Controlled Power Supply




Using two momentary-contact pushbutton switches, or a three-position non-locking rocker switch, this circuit permits raising or lowering the output of a low-voltage DC power supply by push-button action. Exact output voltage is dependant upon the length of time either button is held operated. Optionally, a third momentary-contact button can provide the facility of quickly lowering the output of the supply to zero.

The circuit consists of a compound voltage follower which comprises a FET, op amp and a Darlington pair of output transistors. Thus, raising or lowering the potential on the gate of the FET produces a corresponding change in voltage at the output of the unit. A 100μF capacitor is connected between the FET gate and the negative rail, producing a "hold" function for any potential which is applied to the gate.

From the positive and negative rails resistors are connected to the pushbutton switches, such that when either switch is actuated current flows through the resistor to charge (or discharge) the 100μF capacitor and thus vary the gate potential/output voltage. The size of the resistors determine the rate at which the capacitor is charged/discharged, and thus the response of the output to the time that a button is depressed. The third (optional) button discharges the capacitor directly to the negative rail so that the output may be quickly taken to zero.

B. J. Robertson,
Morphett Vale, SA.

## Register Display Routine for the "Sorcerer"

This program enables the user of a Sorcerer computer to display the contents of its Z80 microprocessor's internal registers on command. It functions by using several of the routines already existing in the Sorcerer Monitor. Register contents are not changed and the display may be called up at any time by merely pressing CTRL R. The program is shown in the panel below:

Having entered this program into the computer, type:

SEI = 0 <CR>
<CTRL>R <CR>

Press CTRL R to call up the display; although it can also be run with the command "GO 6". However, for use as a subroutine called from another program, enter this routine at address 0006.

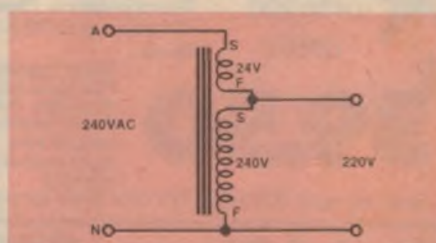
The following is a sample printout:

| | |
|---|---|
| >HL' | EA78 |
| DE' | E9F0 |
| BC' | 0023 |
| AF' | 1242 |
| HL | 0000 |
| DE | 006C |
| BC | 91CD |
| AF | 1242 |
| IY | 7F91 |
| IX | E314 |

T. Fagan,
Middle Park, Vic, 3606.

| ADDR | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | A | B | C | D | E | F |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0000: | CD | 1C | EB | FE | 12 | C0 | DD | E5 | FD | E5 | F5 | C5 | D5 | E5 | D9 | F5 |
| 0010: | C5 | D5 | E5 | 06 | OA | 21 | 38 | 00 | CD | BA | E1 | D1 | CD | E8 | E1 | 23 |
| 0020: | CD | 05 | E2 | 10 | F3 | 06 | 14 | 3B | 10 | FD | E1 | D1 | C1 | F1 | D9 | E1 |
| 0030: | D1 | C1 | F1 | FD | E1 | DD | E1 | C9 | 48 | 4C | 27 | 20 | 00 | 44 | 45 | 27 |
| 0040: | 20 | 00 | 42 | 43 | 27 | 20 | 00 | 41 | 46 | 27 | 20 | 00 | 48 | 4C | 20 | 20 |
| 0050: | 00 | 44 | 45 | 20 | 20 | 00 | 42 | 43 | 20 | 20 | 00 | 41 | 46 | 20 | 20 | 00 |
| 0060: | 49 | 59 | 20 | 20 | 00 | 49 | 58 | 20 | 20 | 00 | 00 | 00 | | | | |

## Economy Mains Autotransformer




A majority of electronic equipment imported from Europe or the USA is rated to run at 220VAC rather than 240VAC and may suffer reduced reliability when run at the higher voltage. An economical solution to this problem is to use a transformer with a 20V secondary connected so it subtracts from the mains supply. The method of connection is shown in the diagram.

Ferguson Transformers Pty Ltd of 331 High St, Chatswood, NSW, 2067 have recently advised us that both their PL and TS series of transformers conform to the required safety standards for the above application and are recommended for this use.

# JAYCAR KITS ▶ QUALITY RESULTS

## DIGITAL CAPACITANCE METER * * *

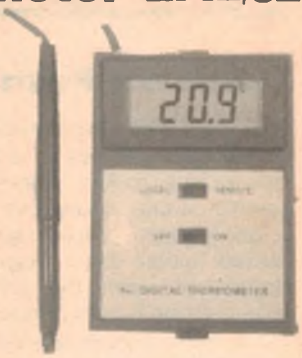
Ref: EA March 1982
This kit once again uses the amazing DPM 200 LCD display/driver module (see below). Capable of measuring capacitance from 1pF to 19.99uF it is a must in every workshop or lab.

Kit includes case.


Only **$59**

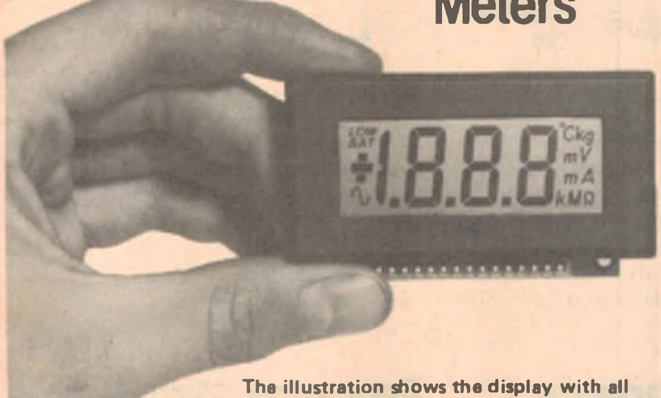
## Digital Thermometer EA2/82

Ref: EA Feb 1982
Read the temperature in your room (or outside) from 0 degrees C to 100 degrees C in fact to within 0.1 degree C. Fantastic resolution on a bright easy-to-read display.




only **$59** ☆
INC CASE

## *sensational* LCD Panel Meters




★ DPM-200 ONLY **$39.50**

case to suit $5.50

The illustration shows the display with all segments and annunciators actuated. The unit is housed in a neat plastic escutcheon. The DPM measures 72x36mm overall. Digital height — 15mm (can be read at distances up to 10 metres).
Specs:
- Input impedance: >100m
- Full scale reading: 199.9mV
- Accuracy 0.05% of reading ∓1 digit
- Power supply: 5-15VDC 50uA
- Sample rate: 3/sec
- Auto polarity, auto zero, over-range warning

Full data sheet supplied with each unit.

## CUDLIPP CRICKET

Ref: EA Feb 1982

One of the most popular kits ever produced by Jaycar. Cudlipp chirps back to you when you talk. Talk about frustrating! Great fun to hide in someones desk!!
The Jaycar kit comes exclusively with 8 great big colourful 2 watt carbon resistors that you use as legs.
Great fun for only

**$12.50** ★

## vocal canceller *

Ref: EA April 1982

This project enables you to cancel out a singers voice on a record so that you can insert your own.
BE A STAR FOR ONLY **$19.50**

## Function Generator

Ref: EA April 1982

"Pigeon Pair" companion to the new 500MHz DFM. Low distortion generator of sine, square and triangular waveforms. From below 20Hz to over 160kHz. Inbuilt 4 digit frequency counter in de-luxe Pac-Tec case. Only $85
JAYCAR EXCLUSIVE — 1% 50ppm metal film resistors used for stability and it's still only $85!!!

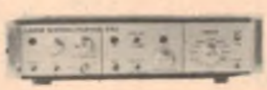
only ★ **$85**

## Digital Storage CRO Adaptor

Ref: Feb 1982 EA

Not only can you avoid buying an expensive CRO but you can have the features of the REALLY expensive ones!!!
- Can display very slow waveforms
- One shot triggering
- Inbuilt graticle shows on TV screen
- Crystal locked timebase
- DC-100kHz bandwidth
- capable of storage operation

Staggering value at $110.



**$110**

## 150W MOSFET AMP KIT *

EXCLUSIVE!!! Special heavy duty EXTRUDED heatsink bracket.

Ref: ETI March 1982

At last high power, with the stability and inherent safety of MOSFETS.
Genuine 150W RMS with power supply on the PCB!! You only need to connect the power trannie and Philips 65D heatsink!!

| | |
|---|---|
| PF4361/1 transformer | $39.50 |
| 65D heatsink, drilled, tapped & black anodised | $39.50 |
| ETI MODULE ONLY | **$79.50** |

## SOUND BENDER **$34.50**

ETI REF: FEB 1982
Jaycar has taken this kit and added a smart all ABS plastic cabinet with specially silk-screened lid. This is the full kit.
If you have a case yourself then the short-form kit is only $24.50!! — includes all parts (less case).

## Jaycar

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| $5-$9.99 ($1) | $10-$24.99 ($2) |
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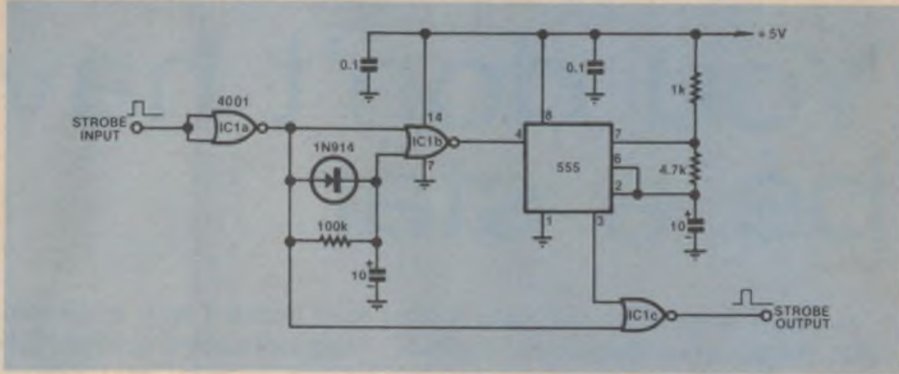
| $100 up ($5.50) | |

## Auto-Repeat Function for RCA VP601 Keyboard

A relatively simple addition to the RCA VP601 keyboard provides an auto-repeat function for any character whenever this is required. The modified keyboard will repeat the character when its key remains pressed for periods exceeding one second. Auto repeat occurs at a rate of 10 characters per second. Thus the keyboard operates normally under normal operating conditions, but provides auto-repeat on command.

The circuit is inserted into the "key pressed" line prior to derivation of strobe and key-down signals. Therefore the following sections of the circuit continue to generate strobe pulses and audio "beeps" for auto-repeat signals in exactly the same manner as for normal sequential key operation.



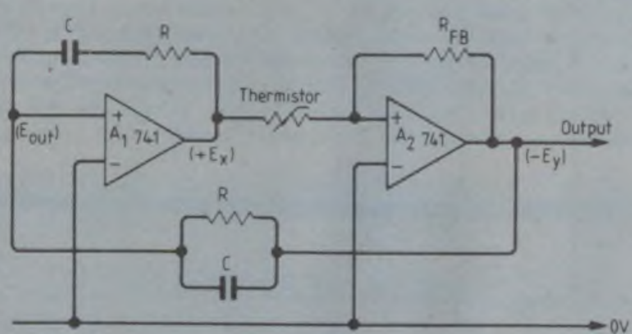

Referring to the circuit it can be seen that the 10μF capacitor at the input to IC1b NOR gate is normally fully charged due to the circuit through the 1N914 diode. The output of this gate is applied to the reset input of a 555 timer, and being normally low prevents the 555 from oscillating in its astable mode.

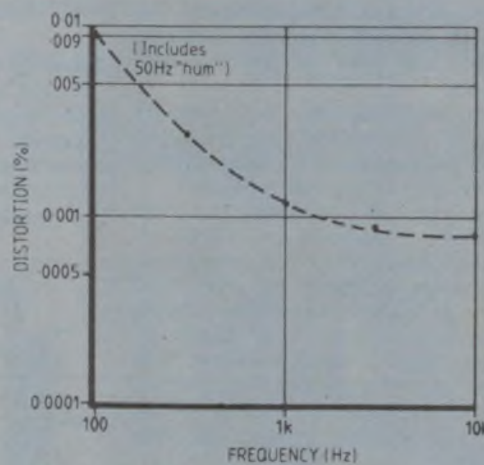
With the circuit in this state, normal input pulses are routed to the output via IC1a and IC1c without modification. Whenever a long input pulse (key held down) is applied to the input, the 10μF capacitor discharges through the 100kΩ resistor; and after approximately one second the output of gate IC1b goes high (discharged capacitor) allowing the 555 to oscillate and hence chop the "key pressed" pulse in IC1c. As soon as the key is released the output of IC1a reverts to high, quickly recharging the 10μF capacitor, returning the circuit to its normal operating mode. Component values around the 555 have been chosen to give a "chopping frequency" of approximately 10Hz.

This circuit can be built up on a small piece of matrix board, and interfaced with the VP601 Encoder Board by cutting the track between R1 and R3. Connect the R1 end to the input; and the R3 end to the output. Power for the circuit may be obtained from the 5V rail of the Encoder Board. Note that a 0.1μF capacitor must be placed across the supply pins of each IC to prevent instability.

M. A. Irving,
Mount Waverly, Vic.

## Novel Wien Bridge Configuration




In an interesting article in a recent issue of "Wireless World", J. L. Linsley Hood of Robins (Electronics), UK has described a new way of using a Wien Bridge in an oscillator circuit to give a sine wave with very low total harmonic distortion (typically less than 0.001%).

He has pointed out that, on a "conventional" oscillator circuit, a large proportion of the output signal voltage appears at the inputs of the amplifier, which leads to nonlinearities in its transfer characteristics due to "common mode" defects in practical amplifiers.

The new sign cascades the elements of the Wien Bridge around two op-amps to alleviate this problem. Refer to the accompanying diagram for details of the configuration of the new design. Performance of a prototype oscillator (built by Linsley Hood) is depicted on the graph accompanying the circuit diagram. Whilst distortion increases as the frequency is reduced below 1kHz, Linsley Hood points out that this is primarily a function of the thermal time constant of the thermistor network, rather than amplifier errors.

In the original article Linsley Hood explores this area in detail and comes up with an alternate system of gain control, utilising an ancillary amplifier and detector circuit to activate a LED, whose light output varies the resistance of a photo-conductive cell, which is used as the gain control element in the new oscillator.

From "Wireless World",
May, 1981.

# Vocal Canceller

# You don't have to be a star

If you have ever imagined yourself as lead vocalist with a famous band, here is your chance to "audition". You can cancel out the lead vocal on almost any stereo record and substitute your own voice or musical instrument.

**by COLIN DAWSON**

In a stereo record of a band or group, the lead vocalist normally appears to be at centre-stage, ie, midway between the two loudspeakers. This is achieved by directing equal amounts of the vocal signal to the left and right channels during the recording process.

Our Vocal Canceller takes advantage of this fact by feeding the left and right channel signals of a stereo record to the inverting and non-inverting inputs of an operational amplifier. The resultant output signal from the op amp is mono (since there is only one output signal) with the common components of the original left and right channels cancelled out. Ergo, the lead vocalist virtually disappears.

You can substitute your own voice by plugging a microphone into the input provided on the canceller. Alternatively, you could plug in a guitar instead.

The success or otherwise of this cancellation will depend upon the particular record. Some records have more reverberation applied to the lead vocalist and so this cancellation process will tend to produce a "disembody" effect rather than a disappearance. Still, the effect can be reasonably satisfying as your substituted voice is "backed" by the original lead vocalist. In fact, you may prefer this.

Our Vocal Canceller is housed in a standard plastic utility case measuring 158 x 95 x 50mm and which is fitted with two knobs and two switches. On one end of the case are four RCA phono sockets. Two of these are inputs and two are outputs. The Canceller is intended to be connected into the Tape Monitor loop which is available on most stereo amplifiers and thus it works at Line Output levels, ie, at several hundred millivolts.

Therefore, when connecting the Vocal Canceller to a typical stereo amplifier, the "Tape Rec" signals from the amplifier go to the inputs of the Canceller while its outputs are connected to the "Tape Mon" inputs on the amplifier.

The two switches on the Canceller are for Power (labelled ON) and Mode which has two positions, Cancel and Normal. In the Normal mode, the canceller circuitry is bypassed and normal stereo reproduction occurs. In the Cancel mode, the depth of the null (or cancellation) can be adjusted by the appropriate knob. The other knob provides a gain control for the microphone input which is suitable for any high impedance dynamic or electret microphone (with inbuilt battery and buffer circuitry).

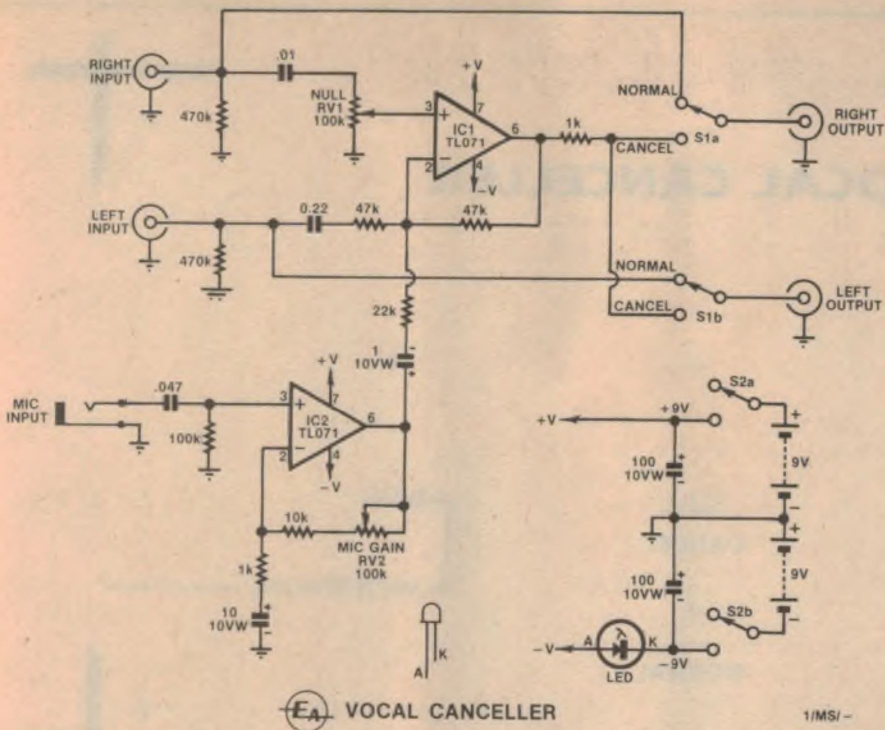
## How it works

A look at the circuit will show that it is quite simple and uses just two low-noise op amps. Our circuit is based on an article in "Popular Electronics" for May 1981. One op amp, IC1, provides the cancellation mode already discussed while the other, IC2, provides a microphone preamplifier.

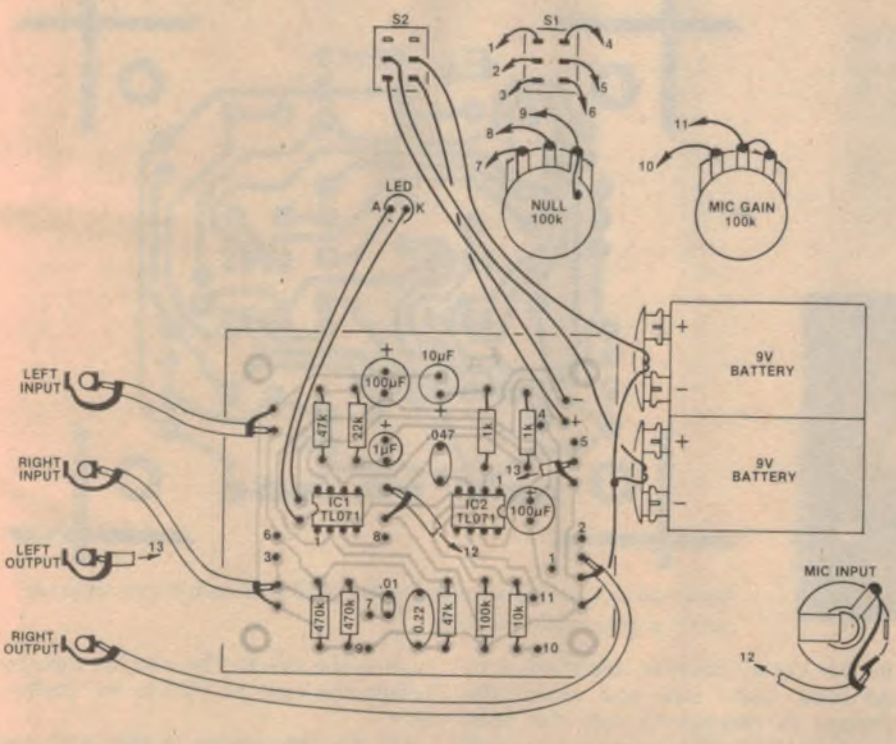
IC1 is arranged in what looks like a conventional inverting amplifier with the left channel signal applied to the inverting input, pin 2, via a 47kΩ resistor and 0.22μF capacitor while DC bias is applied to the non-inverting input, pin 3, via RV1, a 100kΩ potentiometer. However, the circuit departs from normal practice in that a signal is also applied to the non-inverting input via RV1 and a .01μF capacitor. Thus IC1 functions as a differential amplifier and whenever the two signals applied to it are equal in phase and in amplitude they are cancelled out.

IC1 can therefore be considered as an ideal demonstration of a differential amplifier in that it only amplifies signals which have a "difference" between them while signals which are the same (ie, common mode) are rejected. The


*Vocal Canceller cancels the lead vocal and lets you substitute your own voice.*




*The circuit consists of differential amplifier IC1 and microphone preamplifier IC2. Below is the wiring diagram.*




amount of rejection achieved by a differential amplifier is called the "common mode rejection ratio" and for typical op amps this figure is about 80dB.

In fact, if the gain and frequency response of the left and right signal paths were exactly equal, the amount of cancellation or rejection just referred to would be far too high and the remaining signal weak and very lacking in bass. This is because the bass information on most stereo records is mainly mono (ie, centrally located). This makes it easier for the cartridge to track the record and takes advantage of the fact that there is little in the way of directional information (ie, stereo effect) in signals below about 200Hz.

In order to avoid undue cancellation of the bass information on the record, we have arranged the frequency response of the right signal path (to the non-inverting input) to be rolled off at frequencies below about 200Hz. This is done by selecting a .01μF capacitor to couple the signal to RV1 (100kΩ) rather than 0.1μF which would more nearly match the path provided for the left channel by the 0.22μF capacitor and 47kΩ input resistor. Thus, somewhat less cancellation and more bass occurs in the resultant mono signal.

RV1 sets the depth of null, or degree of cancellation of the circuit although, as we have just indicated, the depth of null is limited deliberately by rolling off the frequency response for the right signal path.

IC2 functions as the microphone amplifier and is connected as an inverting amplifier with gain variable between 11 and 111 by means of RV2. The output is connected to the inverting input of ICI via a 11μF capacitor and a 22kΩ resistor which means that this op amp will have a gain of two for the microphone signal.

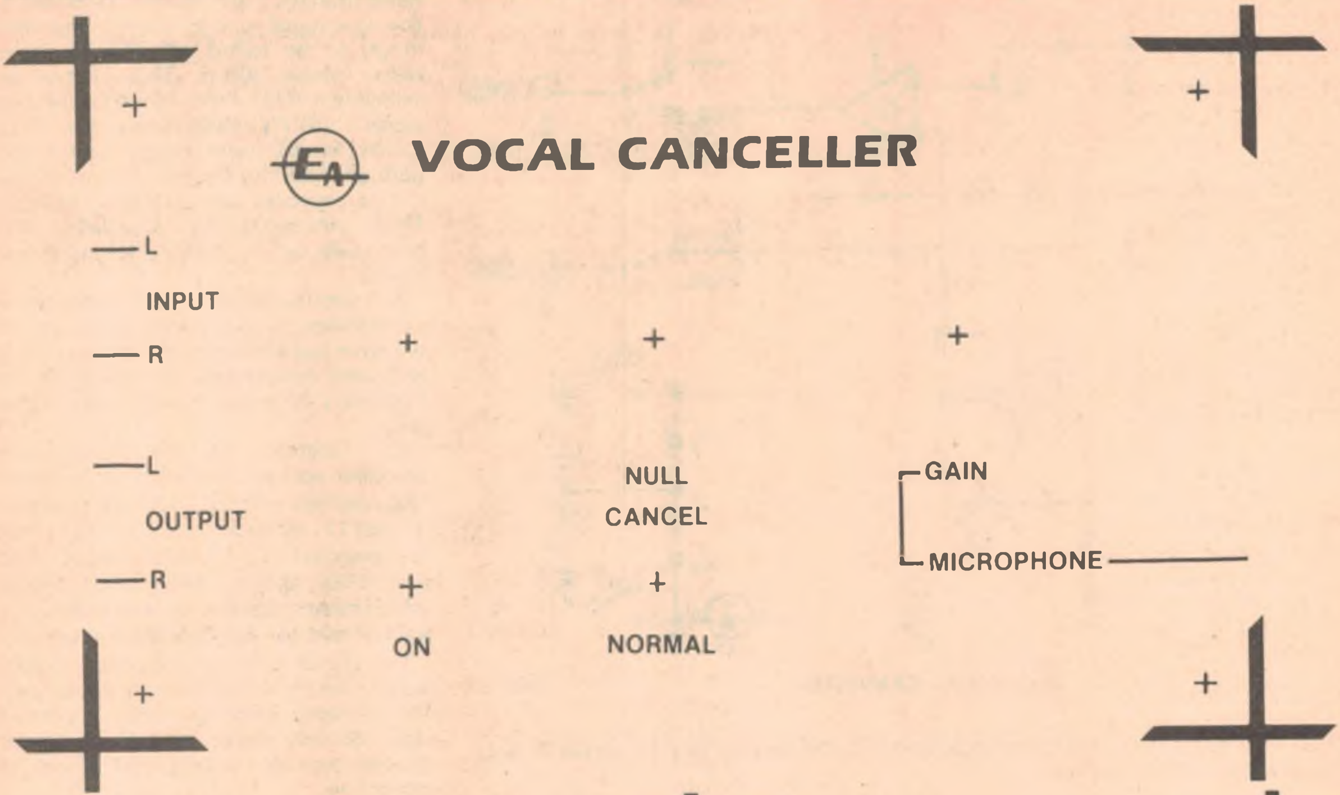
The circuit requires a bi-polar power supply which we have provided by two 9V transistor batteries. With a current drain of only about 4mA the batteries should provide around 100 hours of operation.

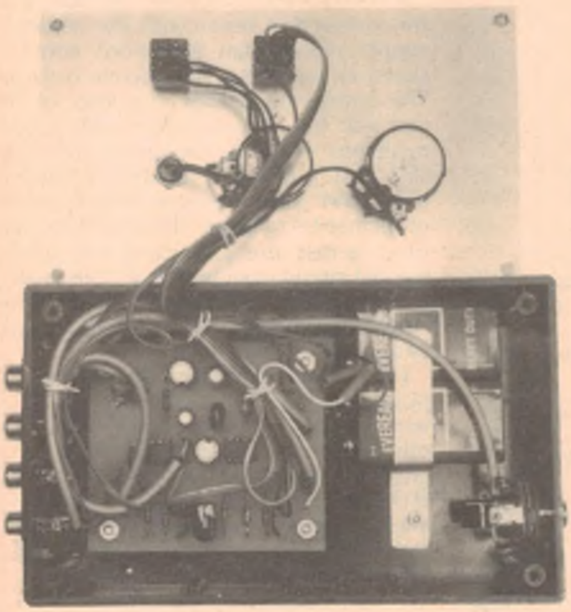
A LED is used as a power indicator and this is wired in series with the negative supply rather than the more conventional arrangement via a series resistor. This arrangement takes advantage of the fact that the op amps draw only a few milliamps which is enough to light the LED and avoid the additional current drain and series resistor which would otherwise be required. The slight voltage drop across the LED does not affect normal circuit operation but does slightly increase the "end-point" voltage of the batteries. Even so, as already indicated, battery life is quite satisfactory.

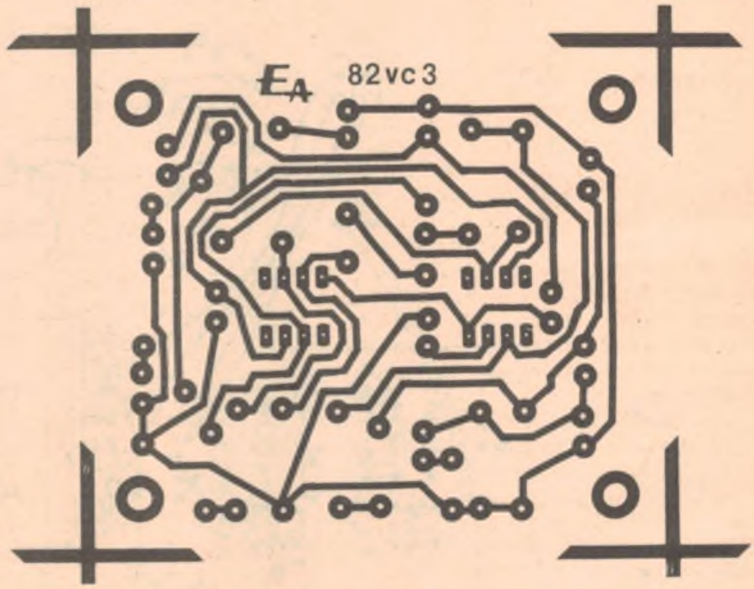
There is one catch with this method of powering the LED. You cannot use LEDs which have an inbuilt series resistor or other means of current limiting. The greater voltage drop across this type of LED will prevent the circuit from working. This means that some LEDs with integral bezels cannot be used. We used a LED with a separate clip-on bezel.

The Canceller is constructed on a printed circuit board (PCB) coded 82vc3, and measuring 75 x 66mm. Mount the components according to the overlay diagram and pay particular attention to the orientation of the ICs as they are opposite to each other. The LED should be mounted on the front panel of the plastic utility box, so just install two hook-up wires at this stage. The only other polarised components on the PCB are the four electrolytic capacitors.

If you are using the plastic utility box suggested earlier, mount the four-way






*Above are actual size artworks for the PCB and front panel, while at right is a view inside the unit.*

RCA socket strip at one end and the microphone socket at the other. We have prepared a Scotchcal front panel for the Vocal Canceller, and if this is to be used, make sure you mount the sockets to correspond with the Scotchcal. The microphone socket may need to be either 6.5 or 3.5mm, depending on the particular microphone you use. If you intend to use the microphone from a portable cassette recorder, you will most likely require a 3.5mm socket.

You will need to drill the front panel to accept the LED, two switches and two pots. These positions are marked on the Scotchcal design. The front panel will also need to be earthed to minimise hum in the circuit. This can be done by linking the case of RV1 to its "earthy" side.

For the connections to the input and output sockets, use shielded wire. All the other connections can be made with unshielded hook-up wire. Be careful of the polarity of the LED as a wrong connection will prevent the circuit from working.

Having completed and checked the construction, turn the Canceller on and check that the LED illuminates. If it does, you are ready to install the Canceller.

> We estimate that the current cost of parts for this project is approximately
>
> **$20**
>
> This includes sales tax.

## PARTS LIST

1 printed circuit board, 82vc3, 75 x 66mm
1 4-way RCA socket strip
1 microphone socket, 6.5mm or 3.5mm (see text)
1 plastic utility box, 158 x 95 x 50mm
2 DPDT switches
2 9V batteries
2 clips for 9V batteries
2 knobs for front panel
5 screws and nuts for mounting PCB and battery holder
Shielded and unshielded hook-up wire
2 LF351, TL071 FET input op amps
1 LED bezel

CAPACITORS
2 100μF 10VW electrolytic
1 10μF 10VW electrolytic
1 1μF 10VW electrolytic
1 0.22μF metallised polyester (greencap)
1 0.047μF greencap
1 0.01μF greencap

RESISTORS (½W, 5%)
2 x 470kΩ, 1 x 100kΩ, 2 x 47kΩ, 1 x 22kΩ, 1 x 10kΩ, 2 x 1kΩ, 2 x 100kΩ linear pots.

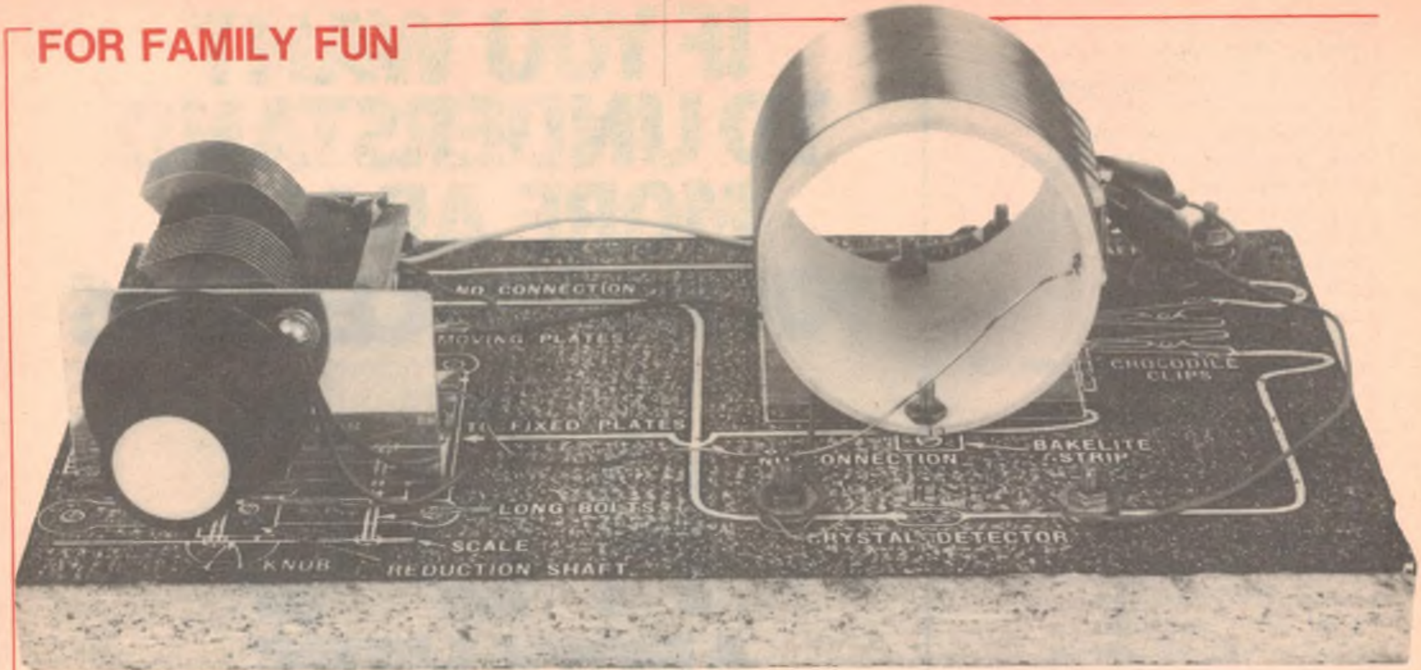
### Installation

The first part of the setting up procedure does not require the Canceller to be switched on. Connect its inputs to the "Tape Rec" sockets on your stereo amplifier and its output to the "Tape Monitor" sockets. Switch the Canceller to the normal position and turn the stereo system on. You should hear normal stereo with the "Tape Monitor" button in or out. If the stereo is distorted, or you can't hear it at all, there is a fault in the wiring.

Now, switch the Canceller on but do not connect a microphone. With S1 still in the "Normal" mode there should be no change from the previous test. Switch the Canceller to the "Cancel" position. Immediately, the stereo should be replaced with mono sound. There will be a decrease in the volume – especially of the lead vocal. Adjust RV1 until the vocal cancellation is maximum. The amount of cancellation possible will vary from record to record, but you should at least be able to put the lead vocal well into the background.

If the circuit is operating properly, connect a pair of headphones to the amplifier, set the microphone gain to minimum and connect a microphone. It is preferable to use headphones rather than speakers until you are familiar with the gain control, otherwise some most unpleasant acoustic feedback may result. With the amplifier set to "Tape monitor" and the Canceller set to

*Continued on page 117*




# Rediscover the Crystal Set

## No batteries, surprisingly good sound, foolproof circuit

**Perhaps the most satisfying project that anyone can build is a crystal set. It does not require a battery and seemingly uses no power. Yet it can pull in a surprising number of broadcast stations and produce good sound quality when connected to a stereo system. And it even works during blackouts!**

Over the years we have certainly published many crystal sets but in recent years they have not seemed particularly attractive. This has been because small transistor radios are so cheap and not really worth building yourself. Also the high impedance headphones which are really essential to the success of a crystal set have become difficult to obtain. But we are getting ahead of ourselves.

What is a crystal set and does it bear any relation to the crystal used in so many watches, computers and communications gear? The answer is that a crystal set is the simplest possible radio receiver and the "crystal" it uses bears no relation to the crystal element used in precision high frequency oscillators in computers and so on.

No. Originally, the crystal referred to here was a piece of galena, a crystalline lead sulphide ore which is a naturally occuring semiconductor material. The galena crystal was mounted in a metal holder and a fine gauge wire called a "cat's whisker" was critically adjusted to touch a sensitive part of the crystal so as to form a primitive diode. And as we all know, a diode only conducts in one direction.

This primitive diode was generally called a crystal detector which referred to its function as a "detector" of radio waves. These days crystal detectors have long since been superseded by germanium and silicon diodes but the simple crystal set circuit remains as simple as it ever was, as is illustrated in Fig. 1.

A crystal set circuit consists of a coil and a capacitor which form a resonant circuit, a diode (or crystal), another capacitor and a pair of headphones. Just how it works can be seen by referring to Fig. 2.

Fig. 2(a) shows the coil and capacitor referred to above connected together to form a resonant circuit. The little arrow on the capacitor shows that it is variable and can be tuned so that the circuit resonates at a particular radio frequency. The radio frequency is modulated (ie, varied in amplitude) by an audio frequency to give the symmetrical waveform shown.

In radio parlance, the radio frequency (RF) is known as the "carrier" while the audio is known as the "modulation".

Where does this RF waveform come from? From your favourite radio station and it is picked up by the aerial and fed in to the coil. As with any radio, you select your favourite signal by tuning the resonant circuit by means of the variable capacitor. This capacitor has air-spaced plates and is commonly known as a tuning gang. The word "gang" refers to the fact that there may be more than one of these variable capacitors "ganged" on the one shaft.

Alright. So far we have tuned the circuit so that it resonates at the particular frequency we want to listen to. This means that it has maximum response at that frequency but we still cannot listen to it because it is still in the form of an RF carrier. We need to separate the audio modulation from the carrier.

This is where the diode (or crystal detector) comes in. Fig. 2(b) shows the diode and a load, R1, connected to the resonant circuit. Since the diode only conducts in one direction, it only passes one half of the RF carrier waveform depicted in Fig. 2(a). So now R1 is fed with tiny DC pulses of RF waveform which vary in amplitude according to the original audio signal.

R1 in Fig. 2(b) actually represents the resistance path for the headphones which finally reproduces the audio signal for your enjoyment. The headphones respond to the average value of the DC pulses "detected" from the RF waveform by the diode. The capacitor C1 smooths the waveform so that the signal applied to the headphones is just the remaining audio modulation. Note that Fig. 2(c) is almost identical to the circuit of Fig. 1.

The major difference between the two circuits, is that the coil depicted in the final circuit has a number of taps to which the aerial is connected.

## No Soldering Required

There are two special aspects of this project. First, apart from the fact that it does not require a power source, no soldering is required. This is in line with the fact that it is a project for the beginner. This should not stop anybody else who wants to experience the intriguing satisfaction of "getting a crystal set to go".

Second, to be really satisfactory, a crystal set needs a pair of sensitive, high impedance headphones. In recent years these have been very difficult to obtain because they have been rendered virtually obsolete by modern low-impedance stereo headphones. However, because Dick Smith had a personal interest in this project, he made a special effort to obtain a large consignment of particularly sensitive phones at a good price.

These high resistance phones have an impedance of 2kΩ (two thousand ohms) and will be sold for $7.90. Alternatively, you can save some brass and opt for an economy 2kΩ earpiece which will set you back only $1.25. For our money, the "proper" headphones are the ones to go for. While they are not hifi and definitely do not sound as "good as a Walkman" they will certainly give sterling service.

## Timber Baseboard

To make this project, you will require a piece of timber or particle board at least 10mm thick and measuring about 220 x 120mm. On one side of this you will affix a reproduction of the diagram on page 70 of this article. We understand that Dick Smith Electronics will be making available an adhesive backed copy of this diagram with the kit for this project which will include all parts, even the timber just mentioned.

All connections on this baseboard are to be made via 1/8-inch (or metric equivalent) screws and nuts. This approach takes advantage of the fact that, for a non-critical circuit such as this, wood is quite a good insulator.

Virtually any tuning gang with a total capacitance of about 350 to 500pF can be used in this project. The gang to be supplied with the DSE kit has two sections which can be connected together to give a total of just over 500pF or about 360pF if just the main section is used by itself. The tuning gang will be supplied with a small aluminium bracket to mount it on the baseboard.

The coil is wound on a 60mm length of 50mm ID (internal diameter) plastic water pipe. This is drilled to take mounting screws and the coil anchor points. It is wound with 24 gauge enamelled copper wire. The enamel on the copper wire is an insulator to prevent shorts between turns.

Anchor the wire at one end of the plastic coil former by passing it through one of the termination holes. Pass about 120mm of the wire through the hole and knot it on the inside of the former. Wind on nine full turns in whichever direction seems easiest, making sure that each

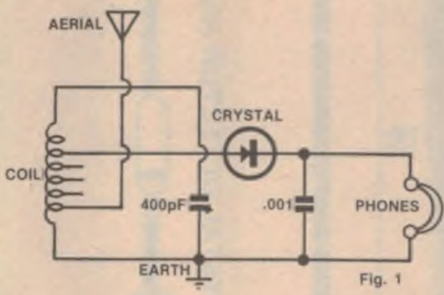



*Fig. 1: complete circuit schematic. Fig. 2: (below) explains how it works.*

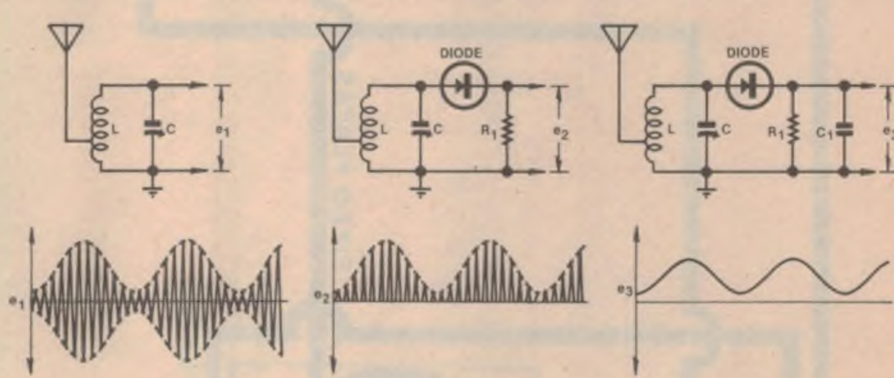
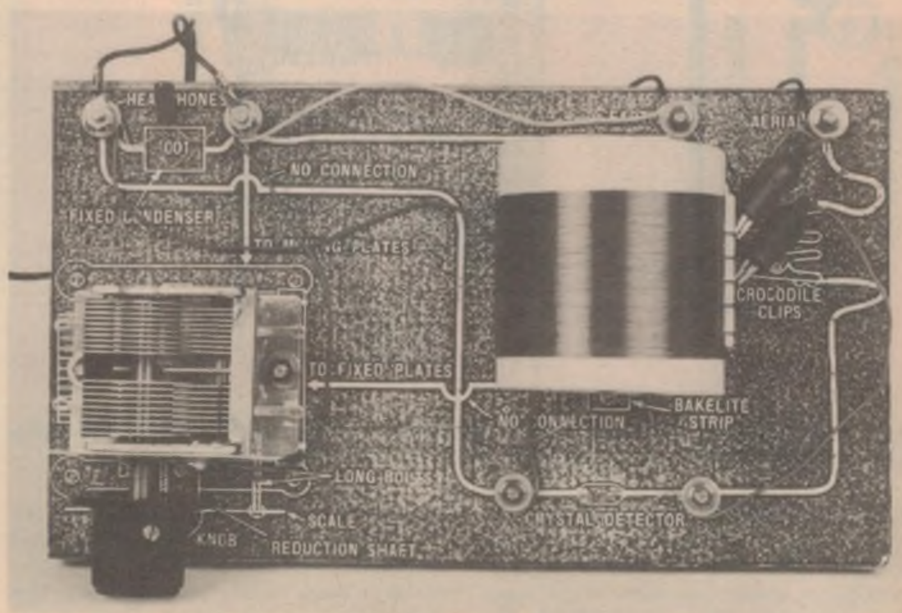
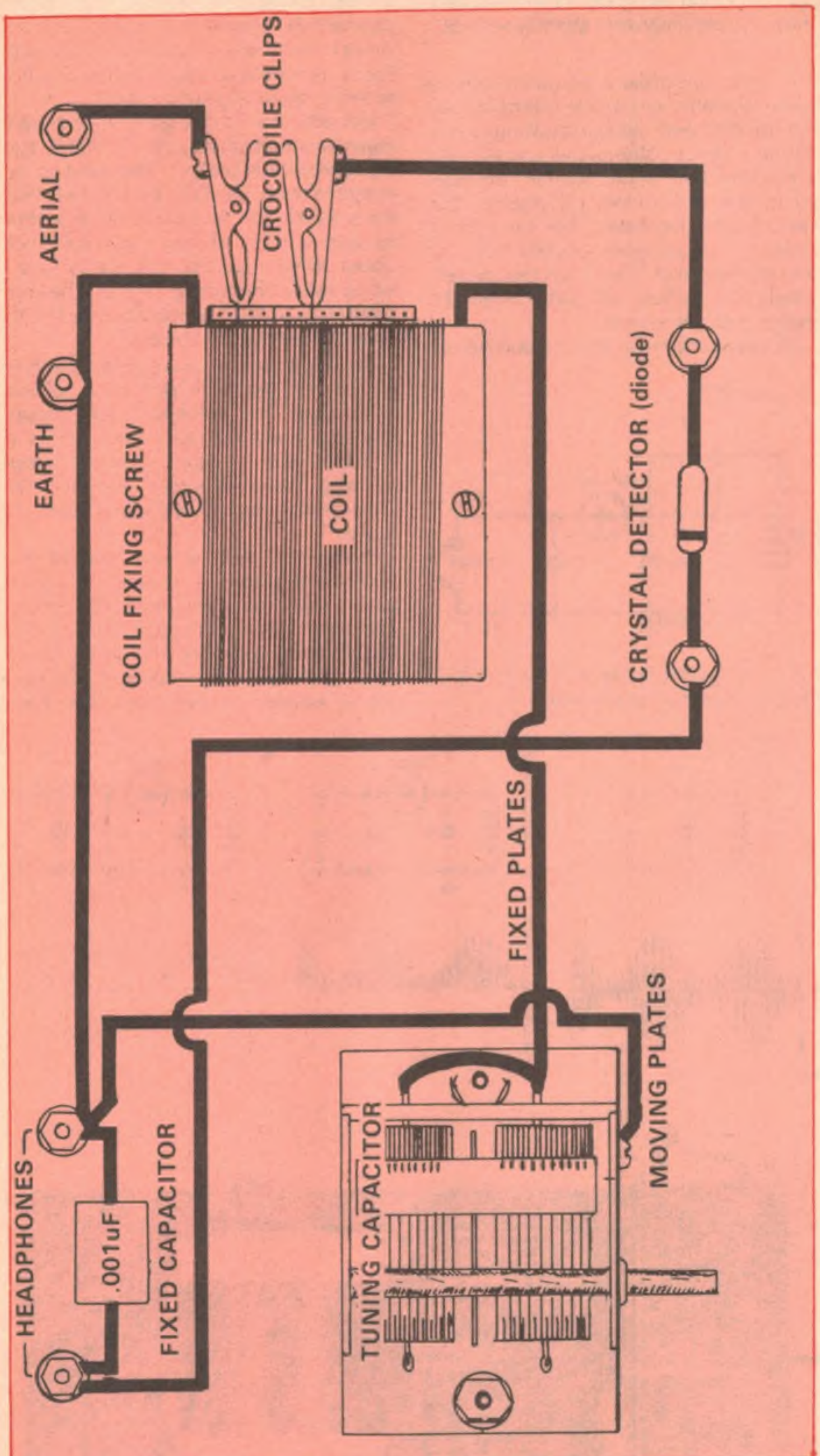



FIG. 2 (a) (b) (c)




*This is what your crystal set will look like when it is finished.*




*Affix a reproduction of this diagram to the timber baseboard and follow the wiring layout exactly. Connections are made using screws and nuts (see text).*

turn is pressed close to the previous one.

When you reach the 10th turn, place one end of a 35mm length of wooden matchstick under the wire. Then place the following turns underneath the matchstick. Continue until you come to the 20th turn. This is again wound over the matchstick, as are turns 30, 40 and 50. Finally, wind on another 15 turns, to make a total of 65. The total winding should then occupy about 40mm of the length of the coil former and the finish can be anchored in the same way as the start.

The next step is to push a second matchstick in alongside the first. This will not be too hard if you first cut a slight chamfer on the end of the matchstick, using a penknife or utility knife. Then push the two matchsticks about 10mm apart.

When you push the two matchsticks apart the wire will stretch slightly but it is not likely to break unless you are very hamfisted. The extra tension on the wire helps keep the coil nice and firm.

If you now carefully scrape the enamel off the five wires going over the five matchsticks and from the start and finish of the winding, you will have virtually finished the coil. The five wires become the tap connections, which are made with small crocodile clips.

## PARTS LIST

*1 timber baseboard, approximately 220 x 120mm*
*1 baseboard label*
*1 tuning gang, maximum capacitance 350 to 500pF*
*1 bracket to suit tuning gang*
*1 plastic coil former, 50mm ID x 60mm long*
*12 metres of 24 B & S enamelled copper wire*
*1 knob to suit gang*
*2 small crocodile clips*
*1 OA91 germanium diode*
*1 .001μF metallised polyester capacitor (greencap)*
*1 set of headphones, impedance 2kΩ OR*
*1 2kΩ dynamic earpiece*

*MISCELLANEOUS*
*Screws, nuts, washers, hookup wire for baseboard connections and aerial.*

*COST ESTIMATE*
*We estimate the current cost of parts for this project to be approximately $7.00 plus the cost of the dynamic headphones.*

Most of the connections in the set are made with screws and nuts, as mentioned previously. The idea is to drill holes for all the screws and then open out the holes on the underside, with a larger drill, so that the screw heads will be recessed. This will avoid the possibility of scratches on your fine olde Tasmanian swamp wattle refectory table.

Pass each screw through its hole and anchor it with a nut. Then sandwich the wires between two washers and secure the lot with another nut and tighten it down. This method of connection applies to all the connections except for that between the tuning gang and the coil. In this case, take the coil wire, which has been scraped clean of enamel insulation and securely crimp it around the lug or lugs on the tuning gang.

While we have shown the diode connected one way in the circuit and wiring diagram, it does not matter which way you connect it. It will work just as well either way. Just make sure it is a germanium diode as a silicon signal diode will hardly work at all.

## Aerial and Earth

Before you can start receiving signals, it is necessary to have an aerial and earth. These days it is more common to refer to the aerial as the antenna but in crystal set parlance, the "aerial" seems to be the favoured word. As far as size is concerned, the bigger the aerial, the better. Ideally, it should be at least 10 metres long and up to 30 metres or more, if you live a long way from the nearest radio station.

If you live on an average suburban lot you may be restricted in the size of the aerial but make it as long and as high as possible, within reason. You can string it from the rooftop to a tree or fence post and you will probably obtain a reasonable signal.

If you live in a home unit, you may find that a strong signal can be obtained from one side of your TV antenna lead.

A good earth connection is also essential for good performance. Ideally, connect the set to a copper or galvanised iron water pipe or to the earthed frame of a permanently connected mains operated appliance such as a refrigerator or freezer. Alternatively, you could drive a length of water pipe directly into the ground and use that for your earth connection.

With the set itself finished, aerial and earth connected, you are ready to try it out. Connect the aerial crocodile clip to the tap on the coil nearest the earthed end. The crocodile clip for the diode detector can then be the next tap up. Now try adjusting the tuning gang and the chances are that you will hear a signal. You can then try other combinations of taps to see which gives the best results.

Generally, you will find the best results with the aerial tap near the bottom (earthy end) of the coil, when a long aerial is used. Moving the tap up the coil reduces the selectivity (the ability of the set to separate stations) and may make two or more stations audible at the one time. You may also want to try the effect of having the detector and the aerial connected to the same tap and the effect of one or both sections of the gang connected together.

Whatever combination serves you best, we are sure that this crystal set will give a large number of readers a lot of satisfaction.

# Dick Smith and the Crystal Set

*At age eight, (above) Dick Smith looked quite normal (?) although he did have an abiding interest in lizards as this photo shows. Was there any connection between lizards and his eventual development into an electronics magnate? Top right: This is Maurice Findlay, about 30 years ago when he designed and wrote the article which is the precursor of the unit featured in this article.*

*Dick Smith was so keen to see this project republished in the magazine that he arranged a special purchase of these high impedance dynamic headphones. They are very sensitive and really look the part.*

*The article in question was actually published in September 1952 and was the first project ever built by the young Dick Smith. Subsequently, after leaving school, Dick Smith took his first job working for Maurice Findlay, at Findlay Communications Pty Ltd. Pictured below with the crystal set built for this article, are Dick Smith and Maurice Findlay, as they are today.*

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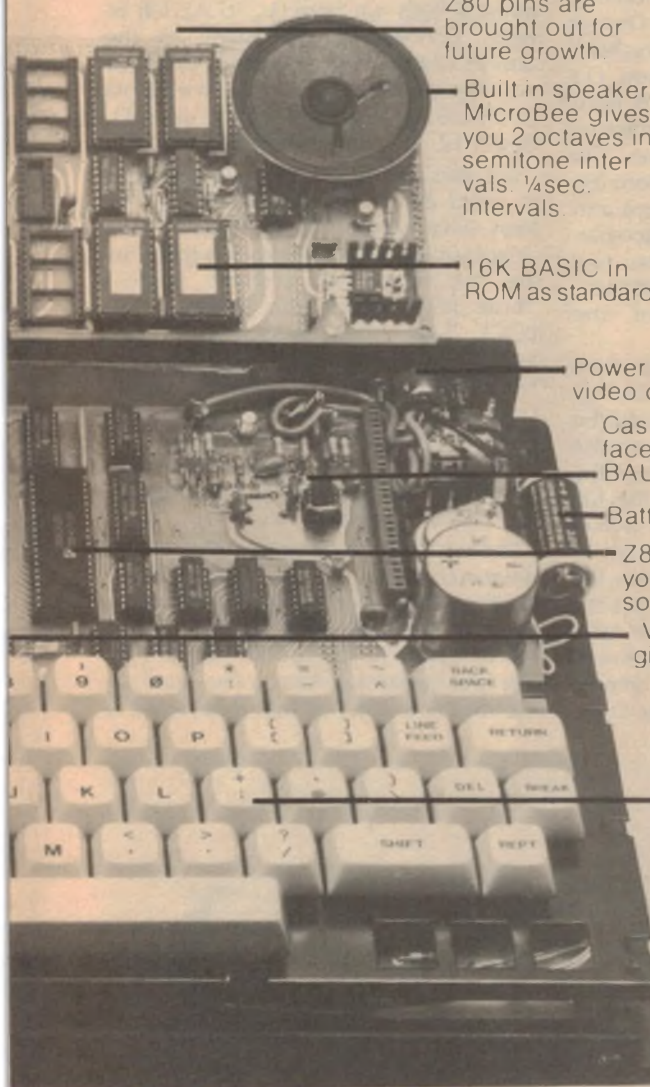


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# A fullsize keyboard for the ZX81

*Frustrated by that little touch-sensitive keyboard of the ZX81? Dick Smith Electronics may have the answer — a professional quality full size keyboard kit. We tried it out, so read on for the results.*

**by PETER VERNON**

Adding a new keyboard to the ZX80/81 is a fairly simple operation if you are handy with a soldering iron, and can keep track of the wiring required. Until now, the problem has been the availability of a suitable keyboard.

Dick Smith's answer is their computer keyboard kit, catalogue number K-3601. This is the same keyboard as used in the Super-80 project. The kit provides 60 momentary contact keyswitches, 59 keytops and a space bar, a metal frame to hold the switches and some mounting hardware. The keytops are injection moulded and attractive in appearance, and the keyswitches themselves have a good positive feel. All in all this is quite a good keyboard for the price, normally $42.95.

Dick Smith Electronics Pty Ltd is making a special offer, however. When purchased with a ZX81 computer the keyboard kit costs just $25. Assembling the kit and connecting the keyboard to the computer is up to the purchaser.

The keyboard goes together quite easily but wiring it for the use with the ZX81 is a little tedious, as the keyswitches must be connected in a 5x8 matrix. We used heavy gauge tinned copper wire, with slip on plastic "spaghetti" insulation where wires cross over. A 40cm length of 13 conductor ribbon cable was used to connect the keyboard to the computer.

The wiring diagram, Fig. 1, shows the matrix in ideal form as a rectangular grid. In reality however, things aren't this simple. The right-hand side of the keyboard, looking from the top, is likely to cause the most confusion. Note that the vertical element of the grid here runs from the "0" (zero) key to the "P" key, then out to the key marked "RETURN" and then back and down to the Space-bar.

The horizontal elements on the top row of keys are straight-forward, running from the six key to the zero key. On the next row, the horizontal wiring runs from the "Y" key through to the "P" key. On the third row down, the wiring is from the "H" key to "J", "K", "L" and then to the other contact of the "RETURN" key. On the bottom row, run the wiring from the "B" key, to "N", "M", "." (full stop) and then to the unwired pin of the Space-bar. The result is still a matrix, but our rectangular array has become distorted by the physical configuration of the keyboard we are using.

The next step is to join the vertical wire runs into pairs. Join the wire running from the "1" key to the Shift key to the wire running from the zero key to the Space-bar. The vertical wire run from the "2" key to the "Z" is joined to the full stop key. The "3" key vertical run is joined to the vertical run from the "8" key to the "M" key. The wire running from the "4" to "C" is joined to the wire from the "7" to "N". Finally the "V" and "B" runs are joined together. These pairs are now the five vertical elements of the matrix, and are connected to Data inputs $D_0$ to $D_4$ as shown in Fig. 1.

By soldering the ends of the ribbon cable to the same points on the ZX81 board used to connect the standard membrane keyboard to the computer, our new keyboard was connected in parallel with the existing keys. (Fig. 2)

Connections for the ZX80 are different. Looking at the underside of the PCB, the address lines run from $A_{15}$ to $A_8$, left to right. Connections are made to the anodes of the diodes, D1 for $A_8$ to D8 for $A_{15}$. The data lines go via pullup resistors to U11. $D_4$ goes to pin 14, $D_3$ to pin 4, $D_2$ to pin 12, $D_1$ to pin 6 and $D_0$ to pin 10.

But wait a minute! If the new keyboard is wired as an 5x8 matrix, and has 59 keys, what happens to the other 19 keys unaccounted for? The answer is that they are not connected, and are wasted. These keys include the comma, ESC, LOCK, TAB, CTRL, backspace, DELETE, and BREAK, to name a few. Perhaps the best thing to do is to mount only the 40 keys which are actually scanned by the ZX80/81 computers and save the rest in a "junk box" for future use. They may come in handy at some time, but not for the Sinclair machines!

There is a further problem. One of the unique advantages of the ZX80 and ZX81 is "Key Word" entry. In this scheme, Basic statements such as LET, RUN, PRINT etc are printed on the screen with just one keystroke. After a line number, the machine assumes that a keyword is

*Now the ZX81 sports a new keyboard. Note that the keyboard is bigger than the entire computer, however!*

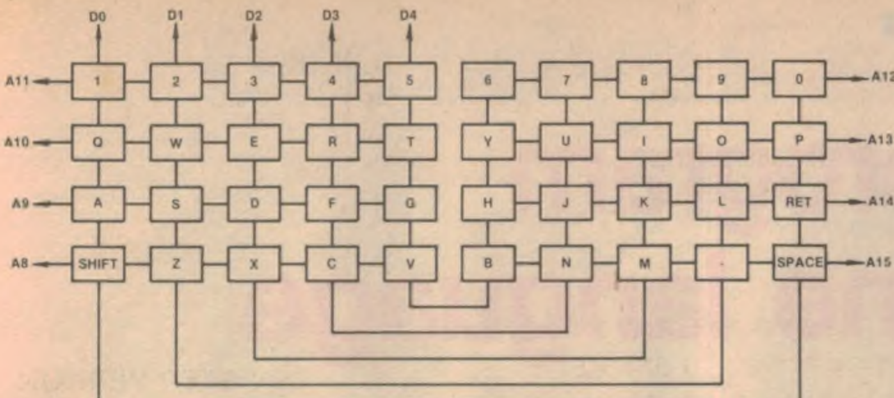
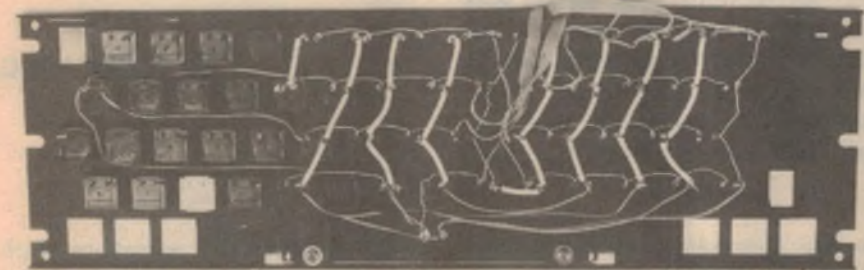
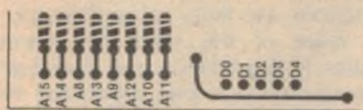



FIG. 1

*This is the way to wire the 8 x 5 keyboard matrix.*



*The wiring is more complicated than the circuit diagram suggests.*




KEYBOARD PINOUTS ON UNDERSIDE OF PCB
FIG. 2

required, and pressing the "P" key, for example, will enter "PRINT" in the program at this point. All Basic statements are entered in this way. Basic functions such as SQR (square root) or COS are entered by first pressing a "function" key, then the key required.

Thus each key of the original keyboard of these computers has at least three functions and some have as many as five. The "P" key, for example means "PRINT" when the computer is expecting a program statement, the letter "P" otherwise; shift P gives quote marks, while function P is TAB. The "S" key is the "SAVE" command, the letter "S", the ARCCOS functions, "LPRINT" and also has an associated graphics character, all shown on the labelling of the keyboard.

The new keyboard does not have these labels, although it does have others which only serve to increase the confusion. Again, as an example, a standard keyboard generates quote marks with a shift "2", and the Dick Smith keyboard is labelled to represent this, bearing no relationship to the keyboard of the ZX80 or ZX81.

One solution would be to make a copy of the legend of the ZX81 keyboard, perhaps from the user manual, and paste it in a convenient spot adjacent to the new keyboard. This will depend on how the new keyboard is mounted. It must be raised off the table top in some way, otherwise it will rest on the somewhat fragile pins of the keyswitches.

The problem cannot be solved by rewiring the keyboard matrix, although at first sight this seems possible. For example, if the "2" key is wired in place of the "P" to accurately represent the shifted character available, it will also produce the letter "P" when not shifted, and the keyword "PRINT"' when a keyword is required. Other wiring changes would raise similar conflicts.

Speaking of wiring changes, the original idea for this conversion came from an English user magazine "Interface".

The essential problem is how necessary such a conversion is. How many users of the Sinclair computers require to enter long slabs of text? The whole design of the Sinclair machines is aimed at reducing typing. None of the programs in "30 programs for the Sinclair ZX80" for example, require more than around 50 lines, with the longest line containing no more than 40 characters. With single keystroke entry of key words, keyboard fatigue is not likely to be a problem.

If you feel that the keyboard conversion is necessary for your existing machine, the Dick Smith keyboard is an inexpensive kit to use. If you are considering buying a computer but are put off the Sinclair machines by the tiny touch-sensitive keyboard, we can only report that this package deal does not really solve the problem.



Continuing our series

# How to program in machine language

Continuing our series on machine language programming this month we look at Extended addressing and shifting bits, BRAs and programs that jump around. Along the way we answer a few puzzling questions and bring it all together with a sample games program written in machine language for the DREAM 6800. At its maximum speed this program is so fast that it's unplayable — a real indication of the speed, if not the usefulness of machine language.

**By TONY HAIG**

Last month we looked at immediate mode addressing, in which the operand of the instruction is used (immediately) as data, usually acting on the two accumulators of the 6800. Computer programs almost always use more variables than can be stored in their internal registers, so they need to use free RAM or ROM as additional storage. This means that microprocessors need to have instructions to move values between registers and external memory devices. The MC6800 instruction set is particularly rich in such memory operations due to Motorola's design philosophy of having no secondary accumulators and accessing all peripheral devices as memory locations.

Extended addressing mode instructions provide the most straightforward access to externally stored data. These instructions all have two 8-bit operands which make up the 16-bit memory address of the data. For instance LDAA $0280 (B60280) will load the number stored at memory location 0280 (hex) into accumulator A, SUBB $0370 (F00370) will subtract the number at 0370 from accumulator B and the result stays in Acc B. A look down the columns headed EXTND in the instruction set summary shows that all the operations valid in immediate mode are also meaningful in extended mode, with another 18 operations also available in this addressing mode.

The functions of the various operations discussed last month should be readily understood in this new addressing mode; where in immediate addressing mode the accumulator (or Index or Stack Pointer in the operations LDX, CPX, LDS) is loaded from, or EORed with, or added to using the operand as data, in extended addressing mode the loading, EORiong, or adding is performed using the value stored at a memory location as the data.

The function of the store register operations (STAA, STAB, STX, STS) should also be obvious — the value currently in the register is stored in the memory location specified by the two operands. Let's now look at a fragment of a program as an example (see Fig. 1). If we ignore the rest of the program the function of this fragment is to load Acc A with the contents of memory location 027A, AND it with the value stored at address 027B and add D1. The result is then stored at 027A. If A7 and 71 were stored at 027A and 027B before the program fragment was performed then when the computer executed this part of the program it would go through the steps mentioned below and would eventually change 027A to F2. (Note that if performed a second time 027A changes to 41. Calculate for yourself what 027A becomes if it was completed a third time.) All values are in hex.

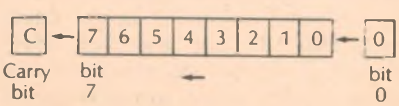
| ADDRESS | VALUE | |
|---|---|---|
| 0217 | B6 | LDAA (Extended) |
| 0218 | 02 | $027A |
| 0219 | 7A | |
| 021A | B4 | ANDA (extended) |
| 021B | 02 | $027B |
| 021C | 7B | |
| 021D | 80 | ADDA (Immediate) |
| 021E | D1 | #D1 |
| 021F | B7 | |
| 0220 | 02 | STA (Extended) |
| 0221 | 7A | $027A |

| | | | |
|---|---|---|---|
| 027A | A7 | 027A | F2 |
| 027B | 71 | 027B | 71 |
| (BEFORE) | | (AFTER) | |

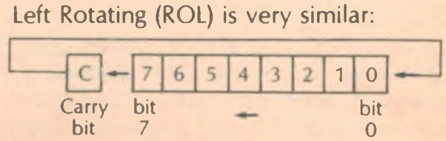
Fig. 1

Let's now look at the operations which are valid in extended addressing but meaningless in immediate mode. The function of the CLR, DEC, and INC operations are fairly self-explanatory — the value of the particular memory location is cleared (has zero stored at it), decremented (has one subtracted from it), or incremented (has one added to it). The operations COM and NEG change the value of memory location into its 1's or 2's complement respectively.

Next we come to the five rotate/shift operations. Consider the decimal operation of multiplying by ten eg, 146 x 10 = 1460. We merely shift everything left one place and put a zero into the units column. Similarly the binary operation of multiplying by two is performed by shifting each bit left one place and putting a zero in bit 0, eg, 0000 0011 x 2 – 0000 0110 ($3_{10}$ x $2_{10}$ = $6_{10}$). But consider 1011 1101 x 10 = 1 0111 1010 ($189_{10}$ x $2_{10}$ = $379_{10}$); the leftmost bit, bit 7, when rotated left in 8 bit binary has no place to go in the new byte and often is too important to lose so it is shifted into the carry bit of the Condition Code Register. This total operation of shifting the byte left one place, shifting a zero into bit 0, and shifting bit 7 out into the carry bit is called Arithmetic Left Shifting (ASL) and can be illustrated as follows:

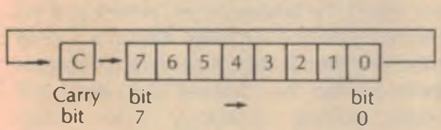



Left Rotating (ROL) is very similar:

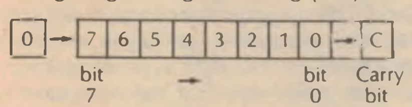


except whatever was in the carry bit before the operation is pushed into bit 0 instead of zero. To multiply a two (or more) byte number by two the low byte should be shifted left then the high byte(s) should be rotated left. (Try checking for yourself that this works.)

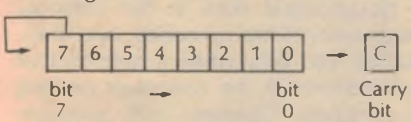
Multiplying by two is more important than it may at first seem, especially when the computer becomes involved in heavy number crunching. By shifting left more than once the computer can quickly multiply by 4, 8, 16 etc and using this fact multiplication by any number can be built up, furthermore often we will want to double a value or use the shift function for I/O or display purposes. Not surprisingly, binary division by two can be performed by shifting or rotating right. Right Rotating (ROR) is the same as left rotating except the bits travel in the other direction:




However there are two types of right shifting, Logical Right Shirting (LSR):




which is the opposite of ASL; also there is Arithmetic Right Shifting (ASR) in which instead of shifting in a zero, leaves bit 7 unchanged:




## Jumping around

The next operation to consider is the Jump (JMP) operation. Like all extended addressing operations the two operands following the op code (7E) form a memory address, so the program "jumps" to that location. The microprocessor's Program Counter (PC) effectively contains the address of the next program instruction byte to be executed, so this instruction amounts to storing the operands in the PC. The JMP operation is the simplest of the jump and branch instructions available to the machine language programmer. Before we look at the more complicated of the PC manipulation instructions we must first look more closely at the CCR.

Recall from the last article that addition and subtraction operations affect the Condition Code Register in various ways, as specified in the instruction set. In operations such as "clear" the result is always zero (obviously) so the effect on the CCR will be to always set the zero status bit (Z-true), reset the negative status bit (zero is non-negative), reset the overflow and carry bits (no overflow or carry can occur) and leave the half carry unaltered since it is only important in addition operations. Information on how each status bit is affected by a given operation is included in Motorola's summary of the 6800 machine language instructions at the extreme right. (See last month's article.) If a particular bit is unaffected by that operation, a dot is shown below the bit in the row describing that operation.

A point worth emphasising is that the computer has no way of knowing how the human programmer is interpreting the data it is manipulating; so it will always perform the status tests even though the human's interpretation may make the test meaningless, eg, if the data is unsigned then negative status and the (signed) overflow status are both meaningless. So the programmer must be careful that he interprets the status bits correctly.

Which immediately raises the question how can these status bits be used (meaningfully of otherwise)? The 6800 machine language has 14 conditional branch operations which are controlled by the value of these bits. Let's look at first the unconditional branch operation BRA (branch always). The BRA operation is similar to the JMP instruction in that whenever it is executed it causes the computer to jump to another part of the program. However, unlike JMP where the two operands define an "absolute" 16 bit address, BRA is performed in the relative addressing mode (the only mode in which branch operations are meaningful) which has one operand also called an "offset", a signed value, which is added to the Program Counter. Since the PC is used as a storage of the address of the next instruction to be executed the computer will continue the program from some other point in the program. It's important to remember that the offset is added at the end of instruction when the PC has already got the address of the instruction after the BRA instruction.

| | ADDRESS | VALUE | |
|---|---|---|---|
| nn = 80 | 0210 | C0 | SUBB |
| | 0211 | 05 | #05 |
| | 0289 | C4 | ANDB |
| | 028A | 7F | #7F |
| | 028B | 7A | DEC |
| nn = FB | 028C | 02 | $027A |
| | 028D | 7A | |
| nn = FE | 028E | 20 | BRA |
| | 028F | nn | nn |
| | 0290 | 7E | JMP |
| nn = 00 | 0291 | C2 | $C297 |
| | 0292 | 97 | |
| nn = 03 | 0293 | 88 | EORA |
| | 0294 | 25 | #25 |
| nn = 7F | 030F | 20 | BRA |
| | 0310 | 4F | 4F |

Fig. 2

Fig. 2 illustrates this by example and highlights three important points. Firstly that BRA 00 makes the computer continue right on as if nothing had happened, since the PC already had the address of the next op code when zero was added to it.

Secondly BRA FE makes the computer jump back to the start of the same BRA FE operation, so therefore the computer "stops" at this instruction and merely performs it hundreds of thousands of times a second. (Remember this – it can be very useful when debugging programs since it stops the computer in its tracks without jumping back to the monitor). And thirdly, note that there is only a limited range of addresses to which the BRA instruction can jump (128 bytes backward or 127 bytes forward from that next address), contrasting with the jump operation which has the range of the entire computer memory. This means that branch instructions requiring a larger range must be performed by jumping to another branch statement or to a jump instruction. The advantages of using BRA instead of JMP are that BRA is a byte shorter and makes the program more readily relocatable (if a working program is moved to a new set of location the "absolute" JMP operands must all be changed while the relative BRA offset will remain correct). The disadvantages are that BRA is slightly slower and it can be messy working out the required offset.

Now that the operation of the unconditional branch has been made clear (hopefully) conditional branching follows easily. An example is BCC (branch if carry clear). When the microprocessor executes this conditional branch operation it tests the branch test (does C=0?) and if the carry bit of the CCR is equal to zero then the test is passed and the computer jumps to a new program location using the one operand as an offset, just as if the instruction was a BRA statement. However, if the carry bit equals one then the test is failed and the processor continues on as if the instruction wasn't there. Most of the tests are quite simple, with the computer testing the status of carry, zero, negative or overflow bits only. However, the other six tests involve sometimes complex combinations of the status bits. These conditional branch statements are usually used after comparisons, such as CMPA or CMPB.

Let's assume we want to know if the unsigned value in Acc A is more than, less than, or equal to some unsigned number, perhaps 20 (hex). If we subtract 20 from Acc A using SUBA #20 Acc A will be changed and so will the Z and C status bits (because the values are unsigned we ignore any change in N or V). If the original value in Acc A was 20 then after the subtraction Acc A will equal zero and the Z status bit will be set (C will not be set). Alternatively Acc A could originally have been 21 or higher so that after the subtraction it would become 01 or higher, the Z bit is reset, and the C bit will also be reset. If, however, Acc A was originally 1F or lower after the subtraction the C bit will be set to indicate a borrow situation and the Z bit will be reset. So if we subtract 20 from Acc A we can test whether the accumulator is equal to 20 (does Z=1?), greater than 20 (does both C=0 and Z=0 alternatively does C+Z=0?), less than 20 (does C+1?), greater than or equal to 20 (does C=0?), less than or equal to 20 (does both C=1 or Z=1? alternatively does C+Z=1?), or not equal to 20 (does Z=0?). So all of the six possibilities can be tested for using the six conditional branch statements BEQ, BHI, BCS, BCC, BLS and BNE.

Of course this system works for any unsigned number, not just 20, and for Acc B as well as Acc A. But what of signed numbers; will those six tests work on signed data as well? The answer is no, the tests involving the carry bit will all be meaningless for data interpreted as being signed, since the carry bit itself is meaningless in one byte signed subtraction. Instead, the negative and overflow bits are important. It turns out (you can check this for yourself) that the various "unsigned tests" involving carry become the required "signed tests" if BCE is used instead of BCC. So although the tests for equal (does Z=1?) and not equal (does Z=0?) remain the same, the other tests are changed: The tests are named BEQ, BNE, BGT, BLT, BGE and BLE (see also Fig. 3). So we have a wide range of tests we can use to compare the accumulators to a signed or unsigned number after using subtraction.

| | Signed Test | Unsigned Test |
|---|---|---|
| Acc A = 20 | BEQ | BEQ |
| Acc A = 20 | BNE | BNE |
| Acc A ≥ 20 | BGT | BHI |
| Acc A ≤ 20 | BLT | BCS |
| Acc A ≥ 20 | BGE | BCC |
| Acc A ≤ 20 | BLE | BLS |

*Fig. 3: testing for a given value.*

The only small problem is that in performing the test the value in the accumulator has been altered to a lower value by the subtraction operation – an undesirable situation. So we have a few operations which can be used which don't alter the value of the register they are testing. The first of these is the compare operation CMPA, CMPB which operates in the same manner as the SUBA or SUBB instructions, except the result instead of going back to the accumulator is left in the Arithmetic Logic Unit (see Fig. 1, last month), and is usually lost in the next operation. However the status bits are not lost and can be used to control the conditional branch operations just as if SUBA or SUBB had been used. CMPA and CMPB are valid in both immediate and extended modes, so that comparisons can be made to a value being the operand or to some number stored in memory.

A very similar operation is CPX, which is valid in immediate and extended modes; in which a sixteen bit unsigned number is subtracted from the index register. Again the status bits are retained and the actual result lost. Remember that C is not tested for and N and V have special tests in this operation.

Another important comparison is the TST operation. This is valid in extended mode and compares the value stored in the memory defined by the two operands to zero. From the setting of the status bits the program can check if the memory is zero, nonzero, greater than zero, etc.

The other useful comparison operation is used to test whether a specific bit of an accumulator has been set. As an example suppose we need to know whether or not bit 6 of Acc A equalled one. Consider the binary number 0100 0000 (which is 40 in hex) which has zeroes in every bit, except bit 6 which has a one. If we AND this number with Acc A using ANDA # 40, let's calculate what happens for a number of values stored in Acc A:

| | | |
|---|---|---|
| Acc A.............. | 1111 1111 | FF |
| Operand ........... | .0100 0000 | .40 |
| Result.............. | 0100 0000 | 40 |
| | | |
| Acc A.............. | 1011 1111 | BF |
| Operand ........... | .0100 0000 | .40 |
| Result.............. | 0000 0000 | 00 |
| | | |
| Acc A.............. | 1101 0100 | D4 |
| Operand ........... | 0100 0000 | .40 |
| Result.............. | 0100 0000 | 40 |

Notice that when the value in Acc A has a one in bit 6 the result is non-zero (hence Z will be cleared) but when bit 6 is zero the result is 00 (hence Z will be set). So to test whether any bit is set or cleared in an accumulator work out the number which has a one for that bit, but all other bits zero and AND that number to the accumulator, the Z status can then control BEQ or BNE. Again the problem arises that ANDA and ANDB alter the accumulator. So the BITA and BITB instructions are available, which perform the ANDA and ANDB instructions without altering Acc A or Acc B.

While on the general subject of PC manipulation I might answer a problem that seems to bother people learning machine language – how does the microprocessor know the difference between information coming from a ROM or RAM or PIA (or disks etc) and how does it know what memory data is an op code, or an operand, or a variable, or just garbage? The answer is firstly (and simply) that it doesn't know, nor needs to know where the data is coming from or going to. The MC6800 chip puts out a signal requesting (or representing) a data byte, specifies a certain address and expects some memory device to supply (or store) the information correctly. If no memory device supplies data for a read memory then it uses whatever garbage is induced into the "drifting" data lines, if it tries storing memory into "non-writeable" memory like ROM's or undefined storage space then the data is lost. So the programmer must make sure that the computer performs memory operations on the right type of memory or must make sure that the computer is not instructed to branch to an undefined memory address.

In answer to the second part of the question the computer can only tell if the hexadecimal data in the memory storage devices are op codes, operands, variables, etc, only when it reaches that data's address in the course of running the program. Consider that program fragment shown in Fig. 2. Just before the computer fetches the ANDB instruction the PC will have 0289 stored in it, the address of the next instruction. It reads the value stored at that address and since it is at the start of a new instruction it interprets it as an op code, stores it in the Instruction Register (one of the buffer registers, see Fig. 1 last month), and the PC is incremented. C4 is an op code requiring an operand, and PC has the address of that operand (028A), so the operand is then loaded into the 6800 from memory, the PC is incremented, and the instruction can be completed.

Now the microprocessor "wants" a new op code so it loads the new op code (7A) in from the address in the PC (028B), the it can increment the PC. 7A is an op code requiring two operands, so the 6800 gets the first operand from the address in the PC (028C), increments the PC, gets the second operand from the new address in the PC (028D), increments the PC, and then can complete the DEC instruction. Notice that each time the program reaches the start of a new instruction the PC has the address of an op code stored, and as the

```
0080        FLAG
```

IF THIS BYTE IS ZERO THEN THE BULLET IS STATIONARY.

```
0081    CLR $0100     7F0100
0084    INC $0083     7C0083
0087    BNE F8        26F8
```

THIS SECTION CLEARS THE SCREEN.

```
0089    LDAA #80      8680
008B    STA $0100     B70100
008E    STA $0162     B70162
```

THIS PUTS TWO DOTS ON THE SCREEN, THE TARGET DOT IN THE TOP LEFT CORNER AND THE BULLET IN ITS INITIAL PLACE.

```
0091    CLR $0080     7F0080
```

THIS INITIALISES THE FLAG.

```
0094    LDAA #40      8640
0096    LDAB #FF      C6FF
0098    SUBB #01      C001
009A    BNE FC        26FC
009C    SUBA #01      8001
009E    BNE F8        26F8
```

THIS IS A TIME DELAY. BEFORE THE COMPUTER FINISHES THIS SECTION IT LOOPS THROUGH ABOUT 33,000 INSTRUCTIONS, WHICH SLOWS THE MOVEMENT DOWN TO A REASONABLE SPEED. CHANGING 0095 ALTERS THE NUMBER OF LOOPS AND THE MOVEMENT SPEED.

```
00A0    LSR $0100     740100
00A3    ROR $0101     760101
00A6    ROR $0102     760102
00A9    ROR $0103     760103
```

THIS IS A FOUR BYTE RIGHT ROTATION OF THE FIRST FOUR BYTES OF THE DISPLAY.

```
00AC    BCC 08        2408
00AE    LDAA $0100    B60100
00B1    ORAA #80      8A80
00B3    STAA $0100    B70100
```

IF A DOT TRIES TO LEAVE THOSE FIRST FOUR THEN THIS PUTS IT BACK INTO THE EXTREME LEFT AND TOP OF THE DISPLAY BUFFER.

```
00B6    LDAA $8010    B68010
00B9    CMPA #F0      81F0
00BB    BEQ 02        2702
00BD    STAA $80      9780
```

THIS CHECKS IF ANY BUTTON IS BEING PRESSED AND IF SO CHANGES THE FLAG TO A NON-ZERO NUMBER.

```
00BF    TST $0080     7D0080
00C2    BEQ D0        27D0
00C4    LDAA $D3      96D3
00C6    STAA $D0      97D0
00C8    SUBA #08      8008
00CA    STAA $D3      97D3
00CC    STAA $D8      97D8
00CE    CLR $015A     7F015A
00D1    LDAB $0162    F60162
00D4    EORB #80      C880
00D6    STAB $0162    F70162
```

THIS CHECKS THE FLAG VALUE, THEN IF THE BULLET IS STATIONARY (SO DOESN'T REQUIRE MOVING) THE COMPUTER BRANCHES BACK TO THE TIME DELAY TO CONTINUE THE PROGRAM. IF THE BULLET DOES REQUIRE MOVING IT IS PERFORMED BY ERASING THE OLD DOT AND PUTTING A NEW DOT EIGHT BYTES LOWER (ONE ROW HIGHER). THE DOT IS EORed INTO POSITION SO IT DESTROYS THE TARGET IF THEY COLLIDE.

```
00D9    CMPA #02      8102
00DB    BNE B7        26B7
00DD    LDAB #5A      C65A
00DF    STAB $D0      D7D0
00E1    LDAB #62      C662
00E3    STAB $D3      D7D3
00E5    STAB $D8      D7D8
00E7    LDAA #80      8680
00E9    BRA A3        20A3
```

THIS CHECKS IF THE BULLET HAS REACHED THE TOP ROW. IF IT HASN'T THEN IT BRANCHES BACK TO THE DELAY SECTION TO CONTINUE THE PROGRAM. IF THE BULLET HAS REACHED THE TOP THEN THE PLAYER IS SET UP WITH A NEW BULLET, AND THE GAME CONTINUES INDEFINITELY.

PC slowly increases, it cycles past the operand's address/es.

That essentially is the only way in which the computer differentiates between the information in the memory devices. All addresses whose particular memory location is stored in the PC at the start of an instruction must have an op code stored, while all the other locations which the PC stores during the running of the program (in between op codes) must be operands. Any memory which during the entire running of the program does not have its address stored in the PC is not part of the program and is available for the storage of data and variables.

This may seem obvious to some readers, but I hope it clears up a problem for others. I hope it also stresses that it is up to the programmer to keep the program bytes and the data bytes separate – don't jump "into" a series of data bytes and don't store values in your program. To digress for a moment: jumping to the wrong location either into data or "landing" on an operand, seems to cause one of three undesirable events: the computer may eventually continue the program after leaving out some instructions or adding some unwanted ones in, the computer may stop dead and do nothing, or the computer may go wild, characterised in my DREAM by a flickering screen and/or rewriting with garbage my carefully entered program. It all seems to depend on whether or not the new op codes happen to be one of the 197 valid codes. Accidental alteration of the program bytes usually has similar results, especially if it is an op code which is rotated or cleared etc.

If the alteration is carefully planned, however, this can be a particularly useful programming trick. The program at the end of this article has two examples of how this trick can be used in changing an operand. Storing a new branch offset also has many useful applications, as does a (careful) change of the operation code. It is worth remembering this trick as it often provides a handy way of shortening long, repetitive program sections. It is very rarely discussed in books on computer programming because the use of programs which alter themselves as they run ("self-modifying code") is considered bad style – chiefly because they can be very hard to debug.

In any case, it is common machine language programming practice to keep the variables separate from the program by storing all the variables in memory at the beginning (or end) of the available memory, followed (preceded) by the program bytes. That section of memory is usually called the "scratchpad" and is referenced frequently by the program in the course of changing, loading, and storing the various variables. This is the reason for having the Direct addressing mode. If the scratchpad is put in the bottom page (lowest 256 bytes of memory) then obviously the scratchpad will be in the addresses between 0000 and 00FF. Since the scratchpad is frequently referred to there will be many instructions like STAA $0080, EORB $008A, LDX$0012 etc. Notice that each time the first operand will be 00. So Direct addressing is the same as Extended addressing except that for Direct instructions the microprocessor assumes that the first half of the address is 00, so the programmer only needs to specify the lower half of the memory address. So those Extended instructions STAA $0080 (B70080), EORB $008A (F80012), LDX $0012 (FE0012) become the Direct instructions STAA $80 (9780), EORB $8A (D88A), and LDX $12 (DE12), and so on. The advantage of using Direct instructions is that they are shorter and faster than similar Extended instructions. However not all Extended mode instructions are available in Direct mode, just 25 of the commonly used ones.

Recall that the dollar sign ($) is used to indicate a load from an address location, so that, for example, the Extended mode instruction LDDA $033F (B6033F in machine code) means load accumulator A with the contents of the address 033F. There should be no confusion between Extended and Direct mode instructions since the first has twice as many operands. The special symbols however do serve to separate instructions like LDX 033F (CE033F) and LDX $033F (FE033F). Relative mode operations do not need any prefix since they are only valid in this one addressing mode.

You should now be armed with sufficient 6800 machine language knowledge to write some simple programs. Writing programs, no matter how small initially, is the best way to really get to know a computer language. Example programs also are usually helpful so we'll look at a short game, written for the DREAM 6800 (but should be adaptable to other 6800 machines) using the instructions encountered in these first two articles. The program makes use of the fact that the value stored at 8010 is usually F0, but changes when a button is pressed. Also I remind you that the display buffer is located at 0100 – 01FF.

The game is a DREAM version of the "Shoot" or "Skeet" game where the player is required to "hit" lighted LED's chasing through six positions. In the DREAM version a dot moves horizontally through 32 positions with an initially stationary bullet dot 14 positions below and halfway along the target's path. On pressing any button on the keybad the bullet moves up to the level of the target dot. If it "hits" the target the target is destroyed, if it misses the bullet now moves horizontally as well and must also be destroyed (the player gets unlimited replacement bullets). The game is over when all targets are eventually destroyed. The target speed should be variable to make the game harder or easier. See also Fig. 4. The listing I have given has the address at the left, the mnemonic, value and comments. The arrows show the branch "paths". Changing the operand at address 0095 varies the speed.

Next month: Indexed and Implied addressing, the stack pointer and subroutines.

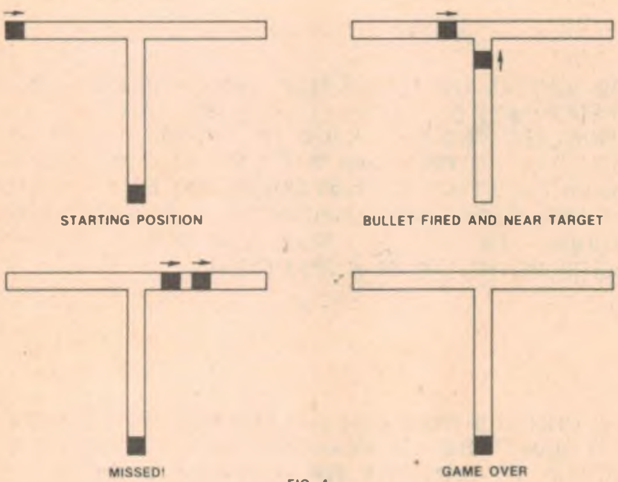



FIG. 4

*At left are diagrams of what the screen should look like at various stages of the DREAM "skeet" game. The program is on the previous page.*

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# Amateur Radio

by Pierce Healy, VK2APQ

## The Antarctic Expedition — solar activity effects skeds

**More on the Antarctic Research Expedition's progress, and news of a CW QRP club, are among the items covered this month.**

During early February, 1982, very severe solar activity with a resulting polar cap absorption effect, and magnetic disturbances, severely restricted the usable frequencies, making contact with the Oceanic Research Foundation impossible for several days. This was a complete reversal of the extremely good conditions experienced during January. At the time of writing propagation was still very disturbed, but showing signs of improvement.

Since the January 15, 1982 contact, reported in last month's notes, and January 29, 1982, daily contacts were made with the Expedition, on board the "Dick Smith Explorer". During that period the schooner was moored in a small natural boat harbour, discovered by Mawson 71 years ago, in Commonwealth Bay. The position is 67 degrees south latitude, 142 degrees 41 minutes east longitude.

The daily skeds on 14105kHz were generally at good signal strength and readability. A 14MHz dipole antenna sloping from the top of the main mast had made quite an improvement to VK0DL signals.

On Saturday and Sunday January 16/17, 1982, visitors to the Museum of Applied Arts and Sciences, Sydney, NSW, were able to join in a contact with VK0DL, having their questions on conditions in Antarctica answered by Don Richards, VK2BXM, the expedition's radio operator.

During the good communication period many messages of congratulations and good wishes were passed to the expedition by amateurs in Sydney, Australia, and Auckland, Christchurch, and Nelson, in New Zealand. On several occasions relatives were able to talk directly to expedition members.

On the January 21, 1982 a special message was received from VK0DL for all crew members' relatives. The message was to allay any distress or fears resulting from news of a mishap the previous evening. A catamaran, two canoe hulls braced together, in which a party of four were going ashore had been swamped in rough water, subjecting the occupants to submersion in the icy water. Quick thinking by Dr David Lewis and other members enabled them to be rescued within minutes. Although suffering from varying degrees of hypothermia, all had recovered within an hour. But the incident was not without its anxious moments.

Apart from passing messages, many interesting and informative facts about Antarctica were received firsthand. The biology work includes counting penguin chicks, seals, and bird life, and the scientific study of ice formation on land adjacent to the mooring, and on Greater and Lesser Mackeller Islands. Tunnelling through snow drift and ice to gain access to Mawson's Hut – an Australian national shrine – was also described. Also mentioned was the temperature in the "radio room" (the schooner wheelhouse) – zero degrees Celcius!

Undoubtedly the most interesting messages described the condition and contents of Mawson's hut: a May 1912 London newspaper, with photographs of the Titanic disaster survivors; the wording on food and medicine container labels; a large, almost full, tin of honey that still smells and tastes good; and the effect that wind and ice has had on the outer wall timber. To hear these descriptions and to ask questions of someone on the spot was an enthralling experience.

After experiencing gusty winds blowing up to 70km/h for five days, the expedition sailed from the boat harbour in calm weather at 1100UTC on January 29, 1982. On the next sked, at 0900UTC January 30, their position was 66° 51min south latitude, 143° 44min east longitude. They were in calm, clear weather with a slight breeze, in the Way Archipelago, checking penguin rookeries and bird life.

During the next three days no contact was possible due to a very severe solar disturbance which affected all radio contact to Australia and New Zealand from Antarctica.

At 0915UTC on February 3, 1982 one of the New Zealand net stations was able to copy a faint CW signal from VK0DL and learn that all was well on board and the position was 66° 52min south latitude, 146° 02min east longitude. A strange feature of this type of disturbance is that phone signals from Australia and New Zealand generally can be copied in Antarctica but signals back are non-existent.

On February 4, 1982, on the 0900UTC sked, it was learned that since leaving Commonwealth Bay they had sailed east and found an iceberg, suitable for scientific study, in Pacquita Bay. However, overnight the ice pack froze, conditions became dangerous, and they had to leave. The antenna on the stern was lost.

Moving west along the coast they found an area of open water in Buchanan Bay. There was plenty of pack ice around but they were looking for another iceberg to study.

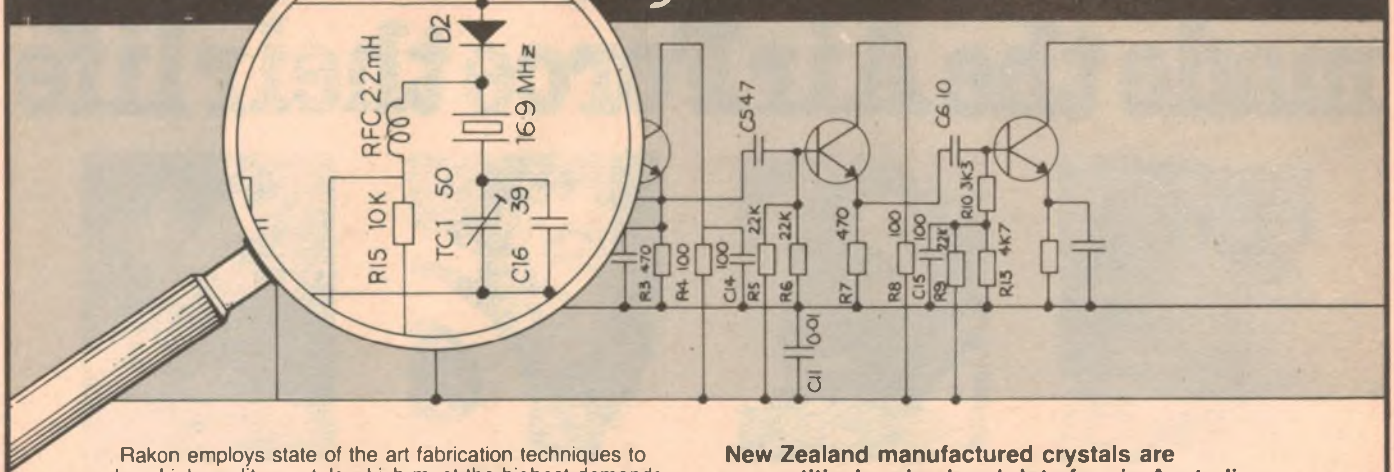
The polar cap absorption effect, solar flares, and magnetic disturbance were still very severely affecting signals from within the Antarctic circle but not so bad on the reverse path.

The position given on February 5, sked was 66° 54min south latitude, 144° 23min east longitude, still in the Buchanan Bay area among pack ice, in a strong breeze. Signals had improved considerably. One message from Don had the landlubbers on the net puzzled. After several requests for repeats it was learned that old nylon stockings have a very important use in the Antarctic, attached to the rigging as wind indicators.

Comparing the position 66° 56min south latitude, 144° 28min east longitude, given at 0915UTC, February 6, with that of February 5, revealed little progress through pack ice in the Buchanan Bay area.

Signals from VK0DL continued to have the characteristic polar flutter selective distortion, or rapid fading into the noise

# Crystal Clear?

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# AMATEUR RADIO

level due to the severe solar disturbance which peaked earlier in the week.

However, description of awesome icebergs, towering ice peaks, and large ice caverns at the tip of the Mertz Glacier have been pieced together by participants in the Oceanic Research Foundation Expedition Net, listening intently to VK0DL.

The conclusion to this month's report on the progress of the expedition is to lay claim on behalf of Don VK2BXM/VK0DL mobile marine and myself VK2APQ — to being the first to establish amateur radio teletype (RTTY) contact between a mobile marine station in Antarctica and Sydney.

To make it more memorable is the fact that it was from an Australian expedition in Commonwealth Bay, within sight of Mawson's hut, 71 years since he established his base and the 100th anniversary of his birth.

It surely symbolises the progress in communications since that early expedition.

Several RTTY contacts have been made. The first fully completed was on Sunday, January 24, 1982, at 1045UTC, lasting nearly two hours. The RTTY terminal units were Tono Theta 7000E with video displays, plus printout in Sydney.

The Tono Theta 7000E and video monitor on board the "Dick Smith Explorer" was made available to the expedition by Vicom International Pty Ltd, through their Sydney branch. It was operating in a temperature around zero degrees Celsius, a good test for both the equipment and the operator's fingers.

### NORTH QUEENSLAND CONVENTION

There were 95 registrations at the fifth WIA North Queensland Convention held at Townsville on September 25-27, 1981. The venue was the Townsville College of Advanced Education. The convention was officially opened by the Mayor of Townsville, Alderman Mike Reynold.

The event was well patronised by trade houses with displays of the latest in amateur equipment and, together with lectures, inspections, and field events, all interests were well catered for.

A most interesting lecture, illustrated with slides, was given by Harry Kinzbrunner, VK4HK, on the Royal Flying Doctor Service 1928-1929. At the James Cook University a lecture was given by Kevin O'Neil on the work being done on transmission lines, followed by a tour of the research facilities. Dr John Nicol, also of the James Cook University, delivered a lecture on high frequency antennas.

There were several other talks and visits, all of which helped to make the event a memorable one.

This is a biennial event — so plan to be in Townsville in 1983.

For those amateurs who in the next few months may be holidaying in the North Queensland area away from the cold south, here are a few details of the Townsville Amateur Radio Club.

President — Roger Cordukes, VK4CD; vice-president and publicity officer — Peter Renton, VK4PV; vice-president and awards manager — Bill Sebbens, VK4XZ; secretary — Don Bowman, VK4ZYZ; treasurer — Ken Telford, VK4ZOC.

Saturday afternoon lectures are held for the novice class and provide a valuable service to the newcomer to amateur radio. AOCP classes are planned for 1982.

The TARC repeater, VK4RAT, on Mount Stuart, gives very good coverage for mobile operation. The frequencies are, input 146.100MHz, output 147.000MHz. The club station call sign is VK4WIT. Beacons on two, six and 10-metre bands are also provided by the club, and are kept in service by John Stevens, VK4AFS.

The TARC monthly newsletter is editored by Evelyn Bahr, VK4EQ.

Throughout the year the club participates in slow Morse code training sessions, field days, Scout Jamboree on the Air, amateur radio displays, and regular general and social meetings.

For full details write to the Secretary, PO Box 964, Townsville, Qld, 4810.

### VK CW QRP CLUB

This club has about 60 members scattered throughout Australia, and is actively seeking new members in all VK call areas.

The aim of the club is to promote the use of CW (Morse code) and QRP (decreased power) as a means of communication between local and overseas stations. Although not a new concept, CW and QRP does offer a challenge in this era of high power, commercially produced, amateur station equipment and the general use of single side band telephony.

It is claimed that QRP CW takes up less bandspace, causes less interference (QRM) and can be used under conditions that make voice communication impractical.

A friendly competition is conducted among club members which caters for those who just want to chat to local stations as well as those keen on DX-hunting. Membership of the club does not compel anyone to submit competition entries on a regular basis. However, everyday on-the-air results can be applied to the competition.

An annual contest is held about November on an international basis, which is attracting an increasing number of entries from Australian and overseas stations.

Members are kept informed of happenings on the club scene by a quarterly news bulletin which covers — contest score boards, DX news, awards, world QRP news, home-built equipment, and items of general interest.

Membership fee is $4 plus $1 for a membership certificate issued when a total of 50 points is scored in the local/DX competition. An informative brochure for prospective members covering all aspects of the VK CW QRP Club may be obtained from the following:

Barry Bennets, VK1BB, 48 Chuculba Cr Giralang ACT 2617.

Colin Stevenson VK2VVA, PO Box 109, Mt Druitt NSW 2770.

Lou Iaquinto VK3DFI, 36 Amelia Street, McKinnon Vic 3204.

John Saunders VK4VEH, C/- S. Marks Coll PO, James Cook University, Townsville Qld 4811.

Len O'Donnel VK5ZF, 33 Lucas Street, Richmond SA 5033.

Jack Swiney VK6JS, Collova Way, Wattleup WA 6166.

Rai Taylor VK7VV, 25 Twelfth Avenue, West Moonah Tas 7009.

Inquiries from VK8 or VK9 call areas should go to VK6JS or the nearest state representative.

### TASMAN SPANNED ON 1296MHz

Dick Norman, VK2BDN of Croydon, Sydney, NSW worked B. Ryall, ZL1AVZ in Auckland, NZ on 1296MHz, distance approximately 2163km, at 6.47 EST on 9/2/82. VK2BDN used 30W to two loop Yagis at 18m high, while ZL1AVZ used 1.3W to a 3.6m dish antenna. As far as it is known, this is the first time that the Tasman has been spanned on 1296MHz.

Radio clubs and other organisations, as well as individual amateur operators, are invited to submit news and notes of their activities for inclusion in these columns. Photographs will be published when of sufficient general interest, and where space permits. All material should be sent to Pierce Healy at 69 Taylor Street, Bankstown, NSW 2200.

# Shortwave Scene

by Arthur Cushen, MBE

## Alaska site of planned Gospel station

**The Federal Communications Commission in Washington has received an application from the World Christian Broadcasting Corporation to establish a shortwave transmitter at Anchor Point, Alaska, to beam programs over the North Pole to Europe.**

The plans are for a 100kW shortwave transmitter to be located at Anchor Point, the southernmost tip of Alaska, to broadcast to Russia, the Far East and over the Pole to Europe. A curtain antenna and a log periodic antenna will be used to cover the target area. There has been some local reaction to the operation of a high powered shortwave station located near a populated area, according to a member of the FCC, discussing the application with Jonathan Marks of Radio Netherland.

The proposal to send a signal over the polar area, which is subject to often severe disturbed reception due to aurora displays, has led to the technical feasibility of the station being questioned in many quarters. Plans are for the station to be operating early next year and if the project becomes a reality Alaska for the first time will be available on shortwave, as a new country in international broadcasting. In the past the Alaskan mediumwave stations have been the only means of confirming reception of the 50th State of the United States.

**RADIO NEW ORLEANS**

After plenty of advance publicity about WRNO Radio New Orleans and its planned shortwave commercial programing to Europe and Canada, the station is finally in operation. The initial tests were carried out in January using a 100kW transmitter beaming signals across the Pole to Europe and were very well received in Australia and New Zealand. Our reception of the tests was on 17895kHz up to 2000UTC while Harry Weatherley in Melbourne noted the broadcasts at 2200UTC on 11890kHz. The station address is: WRNO Radio New Orleans Worldwide, New Orleans, 70002 Louisiana, USA.

The tentative schedule is 1800-2000UTC 17895kHz; 2000-2200 15355; 2200-2400 11890; 2400-0200 11965; 0200-0700 6155. On Sundays the transmissions will be for 24 hours. Commercial programming is being restricted to 12 minutes in each hour with bright music being the main feature of the broadcasts. WRNO is using a variety of frequencies all of which should be heard in Australia during the broadcast day.

Notes from readers should be sent to Arthur Cushen, 212 Earn Street, Invercargill NZ. All times are UTC (GMT). Add eight hours for WAST, 10 hours for EAST and 12 hours for NZT. In areas observing daylight time, add a further hour.

**EUROPEAN NEWS**

**BELGIUM:** Brussels has retimed its English broadcast heard during our late mornings and this is now on the air from 0030-0115UTC on 9870 and 11695kHz. A service to Asia 1400-1430 broadcast Monday to Friday is received on 21810kHz. Two new frequencies have been observed with local programing; 9780kHz opens at 0800 in Dutch while 17900kHz has been heard in French at 1830.

**GREECE:** Athens broadcasting to Australia at 2100UTC has moved to 15335kHz from 15345 to avoid interference from the Armed Forces Radio. The broadcast is also on 9645 and 11730kHz and is repeated to Australia 2200-2250 on 9645kHz.

**IRELAND:** South Dublin Radio 6240kHz broadcasts on Sunday 0600-0800UTC using 1kW, according to a verification. The station address is South Dublin Radio, North St, Sworde, County of Dublin, Ireland.

**ASIAN NEWS**

**DUBAI:** Radio Dubai has made a frequency change to avoid interference with Radio Nederland Bonaire on 9590kHz. The new frequency is 9595kHz which carries English news at 0330UTC, and is beamed to North America. Two other channels 11755 and 11940kHz carry the same program with the latter channel suffering some interference from Radio Canada before the start of the English news.

**MALAYSIA:** A new time zone has been created in this area and Malaysia, Singapore, Sarawak and Sabah are now all eight hours ahead of UTC. Formerly Singapore and Malaysia were seven and a half hours ahead of UTC, while the other two countries were eight hours ahead of UTC.

**JAPAN:** The Far East Network in Tokyo on 6155kHz is received at 0900UTC when frequency information and a jingle is presented before the news. Bryan Clark of Auckland, NZ, reports fair reception of this transmission with some interference from a Russian Home Service program. Chris Rogers of Melbourne, reporting in DX Post, gives information on reception of another frequency, 3910kHz, which is heard at 1600UTC presenting a program of popular music.

**SRI LANKA:** The SLBC has been heard on 6075kHz with an English gospel service at 1245UTC and station identification at 1300. Simon Tuck of Adelaide reported in DX Post that this frequency suffers some interference from KGEI San Francisco during the early part of reception.

**NORTH KOREA:** Radio Pyongyang is using some new frequencies for its English broadcast to the South Pacific in the transmission 0800-0950UTC. 11780kHz suffers interference from Radio Nacional, Brazilia while 9977kHz is the channel giving the best reception. Another outlet, 3560kHz beamed to South East Asia, gives poor reception. A transmission at 0600-0750UTC on 9420kHz to Europe gives the best reception in this area. 11945kHz also carries the same broadcast, according to the BBC

**LATIN AMERICAN NEWS**

**ARGENTINE-ANTARCTICA:** Radio Nacional Arcangel San Gabriel has been heard on 15476kHz closing at 0105 or 0108UTC. This interesting station was heard by Bryan Clark of Auckland and Steven Greenyer of Invercargill over the past few weeks and its signal strength should improve during the winter months in Australia.

**BRAZIL:** Signals from Brazilian stations at 0800UTC have been well received on 9585, 9675, 11765 and 11780kHz. All these stations are commercial except 11780kHz which is an internal broadcast by Radio Nacional at Brazilia.

# The Australian CB SCENE

## 23-channel transceivers acceptable again

The word has finally come through that 23-channel CB sets already in this country, which pass the FCC 1976 specifications, will be licenced, whether or not they have been licenced previously. This opens the way for many people to have their equipment legalised.

It is obvious that the Department is opening as many doors as possible to enable operators to become "legal" and I urge you to take advantage of this opportunity, not only for your own benefit, but for the benefit of the CBRS. As I have said many times: the more operators there are licensed, the greater the weight of our arguments when we ask for concessions from the Department.

Or, to put it another way, when negotiating with the Department, it is helpful not to have the spectre of CB "pirates" looming in the background!

### From New Zealand

I was interested to receive a letter from a CBer in New Zealand, following my remarks in the December issue about the CB scene in that country. The letter comes from Mr Kevin McLean of Auckland and reads as follows:

*I read with interest your comments in "Electronics Australia". While I cannot comment on the clippings from "Truth", as I did not read them, I would like to make a few observations.*

*While one or two Radio Inspectors here may be over-zealous in their job, I have generally found them to be helpful in the Auckland area, where most of the problems with CB are.*

*However, I understand that the problems we have had in Auckland are also appearing in other centres.*

*The CB Radio Association of NZ is the representative body for NZ CBers and the only organisation the NZPO will listen to on their behalf. They can do nothing else but abide by the radio regulations as they are and try, through negotiation, to change the regulations to the benefit of NZ CBers at large.*

*I personally belong to a club that is affiliated with the CBRANZ and we believe that the people do have the power to change the law – but only while operating within the law.*

*While many CBers would like to be able to talk overseas, the view of the majority of responsible CBers is that regulations can be changed to allow this through negotiation. But, if it is changed so that we can talk overseas on 26MHz, we would then be encouraging law breaking in some other country, as we are the only country using 26MHz; all others are using the 27MHz band.*

*As for asking Australian operators who exploit the 26MHz band to "cool it", all I can say is "thank you", as the signals from over the "pond" do cause considerable problems. We are hoping that the time will ultimately come when we will be able to have a legal QSO with our counterparts in Australia.*

Kevin McLean, AK 2366.

Well, thank you for your letter, Kevin. I only wish that more CBers in NZ would put pen to paper, so that we could gain a better knowledge of events and attitudes in your country.

### And From Britain . . .

By courtesy of Ken Upton and the "Sunday Post" for November 1, 1981, I have this report from Britain:

"Car accessory shops throughout the country are preparing for an onslaught tomorrow when Citizens Band radio becomes legal.

"Some shops have been taking orders for weeks from customers eager to break on to the airwaves.

"One Glasgow shop has sold 20 sets in the last week, and has a further 47 waiting to be picked up tomorrow morning.

"With each CB radio and aerial fetching up to £100, some retailers report record takings.

"One dealer said he's unable to keep up with demand. If sales keep at their present level, he'll have exhausted his supply by the weekend. Many sets have been imported from countries where CB is already legal.

"One retailer expects the 5000 CB users in the Glasgow area will double in a year.

"But many radio 'hams' are determined not to change to the new legal frequencies. They say they've already spent hundreds of pounds on equipment and won't alter it.

"Citizen Band radio has caused a great deal of controversy since the first sets arrived in this country a few years ago.

"Many householders have had their TV reception interrupted by CB conversations and hospital and other paging systems suffered from interference.

"The Lord Provost of Glasgow, Dr Michael Kelly, is a CB enthusiast. He plans to have a set fitted into his Rolls-Royce and claims it will make him more accessible to the public."

For once, Jan Christensen is speechless!

### About the NCRA

Finally, I want to give expression to my promise to give a resume of some currently active CB organisations. At the top of the list is the NCRA.

The National Citizens Radio Association of Australia (NCRA) is the longest running CB association in Australia, and probably the best known. Founded in 1976, it quickly became a body consisting of over 300 clubs, with Divisions in each of the States, with the exception of SA and the Northern Territory.

One of its earliest achievements was the founding of the Citizens Radio Emergency Service Teams (CREST). The top executives of the NCRA were also the top executives of CREST. Since that time the two organisations have gone their own way, until they reached their present autonomous state.

Legalisation brought problems, as many clubs let their membership lapse because, to many, the fight was over. Financial problems plagued the organisation, and they still do. Because of manpower and financial difficulties, the NCRA is now controlled nationally by the National Executive and the National Council. Hard work on behalf of the executive, and the faith and support of many members ensures that the NCRA is still considered the major spokesman for the CB operators of Australia by the Department. Submissions and letters are constantly being sent to the Department, which gives careful consideration to them.

The NCRA is co-founder of the World Personal Radio Congress; has, as affiliates, the Citizens Band Radio Council of Ireland, the British Sidebanders HQ and is associated with the Citizens Radio Repeater Association and the Australian Citizens Band and Radio Association.

Membership fees are: $10 per club registration plus $2 per financial member per year. Individual membership is also available: $10 per year full membership or $2 per year Associate membership.

Enquiries should be sent to NCRA, PO Box 406, FORTITUDE VALLEY, 4006, which also happens to be the postal address for correspondence in relation to this column. That is because I am the National Liaison Officer for the NCRA . . . and it saves me having to spend money getting my own PO box.

***Jan Christensen***

# 50 & 25 YEARS AGO

*"Electronics Australia" is one of the longest running technical publications in the world. We started as "Wireless Weekly" in August 1922 and became "Radio and Hobbies in Australia" in April 1939. The title was changed to "Radio, Television and Hobbies" in February 1955 and finally, to "Electronics Australia" in April 1965. Below we feature some items from past issues.*

Wireless Weekly 3d

***April 1932***

**High Power:** The opening of 5CK, the new relay station at Crystal Brook, South Australia, has given us the first taste of high power broadcasting.

Transmitting with 15 kilowatts in the aerial (about three or four times that of 2FC) the station is heard here in Sydney like a local broadcaster, although situated many hundreds of miles away.

☆ ☆ ☆

**Kilocycles:** Although it is not quite so impressive, Americans now prefer saying "600 centimetres" instead of "fifty thousand kilocycles" because it is easy to say; although whether a metre or a cycle is more suitable for measurements is not easy to say.

☆ ☆ ☆

**Music:** After 11pm, music in one Stockholm house or flat must not be audible in another, according to a new bylaw made in that city.

☆ ☆ ☆

**Surgery:** Electro medicine, especially high frequency surgery, has opened a new field for the modern physician. Today, high frequency surgery has saved the lives of thousands of persons.

We already know the fact that a high frequency field traversing the body produces heat in the body. This is used, for instance, in the diathermy, where a high frequency current is applied to the tissue by direct contact electrodes.

☆ ☆ ☆

**No fading:** Complete absence of of static disturbances and fading, which are so troublesome in long-wave long distance reception, is noted in connection with research on the ultra-short beam-wave apparatus, according to Senator Guglielmo Marconi, who has been engaged for some time in such experiments. The very short waves are also very economical, using only 60 watts of power. Senator Marconi found that the waves will penetrate the brick walls of Italian houses with ease, while American buildings absorb them on account of the amounts of steel and iron used in their construction.

RADIO 1/6 TELEVISION AND HOBBIES

***April 1957***

**Electronic memory:** The electronic memory, a key element in modern commercial and military computers, has been reduced to unprecedented compactness and simplicity by RCA Laboratories with the development of a novel printed plate magnetic storage unit that can tuck away 256 bits of computer information in a thin wafer less than an inch square.

Linked in series to form a large-capacity memory system, the tiny plates will enable computers to store electronically more than a million bits of information in a space about the size of a shoebox, and to recall the bits in a few millionths of a second in any desired order, combination, or quantity.

☆ ☆ ☆

**Space travel decried:** Enterprising scientists who were planning journeys to the moon could not have been encouraged by a pessimistic forecast during the month.

Dr Lee de Forest, one of America's most famous scientists, dismissed as impossible one of modern science's persistent dreams — travel into outer space.

Dr de Forest known as the Father of Electronics, predicted that man would never reach the moon, let alone travel by rocketship to strange worlds in distant galaxies.

He said that only his scientific imagination will ever make man a planetary migrant.

Dr de Forest invented the vacuum tube that made possible the development of modern radio broadcasting, television and radar.

☆ ☆ ☆

**No more fighter planes:** Several controversial defence matters seem to have been resolved in recent months.

Some weeks ago the RAF was reported to have decided upon the last type of fighter plane it would take into service.

Defence chiefs consider that guided missiles have rendered fighters obsolete; that Britain's future menace will not come for manned bomber aircraft as in the last war.

ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ...

ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ... ALTRONICS ...

## STUDIO FORMAT
## ETI 5000 STEREO CONTROL PREAMPLIFIER

**There have been countless accolades exclaiming this brilliant design by Australia's top audio design engineer David Tilbrook — and with good reason.**

### SHEER SUPERB SOUND CLARITY
**Together with noise levels that would do studio equipment proud.**

### PART OF THE SECRET IS . . .
**the use of very fast response time "State of the art" OP amp semis, which have only become readily available in recent times.**

As a demonstration of our faith in this classic designed preamplifier we proudly release the **STUDIO FORMAT 5000 PREAMP** which includes some very worthwhile refinements as detailed here:—

* Gold plated RCA Jacks on all phono inputs.
* 1 x pair gold plated RCA Line Plugs, supplied.
* Military spec. National Semiconductor LM 394's employed.
* Low capacitance screened cable, supplied; IC sockets provided throughout; Multicoloured led display.
* Metal film 1% resistors used throughout all audio circuitry.
* Pretinned PCB's.
* Satin Black brush finished, aluminium control knobs.

### FACILITIES AND SPECIFICATIONS

**Inputs**

| | |
|---|---|
| Low Level | — Moving coil, moving magnet 1, moving magnet 2. |
| High Level | — Tuner, Aux 1, Aux 2. |
| Tape | — Tape 1, Tape 2. |
| Calibration | — Inbuilt 400HZ Oscillator. |

**Led Level Meters**

| | |
|---|---|
| Mode selection to | — Source, tape 1 record level, tape 2 record level. |
| Range | — Calibrated — 48 to + 9db. |
| Display | — Peak and average level simultaneously. |
| Frequency Response | — 15 HZ — 130 KHZ + 0db — 1DB. |
| Distortion | — Less than .003% all inputs. |
| S/N Ratio | — Greater than 100 db (A weighted) High Level IP/S. Greater than 92 db (A weighted) Moving Magnet IP. Greater than 75 db (A weighted) Moving Coil IP. |
| Monitor Output | — Enables comparison of record level to source levels. |

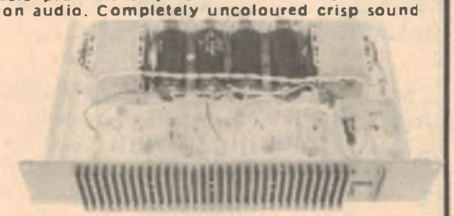
**DELUXE STUDIO FORMAT 5000 PREAMP KIT** K 5001 . . . **$275.00**

Complete kit includes all ETI specified parts plus the Studio Format Package. Full instruction booklet included.

SEE ETI MAGAZINE JULY '81—OCT. '81 FOR FULL DETAILS.

## ETI 5000 STEREO MOSFET AMPLIFIER

**See ETI magazine Jan. '81—April '81. New generation mosfet power semis facilitate David Tilbrook's classic power amplifier. Listening tests prove it surpasses even the best in conventional amplifiers in low fatigue, high definition audio. Completely uncoloured crisp sound purity.**



**EVEN BETTER**: This beautifully engineered amp design is based principally on two identical printed circuit boards with a minimum of other wiring, thus enabling even a relative "beginner" to accomplish building this project as long as the step by step instructions are followed.

**The Altronics Kit includes the DELUXE FINISH FRONT PANEL HEATSINK.**

* Original specified chassis bar design case. * All metal work finished satin black. * Flux shorting strap transformers used to minimise hum * Low leakage power supply electrolytics used.

### SPECIFICATIONS:
**Power Output:** 100 watts into 8 ohms x 2. **Frequency Response:** 8 HZ - 20 KHZ + 0db — .4db.
**Noise:** 116 db below full output. **Input sensitivity:** IV RMS for 100 W output.
**DISTORTION:** Less than .001% at 1 KHZ and full output.
**STABILITY:** Unconditional stable.

COMPLETE MOSFET AMP KIT K 5005 . . . . . . . . . . . . . . . . . . . . **$289.00**

## DIGITAL FREQUENCY METER
See Electronics Aust. Mag. Dec. 81-Feb. '82

**500 MHZ, 7 DIGIT RESOLUTION PLUS PERIOD MEASUREMENT FEATURE**


**IMPORTANT NOTES:**
(1) This project is well within the scope of the "not so experienced" as virtually all components are contained on a single PCB.
(2) ALTRONICS USE ONLY THE SPECIFIED INTERSCIL LSI — BEWARE OF INFERIOR KITS THAT DO NOT CONFORM TO THE ORIGINAL DESIGN.

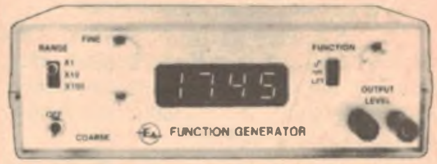
* Prepunched and screened front panel, no drilling or filling required. * Bright high efficiency 7 segment display. * Frequency ranges 0-10MHz, 0-50MHz, 10-50MHz (with optional pre-scaler) * 4 gating times — 01, .1, 1, 10 seconds. * 4 period measuring ranges 1, 10, 100 and 1000 input cycles give 0.1uS resolution. * High input sensitivity — 10mV to 30MHz, 100mV at 50MHz @ 1M input impedance, 200mV at 500MHz @ 75 ohms input impedance. * High accuracy — typically better than .005%/count uncalibrated.

**Costs a fraction of commercial counters.**

**EXCLUSIVE ALTRONICS KIT FEATURES:**
* IC sockets provided throughout.
* Low aging 10,000 MHZ XTAL.
* Thermalloy heatsink for 5V regulator.
* Quality Pactec Instrument Case with tilting bail.

K 2500 (50 MHZ version) . . . . . **$119.50**
K 2501 Pre-scaler . . . . . . . . . . **$ 26.00**
(add for 500 MHZ version)

## FUNCTION GENERATOR WITH DIGITAL DISPLAY




EA's new Function Generator covers the frequency range from 15Hz to 170kHz in three ranges with coarse and fine frequency controls. An economical 4-digit display has been incorporated to eliminate dial calibration. Sine wave distortion can be trimmed to around 0.5%.
See EA April, 1982

K 2505 . . . . . . . . . . . . . . . . . **$79.50**

## ALTRONICS POWER SUPPLY

**BASED ON EA LM 317K PROJECT**
**Every workshop, school and hobbyist should get one now!**


* Overload and short circuit protected.
* Full voltage and current metering.
* 3-32 volt output at 1 AMP.
* Uses LM 317K variable regulator.
* Full instructions and every last part included.

**VALUE PLUS!**

K 3200 . . . . . . . . . . . . . . . . . **$39.95**

## DIGITAL CAPACITANCE METER
Electronics Australia Project. Measures 1PF — 99.99 UF. 240V Mains Powered. Bright LED Display. Easy to build. Complete kit of parts and full instructions.

K 2520 . . . . . . . . . . . . . . . . . **$45.00**

## DUAL TRACKING POWER SUPPLY


+ and — 22V up to 2 AMPS
+ 5V at .9 AMP
Fully Protected against short circuits, overloads and thermal runaway.
See EA March, 1982

K 2507 . . . . . . . . . . . . . . . . . **$86.00**

## DIGITAL THERMOMETER LCD


See EA Feb. '82. Fantastic new project. * 1°C Resolution * Has inbuilt sensor for portable use * External sensor capacity allows measurement of fish tanks, heatsinks etc. Uses brand new DPM-200 15mm LCD Display. Easy to build.

K 2530 . . . **$59.95**

BANKCARD JETSERVICE-DELIVERY NEXT DAY   BANKCARD JETSERVICE-

# New Products...

**Product reviews, releases & services**

## Trio CS-1820 20MHz Dual Trace Oscilloscope

**TRIO have a reputation for producing fine equipment and this new oscilloscope will do nothing to harm that reputation. The CS-1820 will appeal to professional or amateur alike, requiring a high quality oscilloscope. If features a delayed time base, 20MHz bandwidth and 2mV/division sensitivity.**

Dimensions of the CS-1820 are 190(H) × 260(W) × 435(D). The front panel has an uncluttered appearance with enough room between the controls for easy finger access. Vertical channel controls are located on the lower section of the front panel, under the CRT.

The vertical channel conrols comprise: 5-2-1 stepped attenuators (covering a range from 5V to 5mV/division), concentric vernier attenuators with indented calibrate positions, input coupling switches (AC,GND,DC), a mode selector switch (CH1, CH2, DUAL, and ADD), a pushbutton to invert CH2's display and vertical shift controls.

The vertical shift controls normally provide ×5 vertical magnification when pulled out. The exception is when the stepped attenuators are in the 5mV position. In this case pulling out the vertical shift controls switches the vertical sensitivity to 2mV/division.

The CRT has a 95(H) × 118(W), flat, rectangular face with an internal 8 × 10 division graticule etched on it. There are also 0, 10, 90 and 100% markings on the CRT face to assist in determining pulse rise and fall times. A minor irritation is that there is no internal illumination of the graticule. When taking measurements off the CRT some means of highlighting the graticule makes the job easier and reduces the chance of error.

Measured accuracy of the time base was ±1%, well within the ±3% specification. A x5 time base magnifier is also provided. This had an accuracy within ±2%, much better than the ±10% specification quoted in the handbook.

The twenty-first position on the time base switch places the CS-1820 in the X-Y mode with CH1 providing Y-axis deflection and CH2 providing X-axis deflection. In this mode the CS-1820 had only 3° of phase shift between the CH1 and CH2 amplifiers at 300kHz. This is a very good result and speaks highly for the vertical amplifiers in the CS-1820.

Vertical channel sensitivities were found to be within ±3%. Quoted bandwidth is 20MHz but we measured bandwidth to 31MHz. For a 20MHz oscilloscope this is excellent.

The triggering circuitry performed well, maintaining effective trigger to over 80MHz. The usual trigger facilities are provided allowing triggering from CH1, CH2, LINE and EXT sources. Either positive or negative slopes can be chosen for triggering. The coupling between the input and the trigger circuitry can be altered between AC, LF rej, HF rej, and DC. This allows selective triggering off various components in a complex waveform.

Located on the right hand side of the CRT is the control for the delayed time base. This is a five position switch with a range of delays from 100ms to 1$\mu$s. A concentric vernier control varies the delay over a 10:1 range between the limits inscribed on either side of the switch position. In practice the vernier control exceeds the stated delay limits by a small amount to provide some overlap between ranges.

*An uncluttered appearance and a high standard of finish are combined in this new oscilloscope from Trio.*

The delayed time base control is activated by the "delay inten'd" button situated in the row of four buttons on the right hand side of the CS-1820. With this button pushed the delay is set by the rotary DELAY TIME switch in conjunction with the vernier control. Next either the CH1 or CH2 buttons (or both) are pushed. This delays a selected portion of the trace allowing it to be expanded and examined in more detail.

The last controls to be mentioned are the HOLDOFF control, which assists with triggering when examining complex pulse waveforms, the POWER-INTENSITY control and the FOCUS control. A small drawback with the focus control is that there is some time delay between adjusting the control and the final effect on the trace.

A minor criticism of the CS-1820 is with the location of the 2mV position of the vertical attenuator. When pulling the vertical position control to obtain 2mV sensitivity, it is very easy to offset the trace a small amount. This can lead to errors when taking measurements if you are not careful.

The instruction manual supplied with the CS-1820 is fairly comprehensive and contains sections on specifications, operation, applications and maintenance as well as providing a full circuit diagram.

At $965 (plus 17½% sales tax where applicable) the CS-1820 offers very good value for money. The presentation is good, the controls are smooth and easy to use, and the unit was commendably within specifications. Probes are not included with the oscilloscope, however the manual suggests a PC-22 probe (also from Trio) which is a switchable (1:1 or 10:1) 10MΩ probe.

Further information on the CS-1820 can be obtained from retailers of Trio equipment or from the Australian distributors, Parameters Pty Ltd, 41 Herbert Street, Artarmon, NSW, 2064. (J.S.)

## Soanar's capacitors are smaller

The development of new manufacturing techniques by two of the world's largest capacitor manufacturers, the Elna Co Ltd and Samwha Electric Co Ltd, has resulted in significant reductions in the size of their electrolytic capacitors.

As a result, Soanar Electronics Pty Ltd is advising customers that future deliveries of Soanar type RB radial lead PCB electrolytics and Soanar type RT axial lead electrolytics could be smaller than the sizes shown in the Soanar catalog.

Electrical specifications including leakage current, temperature and voltage ratings are enhanced. Smaller size also has the advantage of less demand on board space, reduced susceptibility to vibration and easier use of automatic insertion and assembly equipment.

Soanar request that customers contact the company to obtain details of the new sizes and specifications of the capacitors before they proceed with the design and lay-out of new printed circuit boards. The address is Soanar Electronics Pty Ltd, 30 Lexton Rd, Box Hill, Vic 3128.

## Digital multimeter

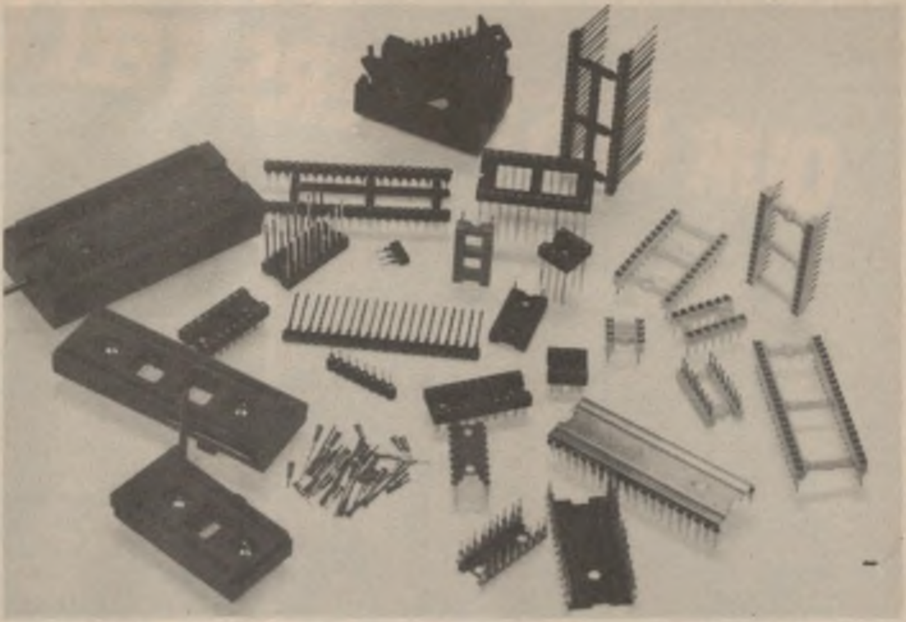

AWA's new DM500 digital multimeter is now available from AWA's North Ryde division and interstate agents and offices.

The new multimeter has 30 ranges measuring AC and DC voltages, and currents up to 10A. Ohms measurement, a diode and transistor checker and a continuity tester are also included.

The digital multimeter is provided with a carrying case, test prods, battery and spare fuse. A range of optional accessories such as a high frequency probe, IC clip and a test lead set are also available.

For further information contact the Instrumentation Department, AWA Ltd, 422 Lane Cove Rd, North Ryde, 2113.

## Full range of IC sockets from Utilux



A comprehensive range of integrated circuit sockets is now available from Utilux Pty Ltd. Parts from a single pin through to conventional dual-in-line styles and zero insertion force types can be supplied from stock.

Two types of DIL socket are offered: the Series 3406, available in standard sizes for PCB mounting, and the Series 7600 high reliability type with gold plated contact springs, which are available in either PCB styles or wire-wrap types.

Series 21600 zero insertion force sockets can also be supplied. In addition Utilux has a new range of DIN rack and panel connectors in a variety of contact plating materials and configurations, made to the German DIN specification.

For further information contact the company at 14 Commercial Rd, Kingsgrove, NSW, 2208.

## Easter sample bag from Jaycar

Once again, Jaycar's Easter celebration is on, with a sample bag of goodies available for a fraction of its value.

The Jaycar sample bag contains four packs of plastic tubing, assorted knobs, resistors, radio dials, battery clips and bezels, including the unusual, such as a 2.5mm to 5mm plug socket connector. A Milky Bar and copies of "Hobby Electronics" are also included.

Our early prototype sample bag also contained a Phantom comic. However, the feeling at Jaycar is that the Phantom comics of late aren't quiet up to scratch, so the company is switching to Spiderman comics, which they feel are more in keeping with their up-to-date image.

Retail value of the sample bag contents is claimed to be over $25, but Jaycar customers can purchase it for just $6.50. They are available from Jaycar's new store at 125 York St, Sydney (above Dick Smith Electronics). Don't go calling at the showground Commemorative Pavillion – this is strictly a Jaycar offer!

Jaycar also has available a range of push-on knobs for miniature controls, which can be supplied with coloured inserts in red, green, yellow, white, blue or grey to identify different controls, or to simply "dress-up" that new project.

## New soldering aids from Royston Electronics

Royston Electronics are distributors of a wide range of manufacturing aids for the electronics industry. New products available from the company include an 80W temperature controlled desoldering tool, a range of Royal solder dipping pots and the Heller automatic axial lead forming machine.

The CT200-1 desoldering tool features continuously variable temperature, achieved by electronic feedback and switching, and will operate from any Royal re-work station. Provisions to prevent the tool clogging with solder include a two-stage thermal transfer assembly. The extended fitting ensures that the solder remains molten until it reaches the collection chamber.

Royal solder dipping pots are available with solder capacities of 28g and 84g. Various crucible shapes are available to

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W. J. Browse

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**Dick Smith and Staff.**

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| $10.00-$24.99 | $2.20 |
| $25.00-$49.99 | $3.30 |
| $50.00-$99.99 | $4.40 |
| $100.00 or more | $6.00 |

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## MAJOR DICK SMITH RE-SELLERS

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55 Main Street. Phone 91 1208

**BENDIGO, VIC: Summer Electronics**
7 Edward St. Bendigo Ph: 43 1977

**BALLINA, NSW: A. Cummings & Co.**
91-93 River Street. Phone 86 2285

**BROKEN HILL, NSW: Crystal TV Rentals**
66 Crystal Street. Phone 6897

**CAIRNS, QLD: Thompson Instrument Services**
79-81 McLeod Street. Phone 51 2404

**COFFS HARBOUR, NSW: Coffs Hbr Electronics**
3 Coffs Plaza, Park Ave. Phone 52 5684

**DARWIN, NT: Kent Electronics**
42 Stuart Hwy. Phone 81 4749

**DARWIN, NT: Ventronics**
24-26 Cavenagh Street

**EAST MAITLAND, NSW: East Maitland Elect.**
Cnr Lawes & High Streets. Phone 33 7327

**GERALDTON, WA: KB Electronics & Marine**
361 Main Terrace. Phone 21 2176

**GOSFORD, NSW: Tomorrow's Electronics**
68 William Street. Phone 24 7246

**HOBART, TAS.: Beta Electronics**
123a Bathurst Street. Phone 34 8232

**KINGSTON, TAS.: Kingston Electronics**
Channel Court. Phone 29 6802

**LAUNCESTON, TAS.: Advanced Electronics**
5a The Quadrant. Phone 31 7075

**LISMORE, NSW: Decro Electric**
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**MACKAY, QLD: Stevens Electronics**
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**MARYBOROUGH, QLD: Keller Electronics**
218 Adelaide Street. Phone 21 4559

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5 Elizabeth Street. Phone 25 6404

**MILDURA, NSW: McWilliams Electronics**
40 Lemon Avenue. Phone 23 6410

**NAMBOUR, QLD: Nambour Electronic Shop**
Shop 4 Lowan House Ann Street. Phone: 41 1604

**NEWCASTLE, NSW: Elektron 2000**
Shop 18, Hunter Shopping Village. Phone 26 2644

**ORANGE, NSW: M & W Electronics**
173 Summer Street. Phone 62 6491

**PENRITH, NSW: Acorn Electronics**
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**ROCKHAMPTON, QLD: Purely Electronics**
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**SOUTHPORT, QLD: Amateur's Paradise**
Shop 144 Scarborough St. Phone 32 2644

**TAMWORTH, NSW: Sound Components**
111 Bridge Street. Phone 32 9877

**TOOWOOMBA, QLD: Hunts Electronics**
18 Neil Street. Phone 32 9677

**TOWNSVILLE, QLD: Tropical TV**
49 Fulham Road. Vincent Village. Phone 79 1421

**TRARALGON, VIC: Power'n'Sound**
147 Argyle Street. Phone 74 3638

**WAGGA, NSW: Wagga Wholesale Electronics**
82 Forsyth Street

**WODONGA, VIC: A & M Electronics**
78a High Street. Phone. 24 4588

**WHYALLA, SA: Meller Enterprises**
Shop 2, Forsythe Street. Phone 45 4764

**These are our major dealers, however we cannot guarantee they will have all these items in stock and at the prices advertised.**

DSE/A209

solder dip tags, wires and small component leads. A third model operates at 360°C and is intended to provide efficient tinning of enamelled and copper wires.

All of the solder pots feature protective cages which are perforated to allow a free flow of air around the barrel to prevent over-heating. A heavy cast base provides stability for the pots.

Heller's System H116A axial lead forming machine will cut and form the leads of components from tiny diodes up to 0.75W resistors. Lead dies are available from 0.5mm to 1.2mm sizes. The machine handles loose components via vibrating hoppers as well as component cards and bandoliers, at speeds of up to 17,000 an hour. Lead dies are easily adjusted to cut and form leads to virtually any dimension, with many different standard and U-form configurations.

Full details of all equipment mentioned is available from Royston Electronics, 27 Normanby Rd, Notting Hill, Vic 3168, or 15/59 Moxon Rd, Punchbowl, NSW 2196.

## Compact 10Hz-100kHz signal generator

A compact signal generator providing sine and square wave outputs from 10Hz to 100kHz and distortion figures of around .02% at 1kHz has been introduced by Philips Test & Measuring Instruments.

Designated the PM 5109, the generator provides a choice of asymmetrical or dual floating symmetrical outputs as well as TTL level and DIN speaker outputs. Operation can be either in a low distortion or a fast setting mode.

Open circuit output is around 30V peak to peak – around 10V RMS – on the asymmetrical output. Both sine and square wave signals are available with stepped, calibrated attenuation of up to 60dB with 20dB continuous attenuation. Output impedance can be switched between 600Ω and 50Ω.

Also available from Philips Test & Measuring Instruments is a versatile function generator with both linear and logarithmic sweep facilities. The PM 5133 provides sine, square and triangular waves from .01Hz to 2MHz as well as positive and negative going pulses. The logarithmic sweep ranges cover more than four decades.

Output frequency and open-circuit voltage is pushbutton selectable with indication on a 3½-digit LED display. Maximum output is 20V peak to peak, 10V peak for pulses, with a ±5V offset. Both stepped and variable attenuation is provided.

For further information contact Philips Scientific & Industrial Equipment, 25-27 Paul Street, North Ryde, 2113.

## Australia's Radio Pioneers . . . ctd from p21

One of the most memorable occasions of that 1938 convention was Ray Allsop's stereo demonstration – the first in Australia and only the second in the world. An audience of 2000 in Sydney's Plaza Theatre listened to an orchestra playing in the nearby Regent Theatre, the stereo components being carried by two equalised PMG landlines to a sophisticated array of loudspeakers backstage at the Plaza (even in those days the terms "woofer" and "tweeter" were in use). In addition, Allsop treated his captive audience to some specially produced short films with stereo soundtracks, including a table tennis match which "was particularly realistic in that the bounce of the ball from side to side was easily followed, both visually and aurally". It is interesting to recall that this historic demonstration was described as "stereoscopic" sound, because it was thought that the word "stereophonic" had been copyrighted by overseas interests.

The 1938 World Radio Convention provided international recognition that Australian electronics had come of age and, as the stern lessons of history were to show, not a moment too soon. Within a few years Australia would be virtually isolated by the tides of conquest and would become the main strategic base and arsenal of the Allied war effort in the South West Pacific. When that occurred, the professional capability of the electronics industry would be taxed to the limit in producing the tools of victory on a scale that would have seemed impossible only a few years before.

# The Official Line

— from the Department of Communications

## Department to study monitoring of emissions from satellites over Australia

**The Department of Communications is looking into the possibility of monitoring electromagnetic emissions from both orbiting and geostationary satellites over Australia.**

We want to monitor these emissions in order to identify sources of interference to Australia's terrestrial radio services and, in years to come, interference to our satellite services by those operated by other countries. (It may surprise readers to know that today about 66 geostationary satellites are visible from Australia, and, as well, many orbiting satellites make frequent passes over the Australian mainland.)

In addition, as a member of the International Telecommunication Union, and given our geographical position in the southern hemisphere, it is Australia's responsibility to be able to verify that radio regulations relating to space services in our region are being observed. Similarly, there is a need to define adequately power flux densities and other characteristics of satellite emissions so as to avoid unacceptable levels of interference to our radio-communications services in general.

This need will become more important in the future since it is clear that there will be more intensive sharing of frequency bands between terrestrial and space services.

The department is also investigating the overhauling of its monitoring services in general and a draft program being prepared includes satellite monitoring, a central laboratory in Canberra, and the upgrading of equipment used by our officers in the field.

We want to reduce the number of comprehensive monitoring stations which include the large antenna installations needed for receiving signals in the high frequency (HF) bands and for direction finding. Whereas historically this type of station was set up in each state, we now believe that a lesser number of strategically placed, well-equipped stations will be able to serve our international monitoring requirements and also most of our needs to monitor the use of the medium frequency (MF) and HF bands within Australia.

There are plans to provide specialised, semi-permanent and transportable monitoring facilities within the more settled areas and in the major cities to monitor the VHF and UHF bands. Some of these stations will be operated either by remote control or automatically.

As with satellite monitoring, terrestrial monitoring is essential for good management of the radio frequency spectrum. It allows us to determine channel occupancy and whether more use can be made of various channels. Through monitoring we can trace sources of interference and check on unlicensed operations.

So far as monitoring of satellites is concerned we would probably begin by installing a small antenna on the roof of our departmental headquarters in Canberra and then graduate to a larger, more sensitive antenna suitable for tracking orbiting satellites. This facility could perhaps be installed in the countryside around Canberra. One possible location is a valley such as the one in which the Canberra deep space complex at Tidbinbilla is located.

A West German satellite monitoring station, which came on stream in October 1980, is owned by the Federal German Post Office and located at Leeheim, some distance from Frankfurt. It is claimed that the station can detect any satellite transmitting in the monitored frequency ranges. The station's aims are to:

- Monitor emissions of space stations to check whether they are adhering to their basic characteristics. Where frequency tolerances are exceeded and the country's radio service interfered with, the Germans report such infringements to the telecommunications administration responsible.
- Detect harmful interference either caused by space stations or affecting them. Sources of interference can be ascertained by means of measurement and action taken to eliminate them through discussion with the administration responsible.
- Monitor frequency ranges exclusively allocated to space services or shared between space and terrestrial services to determine their real occupancy. The results will help radio frequency management in Germany select new channels and may also be made available to the international frequency registration board.

The two antennas on the German station allow coverage of the frequency range of 130MHz to 13GHz. A log-periodic dipole array is used below 1300MHz and a 12-metre cassegrain antenna above 1300MHz. The receiving system does not cover all satellite bands, but further expansion will ensure full coverage of all bands within the limit of the antenna system, which is about 18GHz.

The Department believes that a satellite monitoring station in Australia is necessary, if not immediately then certainly in the long term, because of the significant expansion in the use of geostationary and orbiting satellites, some of which have already caused interference in this country.

R. B. Landsdown, Secretary,
Department of Communications.

# CLAMP METER
## MODEL YF-700

Top of the range model AC Voltage 150V 300V 600V AC Current 6A 15A 60A 150A 300A. Resistance 5kΩ (Midscole 200Ω)

**was $49.99**

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**$43.55**

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## P.C. EDGE CONNECTORS

| | |
|---|---|
| S100 gold plated wire wrap | $8.50 |
| S100 solder tail | $6.90 |
| D2 Motorola bus | |
| 43/86 solder tail | $8.50 |
| 43/86 gold plated wire wrap | $11.50 |

## 10 TURN POTENTIOMETERS

Stock resistance values
50R 100R 200R
500R 1K 2K 5K
10K 20K 50K
100k

Spectrol model 534 ¼" shaft
Price 1—9 $9.50
10 + values may be mixed $8.90

## DIP PLUGS

Ideal for use with flat ribbon cable or to mount components on

| | |
|---|---|
| 14 pin $1.20 | 24 pin $1.20 |
| 16 pin $1.40 | 40 pins $5 |

## POWER TRANSFORMERS

SPECIALLY DESIGNED FOR MICROCOMPUTERS

- Good regulation electrostatic shield
- RI 810
  8V @ 10A x 15V @ 1A $26.50
- RI 820 8V @ 20A 15V @ 1A
  15V @ 3A $36.50

## 20 TURN CERMET TRIM POT

## SPECTROL 43P ACTUAL SIZE

STOCK RESISTANCE VALUES
10R, 20R, 50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 100K, 200K, 500K, 1M, 2M

| | |
|---|---|
| 1—9 | $1.40 |
| 10—99 | $1.30 |
| 100 | $1.20 |

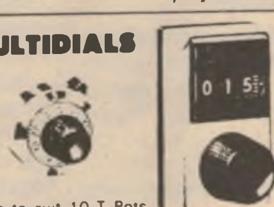
Values may be mixed

## Hexadecimal Keypad
**$28.50 each**

19-key pad includes 1-10 keys ABCDEF and 2 optional keys and a shift key

**Ideal for dream project**

## MULTIDIALS



Dials to suit 10 T Pots

| | |
|---|---|
| Model 21 1.8" dia | $16.50 |
| Model 16 9" dia | $12.50 |
| Model 18 1" x 1.75" dia | $21.50 |

## cermet single TURN TRIM POT

Spectrol model 63P
ACTUAL SIZE

STOCK VALUES
10R, 20R, 50R, 100R, 200R, 500R, 1K, 2K, 5K, 10K, 20K, 50K, 200K, 500K, 1M, 2M

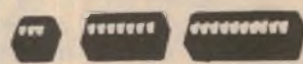
| | |
|---|---|
| 1—9 | $1.00 |
| 10—99 | 0.90 |
| 100 | 0.80 |

Values may be mixed

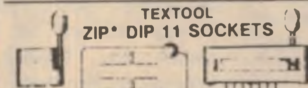
## DIP SWITCHES SPST

| P N | No of Switches | Price |
|---|---|---|
| SD3 | 3 | $1.60 |
| SD4 | 4 | 1.70 |
| SD5 | 5 | 1.90 |
| SD6 | 6 | 2.30 |
| SD7 | 7 | 2.40 |
| SD8 | 8 | 2.50 |
| SD9 | 9 | 2.70 |
| SD10 | 10 | 3.00 |

## DIP SWITCHES SPST



## TEXTOOL ZIP* DIP 11 SOCKETS



| | |
|---|---|
| 16 Pin Zip* Dip 11 | $11.50 |
| 24 Pin Zip* Dip 11 | 12.50 |
| 40 Pin Zip* Dip 11 | 17.50 |

*Zero Insertion Pressure

## INCREDIBLE MEMORY AND DISC DRIVE PRICES

| | 1-9 | 10-25 | 25+ |
|---|---|---|---|
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| 2716 | 4.90 | 4.20 | 3.90 |
| 2732 | 8.00 | 7.50 | 7.00 |
| 4116 (200nS) | 1.95 | 1.80 | 1.75 |
| 4164 64K Dynamic | 11.00 | 10.00 | 9.50 |
| M58725P (2K x 8) Static | 10.00 | 9.00 | 8.50 |

(As used in new 64K Static S100 PCB)
ALL PRICES INCLUDE SALES TAX

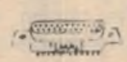
## DISK DRIVES

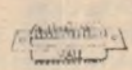
MPI 51 $275.00 + 17.5% ST
MPI 52 $385.00 + 17.5% ST
MPI 91 $415.00 + 17.5% ST
MPI 92 $515.00 + 17.5% ST

## TANDON

TM100-1 $295.00 + 17.5% ST
TM100-2 $385.00 + 17.5% ST
TM100-3 $415.00 + 17.5% ST
TM100-4 $515.00 + 17.5% ST

## RS232 & "D" TYPE CONNECTORS





| PART NO | DESCRIPTION | 1-9 | 10-25 | 25+ |
|---|---|---|---|---|
| DE-9P | 9 PIN MALE | $3.50 | $3.50 | $3.10 |
| DE-9S | 9 PIN F/MALE | 4.50 | 4.20 | 3.90 |
| DE-9C | 9 PIN COVER | 2.20 | 2.10 | 1.90 |
| DA-15P | 15 PIN MALE | 4.50 | 4.20 | 3.90 |
| DA-15S | 15 PIN F/MALE | 5.10 | 4.90 | 4.70 |
| DA-15C | 15 PIN COVER | 2.30 | 2.10 | 2.00 |
| DB-25P | 25 PIN MALE | 5.90 | 5.60 | 5.10 |
| DB-25S | 25 PIN F/MALE | 6.90 | 6.60 | 6.10 |
| DB-25C | 1 pc Grey Hood | 2.40 | 2.20 | 2.00 |
| DB-25C2B | 2 pc Black Hood | 2.80 | 2.70 | 2.50 |
| DB-25C2G | 2 pc Grey Hood | 2.70 | 2.50 | 2.40 |
| DC-37P | 37 PIN MALE | 7.90 | 7.50 | 7.10 |
| DC-37S | 37 PIN F/MALE | 10.90 | 9.90 | 9.10 |
| DC-37C | 37 PIN COVER | 4.90 | 4.50 | 4.10 |
| DH-S | Hardware set (2 Pairs) | 2.10 | 1.90 | 1.80 |

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|---|---|
| AD0140TB | $11.86 |
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| AD01605-TB | $16.54 |
| AD0162-T15 | $18.78 |
| AD0162-T15 | $13.03 |
| AD0162-TB | $13.77 |
| AD0210-SQ8 | $32.70 |
| AD02160-SQ8 | $36.91 |
| AD02161-SQ8 | $33.46 |
| AD10100-W8 | $52.72 |
| AD12100-HP8 | $85.10 |
| AD12100-M15 | $79.11 |
| AD12100-M8 | $79.11 |
| AD12100-W8 | $53.99 |
| AD12200-W8 | $73.12 |
| AD12250-W8 | $90.52 |
| AD12650-W8 | $73.12 |
| AD2273-T8 | $5.03 |
| AD4060-W8 | $19.06 |
| AD5060-SQ4 | $22.05 |
| AD5060-SQ8 | $22.05 |
| AD5060-W8 | $17.59 |
| AD5061-M8 | $17.08 |
| AD70601-W8 | $20.40 |
| AD70620-M8 | $21.54 |
| AD7063-M8 | $20.78 |
| AD70630-M8 | $20.78 |
| AD70650-W8 | $26.96 |
| AD7066-W8 | $26.96 |
| AD80601-W8 | $20.24 |
| AD8061-W8 | $20.24 |
| AD80652-W8 | $26.20 |
| AD8066-W4 | $27.66 |
| AD8081-M8 | $9.81 |
| AD9710-M8 | $41.11 |
| ADF1600-8 | $19.44 |
| ADF500-4500-8 | $19.44 |

## DIODES

| | 10-99 | 100+ |
|---|---|---|
| IN4001 | 6c | 5c |
| IN4002 | 6c | 5c |
| IN4004 | 7c | 6c |
| IN4148 | 5c | 4c |
| IN5404 | 30c | 25c |
| IN5408 | 35c | 30c |
| IN4007 | 12c | 11c |

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**High Thermal Capacity Black Anodised**

| | 1-4 $ | 5-9 $ | 10-49 $ | 50-99 $ | 100-499 $ | 500 plus $ |
|---|---|---|---|---|---|---|
| HS1 — 38mm | 1.85 | 1.75 | 1.50 | 1.35 | 1.00 | 0.90 |
| HS2 — 75mm | 3.00 | 2.90 | 2.50 | 2.00 | 2.00 | 1.50 |
| HS3 — 150mm | 5.80 | 5.40 | 4.90 | 3.80 | 2.90 | 2.70 |
| HS4 — 225mm | 8.10 | 7.60 | 7.10 | 5.90 | 4.50 | 4.30 |
| HS5 — 300mm | 8.90 | 8.40 | 7.90 | 6.50 | 4.90 | 4.60 |
| **Unanodised** | | | | | | |
| HS11 — 38mm | 1.40 | 1.20 | 1.00 | 0.90 | 0.80 | 0.70 |
| HS12 — 75mm | 2.50 | 2.20 | 1.90 | 1.60 | 1.25 | 1.20 |
| HS13 — 150mm | 4.90 | 4.50 | 4.00 | 3.20 | 2.45 | 2.40 |

## BLANK CASSETTES T.D.K.

| | | |
|---|---|---|
| TDK ADC60 | 1 for $3.60 | 10 for $26.00 |
| TDK DC60 | 1 for $2.10 | 10 for $18.00 |
| TDK 00C60 | 1 for $3.50 | 10 for $31.00 |
| TDK SAC60 | 1 for $3.30 | 10 for $29.00 |
| TDK SAXC60 | 1 for $5.70 | 10 for $46.00 |
| TDK DC90 | 1 for $3.05 | 10 for $21.00 |
| TDK ADC 90 | 1 for $3.50 | 10 for $28.00 |
| TDK SAC 90 | 1 for $4.20 | 10 for $37.00 |
| TDK ODC90 | 1 for $4.70 | 10 for $45.00 |
| TDK SAXC90 | 1 for $5.50 | 10 for $49.00 |
| TDK DC120 | 1 for $4.50 | 10 for $37.00 |
| TDK ADC120 | 1 for $5.40 | 10 for $46.50 |

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# Books & Literature

## World Radio & TV Handbook

**1982 WORLD RADIO & TV HANDBOOK, edited by Jens Frost. Thirty-sixth edition published by the World Radio & Television Handbook Company Ltd, Copenhagen, Denmark.**

Having a complete library of all the Handbooks published since 1946, one can look back on the amazing growth of the publication and the complex nature of editing a Handbook which lists all the world's radio and television stations. The directory not only gives the information by continental grouping and country, but also by frequency for medium and shortwave. The 1982 Handbook (70,000 copies first edition) has all the usual operating times, frequency, power, address, program details and the like and in its reference section has lists of all the world's radio clubs, DX programs, time in all countries and a host of other features.

Over, the past two years a special 35-page supplement "Listen to the World", which includes a receiver review and buyers' guide, has been included. In the 1982 edition Larry Magne again tests receivers, from the professional communications receivers such as the Racal RA679 through to the semi-professional receiver such as the NRD 515 onto the Sony ICF6800 and the FRG7700. There are several interesting articles, contributed by experts in their field on such diverse subjects as "The Potential Audience for Shortwave Broadcasting" through to the latest shortwave station, WRNO New Orleans.

The Editor, Jens Frost, and Assistant Editor, Andy Sennitt, and the many collaborators throughout the world who compile the various sections of the Handbook are to be congratulated on another excellent effort. The 1982 edition will be a most valued publication on the radio listeners' bookshelf.

Stocks are available throughout Australia from leading booksellers and in New Zealand from the sole agent, Arthur Cushen, 212 Earn Street, Invercargill. (ATC)

## Towards a standard computer language

**TOWARDS A FORMAL DESCRIPTION OF ADA: D. Bjorner and O. N. Oest (eds). Lecture Notes in Computer Science Vol. 98. Soft covers, 622 pages, 165mm x 24mm. Published by Springer-Verlag 1981. Price $17.10.**

Sometime in 1975, the United States Department of Defence realised that it had too many programmers programming its bombs and missiles in too many different computer languages. The result was a "rapidly increasing expense of military software systems". In order to eliminate this offensive tower of Babel, the military hit upon the idea of a single, standardised programming language that could be used for all military computer systems.

The proposals for the new common language specified that it be built on a base of one of three existing languages, Pascal, Algol 68, or PL/1. All replies to the call for tenders chose to start from Pascal.

Perhaps the essential aspect of Ada is the concept of program modules – dividing the solutions to large, complex problems into smaller, more understandable components. Hence Ada introduces the notion of the "package", consisting of a program specification and a separate section which carries out the specified procedure.

Since the language is made up of a library of packages, each of which can be compiled as needed, Ada can be tailored to a wide variety of computer applications, general data processing, real-time industrial control operations and intensive scientific calculations. The elements of the language can be learned as needed. A subset of Ada corresponds very closely to Pascal, so that transition to the new language is simplified for the hosts of Defence Department programmers.

This book, the 98th Volume in the Lecture Notes in Computer Science series, is a report on the Ada project of the Technical University of Denmark, and consists of a number of papers and M.Sc thesis projects carried out with the intention of providing a "formal definition" of Ada, and to look at some of the problems of writing and testing compilers for the language.

The book consists of three sections and an extensive appendix. Part I describes the organisation of the Danish project for the development of an Ada compiler. Part II is the formal definition of the language in symbolic logic terms, while Part III describes the design of a hypothetical computer to run the compiler. The result is a complete coverage of Ada from an academic perspective. The appendix is a reference manual for the language project, summarising the aspects of the Ada model.

Part II, the formal definition, discusses each command available at each level of the language, the parsing of each command, and the alternatives available in the construction of an Ada compiler. It is a complete treatment of the Ada language from an advanced viewpoint, and not to be recommended for the beginner,.

Based on Pascal, with extensive error checking and "fail-safe" schemes, Ada is a language which requires a lot of computer memory. For this reason we are unlikely to see the full language implemented on a microcomputer, although reports from the United States indicate that certain sub-sets of the language will shortly be available there, including one which runs under CP/M.

Ada, by the way, is named after Augusta Ada Byron, Countess of Lovelace. Daughter of the poet Byron, her notes published in London in 1843 regarding Charles Babbage's "Analytical Engine" included a formula for solving tidal problems on the machine – essentially, the first example of a computer program.

Our review copy came direct from the Australian distributors, D. A. Book Depot Pty Ltd, 11-13 Station St, Mitcham, Vic 3132. (PV)

## Display Electronics: a useful text

**DISPLAY ELECTRONICS, by Ken Tracton. Soft covers, 252 pages, 130 x 210mm, well illustrated with diagrams and photos. Published 1977, by TAB Books, USA. Price $7.50.**

While this book was written a few years ago, it is now in its third printing. This is one indication that in spite of recent developments in this field, this book is still relevant and useful.

Chapter one gives a good discussion of the units of measurement of light and goes on to talk about photon emission and photoelectric effect and PN junction luminescence. Finally, lumped in at the end of this long chapter, is a section on photocells and fibre-optics.

Chapters two and three are given over to LEDs, some LED driver circuits and a sketchy discussion of opto-isolators. Chapter four is titled arrays and displays and is devoted mainly to a dicussion of seven-segment LED displays, and alphanumeric displays. There is also some discussion of multiplex drive for these displays but one would be hard put to understand this method since there are no explanatory diagrams showing the switching waveforms.

Chapter five covers new displays and photosensitive devices and begins with the oldest display device of them all, the cathode ray tube! Very briefly mentioned are flat-panel displays (mainly speculation on how it might be done), and gas discharge displays. And while this book was written some four years ago, the author must have completely ignored or been ignorant of the considerable development that was taking place even then in the area of gas-discharge and fluorescent displays by American and Japanese manufacturers.

Liquid crystal displays and their operation are described reasonably well and this section of the book could be regarded as the most relevant section of all.

Laser diodes are discussed in chapter seven but none of their typical uses (particularly in the Laser-Vision system) are envisaged. Finally chapters eight and nine have a practical bent in that the former is devoted wholly to simple projects which mainly involve LEDs while the latter chapter features some notes for designing with LEDs. There are also a number of appendices with specifications of typical LEDs and displays but these will be of little use since most of the devices listed have been superseded.

In summary, while the field of display electronics has developed considerably since this book was first published in 1977, it still must be considered useful because there are so few books covering the field.

Our copy came from Dick Smith Electronics. (L.D.S.)

## Recently received

**ELECTRONICS FOR OCEAN TECHNOLOGY. IERE Conference Proceedings No. 51. Soft Covers, 348 pages, 207 x 299mm, illustrated.**

This book is the entire proceedings of an IERE-organised conference on Electronics for Ocean Technology which was held in Birmingham on September 8-10, 1981. Thirty-four Papers were presented in four sessions with category names as follows: Sensors and Instrumentation, Data Acquisition and Telemetering, Sonar Systems and Applications, and Fisheries Applications.

No price is quoted for the book but this information can be obtained from the address quoted above.

REVIEWS OF RECENT

# Records & Tapes

CLASSICAL ● POPULAR ● SPECIAL INTEREST

## BERLOIZ REQUIEM: "Achieves a sense of expanse"

**BERLIOZ — Requiem. Placido Domingo (tenor). Orchestra of Paris Chorus and Orchestra of Paris. Conducted by Daniel Barenboim. Brochure and translation of text included with two stereo discs in boxed set. DGG 2707 119.**

Last month, in my review of the first digital recording of the Verdi Requiem, I commented on the spectacular clarity of the recording and the amount of detail revealed. I also mentioned that this may be self-defeating, to some extent, by removing that slight acoustic veil — for want of a better word — which hangs between orchestra and audience, in even the best concert halls and opera houses.

Think for a moment, if you can go far enough back — as I can — to the old Queen's Hall in London (destroyed in the blitz) or Covent Garden, Bayreuth's Festspielhaus, the Vienna Opera House, the Concertgebouw or others which you may care to add. In none of these does the sound of the oboe seem almost within touching distance.

### Room limitations

The fact is that, however capacious your music room, it can never really recreate the effect of a work heard in a large concert hall or a giant cathedral.

Yet this performance does achieve its own form of magnificence. Perhaps this is due to the reverence with which Barenboim approaches the work, at times amounting almost to awe. Yet all is heard and enjoyed at a seemly distance for such massive resources. As such, it comes closer to the effect of a live hearing than a performance with more detailed reproduction or more "presence".

Not that the Berlioz is without this last merit. But its great virtue is that it achieves a sense of expanse to a degree that I have not heard in many other recordings. How this was captured in a recording I cannot guess.

Let me just repeat that the elusive acoustic "veil" that hangs between the orchestra and the audience contributes to the magic of concert-hall sound. I can only explain it by likening it to the glaze that the greatest of the old masters put on their otherwise finished paintings.

Please don't interpret these remarks as a heavy disparagement of the Mehta performance, which is up amongst the best, despite my reservations, as one who has spent a lifetime listening to concert performances. It's just that the Berlioz Requiem under review here escapes those criticisms.

Even so, I repeat that it is too vast a work to compress effectively — no matter how ingeniously — into the confines of a room. One is dealing with a large symphony orchestra, four small brass bands, eight sets of timpani, a chorus and various other sound-making devices; to use the composer's own language: "C'est magnifique, mais ce ne'est pas la guerre."

At any rate you can listen to it in a comfortable ambience.

As to the performance, I covered much of what I felt in my description of Barenboim's reading as "reverent". His command over his resources is relentless but sympathetic. The almost whispered parts of the Kyrie are wonderfully effective and, importantly, quite devoid of pride.

No threat appears in the Dies Irae until the second "verse". Although this starts almost humbly, it builds and does not achieve true might until the menacing Tuba Mirum grows into a giant sound that you can still listen to without earache. There is no hint of inflation (musical). Barenboim always keeps his great forces in balance.

My only serious disappointment was in the singing of Domingo which didn't seem to belong here at all. But the French Choir was grand. In their higher registers, the women sound truly celestial. To list every virtue would overrun my space but I am impelled to mention the true supplication in the Offertorium. It goes far to atone for the Gigli-like lachrymosity Domingo sounds like he is developing, together with an unwanted amount of tremolo.

*Placido Domingo "didn't seem to belong here!"*

But to weigh this set by its merits will set you wondering which of the other five versions still current you might prefer. It could be any. Only one word of warning about the set under review. If you are not familiar with the text, the enunciation leaves a good deal to be desired. The red-pictured box should attract immediate attention in any display. (J.R.)

### A fine performance

**RAVEL — Piano Trio in A Minor.**

**SAINT-SAENS — Piano Trio in F. Maria de la Pau (piano), Yan Pascal Tortellier (violin) and Paul Tortellier (cello). An HMV recording released for members of the World Record Club. R 09432.**

It has always puzzled me that the elegant Ravel work has never achieved the popularity of the composer's now famous and often played quartet. Let's hope the sheer merit of the performance you hear here will help to make it better received, especially as it is issued to the members of the World Record Club at its usual budget price.

Its coupling is the Saint-Saens, a composer much admired by Ravel, whose trio is very easily absorbed at first hearing, despite its many merits, while the Ravel grows on a sympathetic listener with every repetition.

I had better start right away by saying

Reviews in this section are by Julian Russell (J.R.), Paul Frolich (P.F.), Neville Williams (W.N.W.), Leo Simpson (L.D.S.), Norman Marks (N.J.M.), Greg Swain (G.S.), and Danny Hooper (D.H.).

that I have never heard a better performance of the Ravel than on this disc. The work is far from easy if you are just looking for the notes but it is played with peerless attention to nuance — except in the opening bars.

There is nothing of the smart boulevardier about the performance. Indeed it is due only to the perfection of the players' technique that disguises the very deep consideration that led to this masterpiece of chamber music.

There is the flowing but constantly changing tempos of the first movement to advertise the combination's perfect rapport; the ingenuity of the following movement described as a "pantoum", which was a curious type of poem used rarely in France during the 8th century; the exquisite fading of quiet sounds into silence at the end of the third movement; a passacaglia, all the eloquence of the same movement's middle section and a finale as brilliant as anyone could desire. It is a work I can return to time and time again and still find surprises.

The Saint-Saens work precedes the period when he became dour, irritable, violently chauvinistic. He refused to play or even listen to Wagner during World War I. He also achieved an unenviable reputation for triteness and dangerous facility.

The trio dates from as far back as 1863 when he was 28, and is delightfully youthful and fresh though, not unexpectedly, its workmanship is to be admired even as early as this. One appreciates this all the more when considering that it was composed 50 years before the Ravel.

Altogether a much more than ordinarily attractive disc. (J.R.)

## READER'S DIGEST SET


**GREAT ORGAN CLASSICS. Stereo, six-record boxed set from Reader's Digest. Also available on cassette. (Reader's Digest, Box 65 GPO, Sydney 2001).**

I happened to see reference to this set in an English publication and, on inquiry, found that it was available on request from Reader's Digest Australia.

To clarify the title, it really signifies classics on the great organ. Specifically, the organs featured include the instruments at the Coventry Cathedral, Ely Cathedral, St Martin-in-the-Fields, Leeds Parish Church, Westminster Abbey, Bridlington Priory, Ampleforth Abbey, Durham Cathedral, Norwich Cathedral, Hereford Cathedral, St Paul's Cathedral and several others. In fact, the tracks add up to a virtual organ tour of England, involving not only instruments but the organists who regularly play them.

With an average of about four selections per side, the six records have titles which relate to their contents, specifically in some cases, rather vaguely in others. Just to give you an idea, here are a couple of tracks from each:

"Organ Magnificent" — Minuet and Allegro, Royal Fireworks Music (Handel), Finlandia (Sibelius); "The Romantic Organ" — Final from Grand Piece Symphonique (Franck), Nun Danket (Karg-Elert); "J. S. Bach" — Toccata in D-Minor, Passacaglia and Fugue in C Minor; "Concert Classics" — Allegro (1st Movement) from Symphony No 6 (Widor), Litanies (J. Alain); "Cathedral Spires" — Hymn Tune Prelude (Vaughn Williams), Coronation March (Bax); "Wedding Favourites" — Wedding March, Bridal Chorus, Handel's Largo, Clark's Trumpet Voluntary, Jesu, Joy of Man's Desiring, etc.

So much for the contents, which are such as to tempt anyone with an ear for classical organ excerpts. But how do they actually sound off record?

On the Vista/Reader's Digest label, I would assume that the recordings were commissioned as a project with as much uniformity in the recording equipment as would be practical in such a wide range of venues. So, while the individual recordings have a superficially uniform sound, they also provide a basis for those who want to listen more closely to the instruments and the acoustics.

Indeed, one is left with the overall impression that there is a wealth of musical resource and of musical talent to be found in the cathedrals, the parish churches and the priories of Britain.

As for technical detail, I did not have time to listen critically to every single track but the sound is generally well balanced, with just a trace of surface prickle to be heard in some of the softer passages.

The jacket notes provided by Basil Ramsey (dated 1977) make brief reference to certain of the instruments but concentrate mainly on the composers and their music. Overall, a wealth of interest for lovers of the classical organ. (W.N.W.)

## "Escapist charm. . ."


**OFFENBACH — Gaite Parisienne. SAINT-SAENS — Dance Macabre. DUKAS — L'Apprenti Sorcier. Orchestra National de France conducted by Lorin Maazel. CBS Stereo Masterworks Disc. SBR236016.**

This collection looks about as strange as you'd find on any disc yet, unexpectedly, it all sounds very attractive. Gaite Parisienne is presented in the Rosenthal version — that used here by the de Basil Ballet Company just before the war I think.

In the Offenbach you have the once infamous Cancan taken from his Orpheus in the Underworld, played with vigour and sparkle.

The National French Orchestra has improved vastly since it was formed during the late de Gaulle period. Its formation was necessary because other Parisian orchestras were then sadly lacking in morale. I once attended a rehearsal of the complete orchestral works of Ravel conducted by Cluytens in the old Salle Wagram in the early 60s. Cluytens, dissatisfied with the playback of one short section made the band repeat it several times. Finally when they thought they had played it often enough they reached under their chairs and played it again with their hats on!

Cluytens — by birth a disliked Belgian though naturalised French — took the tip, closed the rehearsal and walked out disgusted.

Maazel wins a performance of exhilarating virtuosity that might well have pleased the old general, although his interest in music was minimal — except, of course, for the Marsellaise.

Offenbach's odd companions are also admirably treated. In the once-hackneyed Danse Macabre Maazel himself plays the solo violin part which, in the 1930 shellac version, was "sung" by Russian tenor Vladimir Rosing using the peculiar words "Zig a zig a zig".

The equally hackneyed L'Apprenti Sorcier is also deliciously played. It is, of course, a very much more refined work than the other two. Indeed its composer, Paul Dukas, was so ultra-refined that, on his death bed, he destroyed all the manuscripts he was dissatisfied with. If you're looking for an escapist disc of charm — and distinction, too — you won't do better than this. (J.R.)

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## RECORDS & TAPES — continued

**BARTOK — Sonata (1926); Improvisations on Hungarian Peasant Songs; Suite, Op 14; and Out of Doors. Murray Perahia (piano). CBS Stereo Masterworks Disc 76650.**

Philip Ramey's sleeve notes sagely make a point of the fact that Bartok was just on 40 before he decided on a career as pianist/composer, only to realise that he had only scraps of his own works to introduce to the public. All he had in hand was a collection of short pieces — folk songs, transcriptions, etc.

In 1926, with this deficit in mind, he composed the Piano Sonata, the Out of Doors Suite, both featured in this recital, and the First Piano Concerto which isn't. The two first mentioned should make this production novel enough to appeal to most Bartok admirers.

The opening of the Sonata is aggressively rhythmical, like the post-introductory bars of Stravinsky's Sacre. Indeed the whole of the first movement is reminiscent of the Stravinsky of the early ballets but who had then already abandoned this style in favour of neo-classicism. Yet at the same time Bartok can be felt edging himself towards neo-classical, especially in the second (slow) movement. Bartok also shared another character of Stravinsky's work — the reluctance to leave a note around which a movement is based.

A brisk rondo, obviously based on folkloric origins and made all the more effective by first class faithful sounds, closes the work satisfactorily. Perahia plays it like a demon with inexhaustible technique and changes of sonorities.

The second piece, Improvisations on Hungarian Peasant Songs, announces the theme tonally, then goes into well disguised serial style. Perahia plays it with such understanding that it is not difficult to sort out at first hearing.

The fourth movement is a tranquil sostenuto which produces almost a sunset effect after its predecessors.

The third suite, Out of Doors, is figurative in its programmatic form. It goes without delay into Drums and pipes, aggressively dissonant and rhythmical. The Barcarolle is placid, its chief interest being its harmonic treatment.

Musiques Nocturnes features Bartok's famous ear for tiny night sound made by insects and rustling trees, a sound which he carried with him all his life. The Chase is a realistic account of a furious hunt. I am not sure that Perahia wins all the poetry and what I can only call the microprocessing of nature in the Nocturne but he is quite at home in all the others. (J.R.)

## NEW TEST RECORD


**HI-FI SOUND. Stereo Test Record HFS81. (From M.R. Acoustics, PO Box 165 Annerley, Qld 4103. Phone (07) 48 7598).**

I am reminded by the jacket notes that this is the third test record in the series, the earlier ones having been HFS69 and HFS75. Presumably, the figures relate to the year of release.

In presenting HFS81, the producers John Wright and Clement Brown have in mind the advanced state of modern disc technology and the obvious need for very precise cuts to check and optimise the performance of modern magnetic cartridges. In particular, they are concerned here with phasing, tracking pressure and bias adjustment. The user can rely on aural judgement, although there would be an obvious case for employing instruments, where available, to verify the observations.

In order, the test tracks on the disc are as follow: channel recognition and phasing; lateral modulation and the effect of tracking and bias setting; ditto in respect to vertical modulation levels; channel output and balances at 1000Hz, 5cm/sec amplitude; bias in relation to inner groove performance.

On side two, the first couple of tracks are concerned with the spatial effectiveness when using an ambisonic playback system — of no special relevance to an ordinary stereo installation. Then follow tracks of pink noise and white noise for subjective system evaluation. Finally, there are tracks for checking wow and flutter, pickup resonance and rumble.

The purpose of each track is explained fully in the jacket notes. So, if you're an audiophile who likes to check things out — even though they sometimes leave you rather unhappy — HFS81 is available and ready to oblige! (W.N.W.)

**JE T'AIME. Anthony Ventura and his orchestra. Stereo, Ariola Eurodisc, VPLI-6581. Distributed by RCA.**

If you're in a mind to become all sentimental, you need only to read the first sentence in the jacket notes for this album: "Soft, slow and tender melodies — music to dream by or to cuddle up to — music that evokes memories of someone saying je t'aime — I love you."

Not surprisingly, the sixteen numbers on the disc fit the general theme, as evidenced by the contents of side 1: When A Man Loves A Woman — Tu t'en vas — I'd Love You To Want Me — In The Ghetto — Let It Be — The Green Leaves Of Summer — Adios Amigo — Imagine.

According to the notes, Anthony Ventura has no love for noisy brass and noisy electronic instruments, but that doesn't say that his arrangements are cramped. He uses a whole range of instrumental sound such that, if his formula fits your mood, you'll enjoy the album many times over.

The sound quality is excellent. (W.N.W.)

☆ ☆ ☆

**THE PRAISES OF HIS PEOPLE. The Bill Gaither Trio — Their Best Loved Songs of Praise. Stereo. Word WSB-8838. (From Word Records Aust, 18-26 Canterbury Rd, Heathmont, Vic 3135.)**

In his jacket notes, Producer Bob MacKenzie recalls that he has been associated with the Bill Gaither Trio — Bill, Gloria and Danny — ever since they cut their first album in 1964.

From the outset, their aim has been to communicate the Gospel in a clear, unambiguous way, with the emphasis on sincerity, diction and melody.

In this album, sub-titled "The Early Years", they bring together a dozen of the Gospel songs, written by Bill Gaither, which have found particular acceptance over the years:


Contented — The Longer I Serve Him — Even So, Lord Jesus, Come — Gentle Shepherd — I Could Never Outlove The Lord — Joy Comes in The Morning — Someday — I Will Serve Thee — Getting Used To The Family Of God — Jesus, We Just Want To Thank You — Let's Just Praise The Lord — Peace Shall Come.

Don't worry if the titles are not familiar. The message certainly will be, and the diction is good. But all through, in a mix of solo, duet and trio arrangements, the sound is gently rhythmic and of potential appeal to those who prefer to relax rather than to "get with it"! (W.N.W.)

☆ ☆ ☆

**WITH A SONG AND A PRAYER. Harry Secombe. Stereo, Celebrity VAL 10353. Distributed through RCA.**

Harry Secombe, a familiar figure on television, and a one-time member of the BBC's radio "Goon Show" team, scarcely needs any further introduction. On this album his true and robust voice brings to the listener a dozen well known Gospel songs which will, equally, need no introduction to those who have a background in this kind of music:

Onward Christian Soldiers — It Is No Secret — Swing Low, Sweet Chariot — Beautiful Isle Of Somewhere — All Things Bright And Beautiful — How Great Thou Art — The Battle Hymn Of The Republic — Desiderata — Whispering Hope — The Lord's My Shepherd — A Perfect Day — God Be In My Head.

If these titles seems far removed from the Goon Show, Harry's brother, Rev Fred Secombe, points out in the jacket notes that, in their younger days, the brothers Secombe were choir boys but as much at home with the sound of the local Salvation Army band, as with the St Thomas church organ.

Backing from a chorus and orchestra bring some variety to the very distinctive Secombe voice, but his diction is excellent and I can imagine this album being enjoyed, no end, by those who like straight, no-nonsense renditions of these old Gospel songs. The recording quality is fine. (W.N.W.)

☆ ☆ ☆

**HIGHLIGHTS (From six new digital albums). Digital stereo, RealTime RT-307. [From Emerson Radio (Aust) Pty Ltd, 106 Belmore Rd North, Riverwood, NSW 2210. Phone (02) 534 5266.]**

Most of the digital records I have encountered to date have either been of classical works or something biased in that direction. Here, by way of a change, is a sampler of RealTime jazz albums. There are six selections from six albums as follow:


"Burnin' " from RT-301, Don Menza and his '80s Big Band; "Bud Powell" from RT-304, The John Dentz Reunion Band; "That Old Feeling" from RT-303, Jack Sheldon; "Shaw Nuff" from RT-305, Freddie Hubbard; "Riverboat Shuffle" from RT-306, Wild Bill Davison & Eddie Miller Play Hoagy Carmichael; "Gershwin Medley" from RT-302, Joe Marino Plays 28 All-Time Greatest Hits.

By the sound of the sample tracks, five out of the six albums are pretty heavy

## TWO MORE AUDIOPHILE ALBUMS

**DON BURROWS/ GEORGE GOLLA DUO, This Time Tassie. Cherry Pie, L-70201/2. Festival release.**

This most enjoyable two-record album, from two of Australia's best known musicians, has been mastered at half speed to give a true audiophile quality to a superb live performance at Hobart's Odeon Theatre.

With half-speed mastering, which can be done here by Festival, the master tape is played back at half speed and the signals fed to a cutting lathe, also operating at half speed. The effect of so doing is to lower the frequency spectrum by a factor of two and the peak demands on the recording amplifier and cutting head by up to four times. The end result can be wider dynamic range and lower distortion.

There are sixteen tracks on the album, interspersed with very entertaining comments from Don Burrows on the composers involved, as well as the operation of an Octave Shifter used with the clarinet, where that instrument may be made to sound like a very convincing double bass to accompany George Golla on the electric guitar.

The Titles are: Brown Shoes Blues – Lagoa – What's New – Sweet Georgia Brown – Chico's Bar – Takeda – St Thomas – Modinha – Jazz Nocturne – Frenisi-Say It Isn't So – Saudade – Easy Street – Recuerdos – El Dorado – Swedish Pastry.

Don Burrows shows his versatility by playing four different flutes, clarinet, electric clarinet, alto saxphone and percussion, while George Golla makes his usual beautiful music on an Australian-made Maton electric guitar.

My only quibble with the record would be the balance between the performers and the audience response, if you set the volume for a resonable level for the music, you nearly get blown out of your chair with the applause. Apart from this it is a superb album, complete with sticker stating "You will pay no more for this half speed mastered audiophile recording." (NJM)

☆ ☆ ☆

**BILLY JOEL, The Stranger. Audiophile Stereo CBS Mastersound 82311. [From Concept Audio Pty Ltd, 22 Wattle Rd, Brookvale, NSW 2100. (02) 938 3700].**

If you are a Billy Joel fan with a deep pocket and the best of equipment you might like to sample this re-release of Billy Joel's fairly recent album, with the following nine tracks featuring Billy Joel on piano and vocals, with some additional group support.

Movin' Out – The Stranger – Just The Way You Are – Scenes From An Italian Restaurant – Vienna – Only The Good Die Young – She's Always A Woman – Get It Right The First Time – Everybody Has A Dream.

Compared with ordinary records these Audiophile records certainly have a very quiet surface, extended frequency response and dynamic range, but whether they are worthy of a price tag of $22.99 is something for you to decide yourself.

One thing, they show something of what can be achieved with the disc format that has been around for nearly a century! (NJM)

**DIGITAL HIGHLIGHTS — continued**

stuff, intended for dedicated jazz fans. The last track – Gershwin Medley – is a very facile performance on solo piano and I suspect that it will prompt quite a few of those who hear it to seek out the full album containing other medleys from Carmichael, Ellington and Rodgers.

Technically, the sound quality is first rate and capable of bringing considerable pleasure to those who are keen on jazz. (W.N.W.)

# Microcomputer News & Products

## Australian Standards Association to move on computer-generated interference

Increased use of microcomputers in the home and office is not without problems. The most pressing issue to be confronted is the generation of radio frequency interference, which in some cases can make nearby communications receivers and television sets unusable.

Complaints of interference with communications equipment have been received from police and air traffic control authorities, amateur radio operators and television viewers. The interference can take the form of intermittent noise at any frequency between 1MHz and 1000MHz.

In general, such interference is likely to be worse for a system built up from a number of interconnected components than for an all-in-one system. Noise is generated by the high speed clock and digital logic circuits and conducted out of the computer by connecting cables to other equipment, or radiated by power cables, connecting cables or peripherals.

In the United States, the Federal Communications Commission (FCC) took action in 1979 to let limits to both radiated and conducted interference from computer equipment. From January 1981, home computers which failed to meet the FCC requirements were banned from sale within the United States.

Manufacturers found that it was not easy to meet the FCC requirements. Many well-known companies in the field applied for waivers from the regulations in order to stay in business. However, from the beginning of this year, no more waivers will be granted.

In March, 1981 the United States put forward a proposal to CISPR, the International Special Committee on Radio Interference, aimed at setting a worldwide standard for interference from computer equipment. Since then the matter has been considered at two meetings of the international committee, and a recommendation on limits and methods of measuring interference from computers was agreed to in October, 1981.

Australia is a member of CISPR, and has kept a close watch on the progress of the recommendation through the Standards Association of Australia. Committee TE/3 of the Association has studied two aspects of the problem — interference from personal computers with TV receivers in the vicinity, and interference from computers, video games and similar devices when their output is displayed on domestic television receivers.

At a recent meeting of the committee, it was agreed that an Australian standard on computer generated interference should be prepared, taking into account international proposals on the subject. Steps are now being taken to monitor and control the interference problem associated with the boom in the use of microcomputers.

## Tandy computers down on the farm

Tandy Electronics has introduced a package of computer programs to help out "down on the farm". Today's farmer has to be a businessman, and like his city counterpart he is looking to computers to help manage his business. Microcomputers today are inexpensive, do not need specialised training to use, and are ideally suited to many farm management tasks including accounting, maintenance of stock records and correspondence.

Tandy's new Australian Farm Management software package sells for around $750. In conjunction with a TRS-80 Model III microcomputer and a line printer, it provides a powerful computer system for the farmer.

The Australian Farm Management programs have been developed in conjunction with Guyangal Stud. It uses tested Tandy programs which are then personalised to each farmer's individual needs, for sheep, cattle, pigs or agricultural operations. Often called TRSFARM, the package provides the user with accurate and up to date yield, herd management and farm records.

It also handles taxation records and includes the Scripsit word processing program for the preparation of letters and documents of all kinds.

The Australian Farm Management package can be seen at any Tandy Computer Centre, or ordered through any one of nearly 300 Tandy stores and dealers throughout the country.

## Sinclair computer sales boom

Sinclair Research, developers of the ZX80 and ZX81 computers, recently announced that sales of the ZX81 have now passed a quarter of a million worldwide. Production at the Timex Watch Corporation factory at Dundee, Scotland, has been stepped up by 50,000 a month to meet demand.

*Sinclair's ZX80, precursor to the ZX81.*

The ZX81 is now in use in 21 countries, while in October last year an agreement was signed with Japanese company Mitsui under which 20,000 of the small computers are to be exported to Japan this year, rising to 50,000 next year.

## A machine to run all types of software?

Commodore International has improved upon its low-cost VIC 20 computer with a new model launched recently in the United States. The VIC 64 offers 64K bytes of internal memory, in contrast to the somewhat limited capacity of the VIC 20.

News of this announcement however, has been over-shadowed for US observers by rumours of the next Commodore release — a "virtual machine" which will emulate the features of the most popular machines made by Tandy, Apple and IBM, while selling for far less — around $US1000.

The emulator will use a 6510 microprocessor, but extra processor boards will be available to allow the machine to act as an Apple II, for example. In theory, at least, the user could plug in a board and then run software written for one of the other machines.

Very large libraries of financial, text editing and business programs already exist for the TRS-80 and the Apple II, so the Commodore machine would have access to an extensive range of software without expensive and time-consuming program development.

There are problems with the new approach, however. Getting software from one machine to run on another is not simply a matter of plugging in a new processor board. Memory configuration, I/O addressing and disk formats are all different between, say, the Apple II and the TRS-80 Model II. In addition, Apple Computers holds a patent on the design of its disk system, quite apart from copyright problems with the actual software.

Steve Jobs, founder and chairman of Apple Computers, is not worried, "Sooner or later someone will figure out a less expensive way to build a computer that will run Apple programs, but I am sure that we will manage to compete in the same way that Sony still manages to make a profit even though other companies make turntables that will play the same records that Sony turntables will."

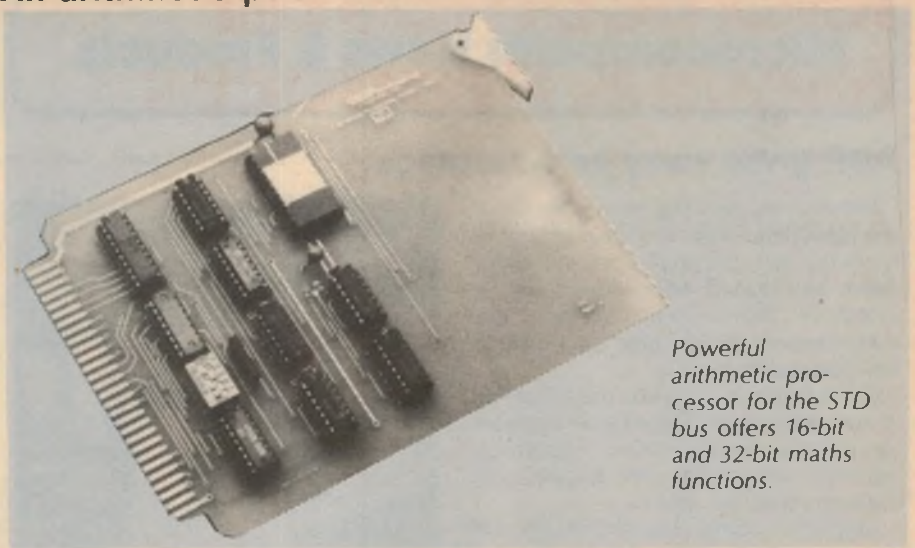
## Laying down the laws on video terminals

The state of Maine in the US recently became the first legislature to consider a bill to make certain video display terminal health and safety measures legally binding.

The bill requires employers to provide annual eye examinations, regular maintenance of equipment, a rest period or change of tasks every two hours and literature on proper VDT use. Violators would be subject to a maximum fine of $200.

Edith Beaulieu, who introduced the bill, says that opposition came primarily from industry, particularly banking and insurance. She says that there is "absolute evidence" that VDTs affect vision. "I contend that the industry is going to be a lot happier with this bill than they will be when someone with sore eyes pushes the wrong key on a computer somewhere."

## An arithmetic processor for the STD bus



*Powerful arithmetic processor for the STD bus offers 16-bit and 32-bit maths functions.*

Applied Micro Technology Inc of the United States has released a fixed and floating point arithmetic processor for the STD bus. Designated the ST4402, the processor accepts commands for manipulation of 16-bit and 32-bit fixed point and 32-bit floating point data values. It can perform addition, subtraction, multiplication and division operations as well as a full complement of transcendental functions.

Functions available include a full range of trigonometric calculations, logarithms and conversions from 16-bit to 32-bit and from fixed point to floating point formats.

Three versions of the board are available, for operation at 2MHz, 3MHz and 4MHz. For more information, contact the company at PO Box 3042, Tuscon, Arizona. Arizona 85702, United States.

## Versatile IMS software

IMS (International), the overseas division of Integrity Management Services Pty Ltd, has announced that the IMS range of software is now available for the Xerox 820 and the HP125 computers using CP/M.

As the Xerox and HP systems are released in Australia it is expected that the current version 3.1 software will be made available. Xerox and Hewlett-Packard join the growing list of systems on which the IMS software will run, including AWA, Cromenco, Archives, North Star, Intertec, Tandy and Altos.

For information contact IMS Pty Ltd, 582 St Kilda Rd, Melbourne, Vic, 3004.

## DGZ80 takes off

Sales of the DGZ80 S-100 board have passed the 1000 mark.

Designed by Dave Griffiths, the DGZ80 board contains (in addition to the processor), 2K of on-board RAM, a PIO (Parallel Input/Output chip) and a Counter Timer chip. Serial and parallel interfaces are also included.

To mark the success of the board, Phil Gleeson, General Manager of Applied Technology, who market the DGZ80, presented the designer with a double size DGZ80 board. He is said to be still looking for the double sized ICs to go with it.

# Microcomputer News & Products

## ADE gives away an Advantage

The Advantage is the newest model in the Northstar range of microcomputers. It offers a fully integrated system, with a 30cm bit-mapped video display 64K of RAM, A Z80A microprocessor, two quad-capacity floppy disk drives and a full featured keyboard.

Full graphics capabilities are a feature of the Advantage. Software is available for producing business graphics, including pie charts, bar graphs, and three-dimensional charts.

Anderson Digital Equipment Pty Ltd are distributors of the Advantage, and when they ran a direct mail competition recently, offering an Advantage microcomputer as first prize, they were inundated with entries from all over Australia.

The lucky winner was Jim MacGill of Melbourne, a company secretary. He was presented with his prize by Jim Gallagher, General Manager of ADE.

*Mr MacGill (right) receives his prize from ADE's General Manager, Mr Jim Gallagher.*

## Adaptive Electronics for the System One

Cromenco has entered the desk top computer market with the new System One computer. The System One is designed for both multi-user and single user applications, and also provides ample room for expansion.

Built around the powerful Z-80A CPU, the basic System One offers 64K of RAM, a printer interface and dual quad-capacity 14cm floppy disk drives which provide 780K of storage. An eight slot S-100 card cage is included for expansion purposes.

Software available includes Cromenco's "Master" series, Writemaster and Slidemaster. Writemaster is an easy to use word processing program, while Slidemaster allows graphics and text displays to be created simply and easily. Images are created interactively using a digitising tablet and pen, then transformed, coloured and annotated for display on the computer screen.

Also available is the DBMS data base management system, allowing data to be entered and stored and reports printed out.

In addition to business oriented packages, there is a wide range of system software available from Cromenco. Currently available languages include Structured Basic, Fortran, Cobol, C, Ratfor and Lisp.

Cromenco also offers a choice of operating systems, including the company's high acclaimed CROMIX multi-user,multi-tasking operating system.

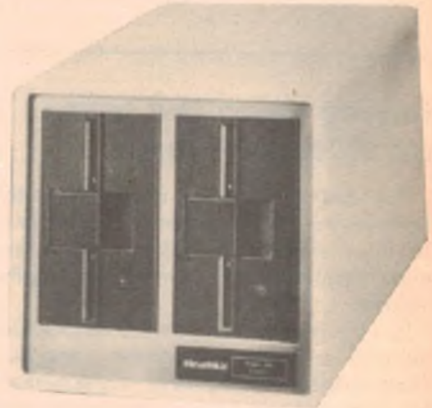
The System One (Model CS-1) is available from Adaptive Electronics Pty Ltd, 418 St Kilda Rd, Melbourne, Vic, 3004. Adaptive Electronics can also supply a comprehensive range of software, back-up service and advice.

## New disk drives for Heathkit computers

Disk storage for Heath/Zenith microcomputer systems has been expanded to more than 640K bytes per 14cm disk with two new products.

First in the range is the H-37 high density disk drive system, which works with a new double-density disk controller board, the Z-89-37. The H-37 is available as either a single or dual disk drive.

The increased storage capacity of the H-37 is made possible by using both sides of the diskette and doubling the density at which information is recorded. The H-37 provides 160 tracks per diskette, in contrast to the 40 tracks provided by Heath/Zenith's single density disk systems. In addition to the increased storage capacity, the H-37 can retrieve information up to 40% faster than previous disk drives from the company.



The H-37 high density drive uses soft-sectored diskettes which are not compatible with the hard-sectored disks used previously. Conversion of programs to the new format can be done using a program included with the H-37, or by using a program called PIP, available in both the HDOS (Heath Disk Operating System) and CP/M. Updates of both CP/M and HDOS are being provided for use with the new drives.

For further information on the new H-37 and the complete Heath computer line, contact your nearest Warburton Franki office, or write direct to the Warburton Franki Heathkit Centre, 220 Park Street, South Melbourne, 3205.

## CAC choses Facom

Facom Australia Pty Ltd has won a contract to install a computer system at Commonwealth Aircraft Corporation Ltd. The need to improve manufacturing efficiency was one reason cited for the purchase of the Facom M150F machine.

Primary function of the new computer system will be to enhance manufacturing procedures when CAC begins work on the New Tactical Fighter program, including component manufacture, assembly and testing on both engine and airframes of the F-18 Hornet fighter.

Secondary functions include handling the payroll and accounting. Manufacturing software packages and the debtors and creditors ledger systems are being applied by the Hoskyns Group Ltd. The payroll software will be supplied by MSA, while Software International will provide a general ledger.

## TI-99/4 Users Groups

- TI-99/4 computer users' clubs are now active in most states. Members can take advantage of discount buying schemes, a monthly magazine, free club software, and tutorials in using their computer. For information, contact the National Co-ordinator, Shane Andersen, at PO Box 101, Kings Cross, NSW, 2011.

## Tandy's "Computerama" and a new 16-bit machine for the US

*The one that started it all, Tandy's TRS-80 Model I, introduced in 1978.*

It has been just four years since Tandy Electronics introduced the first TRS-80 microcomputer to Australia. Since then the company has gone from strength to strength, continually adding to their range of home and business computers.

Two years after the release of the Model I, the company added the TRS-80 Model II business system, with in-built 20cm disk drive. September 1980 saw the introduction of the TRS-80 Pocket Computer, a tiny hand-held unit with Basic. A printer and cassette interface can now be added to that machine.

Last year the Model III was introduced, a powerful one-piece computer with a variety of features and a price tag considerably below that of the Model II. This year sees the introduction of the Tandy Color Computer, a system based on the 6809 microprocessor, and providing advanced colour graphics features in an affordable package.

All of these computers, plus a huge range of printers, disk drives and other peripherals went on display at Tandy's Computerama exhibition, held around Australia during February and March.

Starting at Brisbane's Lennons Plaza Hotel on February 7 and 8, the exhibition included audio-visual presentations, hands-on demonstrations, and advisory centres for everyone from the businessman to young games players. High on the list of attractions were a fully-equipped "Computer Classroom", a sneak preview of the soon-to-be-released TRS-80 hard disk and demonstrations of the microcomputer's role in business management, filing, accounting, planning and forecasting and word processing.

Costs of microcomputers continue to fall, while their capabilities are ever-expanding. Illustrating this trend, Tandy Electronics in the United States has introduced a computer using a 16-bit microprocessor, for around $US4999.

Built around the Motorola 68000, the TRS-80 Model 16 is designed for office applications, and can handle three users simultaneously. Its 16-bit processor makes it much faster than 8-bit machines such as the Apple II, CP.M systems or Tandy's TRS-80 Model II. The processor also allows the system to handle bigger, more complex computing tasks.

The computer Model 16 comes with 128K bytes of internal memory and a 20cm disk drive with 1.25 megabytes of storage. Memory can be expanded to a maximum of 512K, and additional disk drives or a hard disk unit can be added.

In addition to the 16-bit 68000, the Model 16 includes a Z80 processor, so that it can be used to run programs originally written for the Model II TRS-80. The company is also offering an upgrade kit to owners of its Model II. By plugging in a new 68000 circuit board, Model II owners can have the full capabilities of the Model 16 in their existing machine.

At the same time, Tandy announced the US release of a $699 "dumb terminal" – an expansion unit with a screen and keyboard that can be plugged into the Model 16 for second and third users.

Jean Yates, an industry analyst at consultant firm Gnostic Concepts of California, says that compatibility with the Model II will give Tandy a short term advantage, "but the most significant point is that Tandy got there first with the 68000 system".

# Microcomputer News & Products

## Computer Company Pty Ltd hand-held computers

*Mitsubishi hand-held computer offers plug-in bubble memory cartiridges.*

The Computer Company Pty Ltd will release hand-held computers from both Mitsubishi and Panasonic this month. The release is planned to coincide with the opening of the first Computer Company retail outlet in Australia later this month.

Operating on similar lines to the sewing machine franchises developed by its parent, Singer Company, The Computer Company shops have already been highly successful in the United States.

"Of the wide range of Panasonic and Mitsubishi systems which will be available through these outlets, the two hand-held computers are very significant because of their power and capability", said Mr John Barsing, manager of franchise operations for The Computer Company.

The larger of the two computer is made by Mitsubishi. It is about the same size as a portable radio/cassette player and weighs 1.5kg. It offers an 8-bit microprocessor-based system with 30K of RAM and a one megabyte plug-in bubble memory. A full alphanumeric keyboard is included, together with a 40 character 5 x 7 dot matric matrix display.

The Panasonic hand-held computer measures 227 x 30 x 95mm and weighs just 397g. It incorporates a 6502 processor running at 1MHz, 2K of RAM (expandable internally to 4K) and 16K of ROM. Sockets are provides for four program capsules containing up to 64K of programs or data. A built-in NiCd battery pack supplies power to the unit, and uninterrupted storage of all user programs and data is provided by a stand-by circuit.

An internal set of applications programs provides a four-function calculator mode, a free-form file system and editor and several other functions. In addition a range of peripherals is available, including a bus expander, a portable thermal printer, memory expansion, a moderm and terminal software, a cassette interface and a colour television interface.

## New distributors for Archives computers

Archives computers and peripheral products are now being distributed by the newly formed Archives Computers (Australia). The new company is headed by Mr Gower Smith, who brought Archives to Australia for the previous distributor, CGF Electronics. The company will handle both wholesale and retail sales in Victoria and sell through a chain of 22 retailers and equipment manufacturers to secure national representation.

A recent recruiting drive has enabled the company to set up its own in-house software customisation and support staff, and the service division was fully manned from the first day of business.

The Archives III computer, with 5.75 megabytes of hard disk storage built-in has aroused strong interest in the industrial and scientific fields, and newly added office management and accounting software is available for business applications. The Archives computer offers an extremely flexible approach for small businesses, Mr Smith says, as the basic machine can be expanded from .75 megabyte to 23 megabyte of disk storage without changes in the basic hardware.

"The 23 programmable function keys and our locally enhanced configuration of Wordstar also make the system one of the best word processors on the market today", according to Mr Smith.

For further information contact Mr Gower Smith at Archives Computers (Aust) 163 Clarendon Street, South Melbourne, Vic. 3204.

## Club notes

- The Adelaide Micro User Group initially began as a TRS-80 and System-80 users group, but has expanded and diversified and now caters for a wide range of hardware and software interests. The latest special interest group is a Super-80 users' section, so if you live in the Adelaide area and are interested in the Super-80, contact Mr Rob Gillespie, 8 Teusnere Drive, Morhett Vale 5162, who is organising the Super-80 section of the Group.

The Adelaide Micro Users Group is also putting together a kit for a speech synthesiser project based on the Votrax SC01 chip. Contact the group at 36 Sturt Street, Adelaide, SA, 5000, for more information.

- The WA Compucolor /Intecolor User Group meets at the Logic Shop, 454 William Street, North Perth. They publish a newsletter, "CUWEST". The address for mail is c/- WAIT Computing Centre, Kent St, South Bentley, WA, 6102.

## Information wanted for computer club list

Electronics Australia is currently compiling a list of microcomputer clubs and users groups throughout Australia and New Zealand. If you would like your club to appear in this listing, please send us the details as soon as possible. Information required is the name of the club, the address for contact, computer(s) used by members and the number of members (approximately). Details of special interests, club projects or other comments will also be appreciated.

Send information to "Electronics Australia", PO Box 163, Chippendale, NSW 2008. Mark the envelope "Computer club listing".

# SWTPC OF AUSTRALIA

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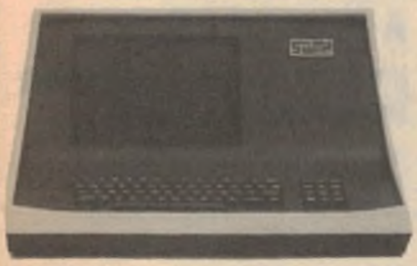
**6809 COMPUTER**




**8212 TERMINAL**
(ASS. IN AUSTRALIA)

## HARDWARE DESCRIPTION

S/09 6809 Computer w/128K Memory
/09 6809 Computer w/64K Memory
8212 12" Terminal w/monitor
DMF 2 Disk System w/2.5m Capacity
CDS-1 Winchester Hard Disk System
MP-09A 6809 Process/Board (assem)
D5-2 double side/double density 720KB
3809 128K Memory Expansion for S/09
MP-LA Parallel Interface
MP-L2 Dual Parallel Interface
MP-N Calculator Interface
MP-R Eprom Programmer
MP-S Serial Interface
MP-64 Memory board 64K
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MP-SX Serial Interface Expansion
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# Column 80

by JAMIESON ROWE

## Attitudes to Programs and Programming

**Do you really use your personal computer as effectively as you could? I suddenly realised the other night that I could use mine a lot more than I do, simply by changing some of my attitudes to programming. Perhaps you could do the same.**

Strange, isn't it, how we humans can become so familiar with things around us that we often overlook them at the very times we could use them to advantage. Sort of not noticing the trees when you're looking for a piece of wood! With me it can happen with tools in particular, and not only that but sometimes it seems that the longer I've had a tool, the more likely I am to overlook it when it could be useful . . .

This really struck me the other night when I was slogging through the design of an audio bandpass filter using IC op-amps. Here I was performing what was virtually the same set of calculations over and over again, to find a practical combination of R and C values. I had been using only my trusty 4½ function pocket calculator (successor to my battered old slide rule), supplemented by the inevitable writing pad and pencil.

Needless to say, progress was rather slow and frustrating. Yet I suddenly realised that over the other side of the room, being totally ignored, was my System-80 computer – with all the computing power to make the job one heck of a lot easier!

As soon as this realisation dawned, I set to work scratching out a simple program to perform the filter calculations I was doing. It took no more than about 10 minutes, yet using it I was able to save hours and hours with the rest of the design. The program wasn't a fancy one with a lot of frills, and it probably had a few rough edges; but it did the job I wanted.

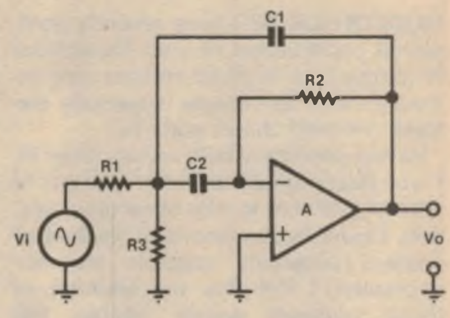
The point I'm trying to make is that it was so easy to overlook the computer when it could be used so easily to very real advantage. All that was needed was a few minutes of programming.

For what it's worth, I've drawn at least two important personal lessons from this experience. Perhaps you'll find they apply to you, too.

One is that despite my familiarity and experience with small computers, I'm obviously as guilty as anyone of overlooking their uses in practical day-to-day situations. While that's my own personal problem, in a sense, I suspect I'm not alone! Perhaps we'll all have to try and be a bit more flexible in our thinking, and not tend to see personal computers as little more than teaching tools and fancy games machines.

The other lesson is probably more interesting, as it directly relates to my/our attitudes to programs and programming. Like most people who've become involved with computers professionally, I've been trained (brainwashed?) to have a rather critical approach to programming. Unless a program is polished and refined, debugged and protected against all foreseeable operator errors, I tend to "look down my nose" at it, and not see it as a real program at all.

It's the same if a program seems inefficient in terms of coding and memory usage. I find myself not even wanting to




W = CENTRE FREQUENCY IN RADIANS
B = BANDWIDTH IN RADIANS
Q = W/B
C1 = C2 = C
R2 = 2/BC
R1 = R2/2A
R3 = $R2/(4Q^2 - 2A)$

BANDPASS FILTER STAGE

try it out, until I've "tidied it up" by replacing the repetitive sections with subroutines, and so on.

Now this attitude to programming is undoubtedly the most practical and helpful in many situations, but like a lot of behavioural "rules" developed by we humans, it is all too easy for it to become fossilised into an inflexible dogma. And when that happens, it can become a liability.

I think this is what my experience with the filter calculations shows. I'm now inclined to think that in many cases, it is more efficient and effective to adopt a deliberate "ad hoc" approach to programming. To simply cobble together a quick and simple program to do the job at hand, rather than adopt the "professional" approach.

Already I can almost hear the programming theorists and academics throwing

*Continued on p117*

```
10 CLS:PRINT"ACTIVE BANDPASS FILTER CALCULATION":PRINT:PRINT
20 INPUT"CAPACITORS C1 & C2 (UF)";C
30 INPUT"CENTRE FREQUENCY (HZ)";F:W=F*2*3.14159
40 INPUT"BANDWIDTH (HZ)";B:B=B*2*3.14159:Q=W/B
50 INPUT"STAGE GAIN";A:PRINT
60 R2=2*10[6/(B*C):R1=R2/(2*A):R3=R2/(4*Q[2-2*A)
70 PRINT"R1=";R1:PRINT"R2=";R2:PRINT"R3=";R3:PRINT"Q= ";Q
80 PRINT"4Q[2=";4*Q[2;"  (WHICH SHOULD EXCEED 2A, WHICH IS ";2*A;")"
90 PRINT:PRINT"ANOTHER CALCULATION? (Y=YES/N=NO):";
100 K$=INKEY$:IFK$=""THEN100ELSEIFK$="Y"THEN10ELSEIFK$<>"N"THEN100ELSEEND
```

# INFORMATION CENTRE

**MUSICOLOUR IV:** I have recently completed construction of your Musicolour IV using a Dick Smith kit and am very impressed with the results, especially the music initiated chaser patterns.

Having previously built a Musicolour III, I was disappointed with the amount of control available for the Musicolour section. Despite your claim that "individual channel sensitivity controls are not necessary" I feel that the addition of these controls would enable the operator better control of the final light show. In particular, I feel with most rock/disco type music the red and yellow light dominate (I'm using the colour flood lights as suggested in your article). This is probably due to the heavy bass component in this music and also the greater light output in the red and yellow ends of the spectrum from the incandescent floods.

My question is could a level control for each channel be added before the filter section and if so would a 100kΩ potentiometer (log or linear?) do? Would this spoil the rest of the circuit and if so what other measures could I take to get some individual control? (G. S., Boroko, PNG.)

● While we have not tried it, the best place to install level controls would be at the outputs of the filters, with the wipers feeding the non-inverting inputs of IC5. A value of 100kΩ would be suitable and you could use a linear or logarithmic characteristic. We point out that the main reason we did not incorporate level controls was that a larger control panel would have been required.

**PLAYMASTER AM/FM STEREO TUNER:** I would like some assistance with two small problems encountered while making up your Playmaster AM/FM Stereo Tuner bought in kit form from Dick Smith Pty Ltd.

Firstly, the FM frequency display cannot be adjusted to read correctly. I have tried all combinations of signal diodes as suggested but can only get a readout of 58 to 88MHz. Secondly, the readout is very shaky or flickering on FM only, but the reception is good on FM.

Apart from these areas the tuner works fine and I would appreciate any suggestions you may be able to offer. The SFE107MA filters are colour coded blue. (T. M., Duffy, ACT.)

● To troubleshoot the FM display of your tuner, disconnect the pin 2 input to the AY-3-8112 IC and check that the display shows "189.3" (the preset frequency for the 8112). If 189.3 is not shown, the 8112 could be faulty. If 189.3 is displayed, Q14 is probably not supplying sufficient drive to the DS8629 prescaler. This situation can be cured by reducing the 220Ω resistor from Q14.

The resistor should be reduced to the point where the display is reliable over the whole range. Do not reduce it more than necessary, otherwise multiplex hash will become a significant component of the residual noise.

**AUDIO MODULE:** Do you know where I can purchase the PC board, code 76A3, for your audio module in your April 1976 edition? How do I go about connecting a 9V battery source to this unit? (C. H., Sheffield, Tas).

● The last page of every issue of our magazine has a panel showing suppliers of PC boards. RCS Radio Pty Ltd, should be able to supply the board. As noted in the article (file 1/MA/51) on this module, the circuit may be used with a 9V supply provided a 4Ω load is used. No other modifications are required.

**PAVLOV'S BAGATELLE** I have recently constructed the Pavlov's Bagatelle described in your August 1981 issue. On testing the operation of the electronics I struck a snag in that the operation of the dispenser solenoid was independent of the status of the timer section. In other words, the AND system for turning on Q3 did not operate correctly and the solenoid was activated every time a pulse was sent by IC4. This was cured by increasing the value of the 1kΩ resistor between pin 3 of IC4 and the base of Q3 to 1.5kΩ.

You may find it worthwhile to bring the critical nature of this resistor value to the attention of other readers who may be encountering similar difficulties. (S. R., North Ryde, NSW.)

● Thank you for your letter S. R. Readers intending to build Pavlov's Bagatelle should take note.

**NON STANDARD CORD:** I have recently tried to use a cassette-player with a power plug consisting of two round pins. This was completely useless to me, as I didn't have an adapter to suit. (The cassette itself was switchable to a 240V power supply.)

Then a friend came along and suggested I use a jug cord as my adapter. The two round pins fits neatly into the jug end of the cord, while the other end

## Problems with the AM/FM tuner

**PLAYMASTER AM/FM DIGITAL TUNER:** I am having lots of problems with multiplex hash in the tuner. I have checked everything in the display module. Also it is lacking signal (won't pull in stations as it should; my tranny does a better job). Please help me here as it is stopping me from using a good looking piece of equipment. (M. J., Naracoorte, SA.)

● You do not indicate in your letter whether the lack of sensitivity occurs on AM, FM or both. What does the signal strength meter show when you are tuned to a station? For example, for reasonably noise-free reception on FM stereo, the signal meter should indicate "6" or more. If you can obtain only minimal signal indication it could be because you're feeding inadequate signal to the antenna terminals. Are you sure that you have reasonably strong signal from the antenna?

As far as the multiplex hash is concerned, are you sure that the hash is due to the readout circuitry? This can be verified by pushing both time-setting buttons together to blank the digital display. If the noise then disappears, it is due to multiplex switching of the display. Multiplex hash on FM reception can be reduced by increasing the 220Ω resistor between the interface board and the input to the DS8629 prescaler. There is a limit to how much you can increase this resistor though, because ultimately the display will cease to read the frequency and will indicate 189.3 instead.

Multiplex hash on AM reception is generally not a problem provided the rod antenna is oriented carefully with respect to the mains cord and is picking up a reasonable signal. Again, for reasonable AM reception the signal meter should indicate "6" or more.

goes to the mains outlet. The cassette player now sits majestically in my room, connected to the power point by Mum's jug cord. (G. S., Hunter's Hill, NSW.)

● Thank you for your letter and suggestion for overcoming a non-standard power cord. Unfortunately, we regard this suggestion as unsafe. A better solution would be to remove the non-standard two-pin plug and fit a standard three-pin mains plug.

The reason we regard this sort of connection as dangerous is that the jug plug need only slip back slightly off the pins for the 240VAC to be easily touched by the unwary. And that could be you!

**CDI & TACHOS:** I have made a CDI ignition from the 1970 edition of your magazine. What I would like to know is do you have a device to enable me to run it off a V8 Torana so that the tacho still works? (J.B., Hornsby, NSW).

● Generally, the tachometers fitted to most vehicles are incompatible with CDI systems. The solution is to rebuild the tachometer or to use an adapter circuit. For the record, we have not published a suitable adapter.

If you adopt the former approach, we have published an article which may be of assistance. Our Tune-up Tachometer published in October 1975 (file 3/TM/11) is compatible with CDI, although the SAK140 tachometer IC may now be difficult to obtain.

Alternatively, and some would suggest that this is the best solution, you could fit the Transistor-Assisted Ignition System described in December, 1979. This has none of the disadvantages of CDI, such as crossfiring, and is compatible with virtually all tachometers.

## Mitsubishi LT-5V turntable . . . ctd from p34

wise to touch the tone arm but once the stylus has lowered onto the record one can manually lift and lower the arm without any likelihood of damage, provided you are not hamfisted and do not drop the headshell onto the record.

Indeed, this reviewer came to the conclusion that the first modification that he would make to the LT-5V, in the event of purchase, would be to add a finger lift to the headshell. The design just seems to ask for it and manual cueing is certainly a lot quicker than letting the machine do it.

The cartridge fitted to the LT-5V is an Audio-Technica AT-12E which is a moving magnet type with an elliptical diamond stylus. This has a modest output sensitivity of 0.7mV/cm/sec and a recommended tracking force of 1.5g.

We were unable to check the accuracy of the tracking force adjustments on the LT-5V but, suffice to say, that when set to track at 1.5g, the Audio-Technica cartridge performed very well on our standard tracking test discs. For example, on the W&G 25/2434 drum test tracks, the AT12E tracked all except the highest +16dB level, and that only with the very slightest mistracking. Similarly, on the CBS STR-110 high level sine wave tracks, the AT-12E only slightly mistracked the highest +18dB level.

On frequency response tests, with the CBS STR-100 test disc, the cartridge did not perform quite so well. It was some 9dB down at 20kHz and even at frequencies between 4kHz and 10kHz it was about two or 3dB down. There did not appear to be any sign of a high frequency resonance, either in the frequency response itself or in the crosstalk characteristic. And adding shunt capacitance to the loading did not alter this characteristic.

Unexpectedly, separation between channels was much better in one direction than the other, at 37dB and 23dB at 1kHz. The latter figure actually meets the specification of the cartridge and while it is adequate, it is nothing to write home about. On the other hand, separation at 20kHz was 16dB in one direction and 20dB in the other, which is really very good.

Square wave response of the cartridge reinforced the impression of an overdamped characteristic — it had very little in way of overshoot, negligible ringing and slightly rounded tops to the waveform. Sine waveform was typical of many moving magnet cartidges with a slewing characteristic at frequencies between 5kHz and 12kHz.

Sound quality of the cartridge was generally very good although there was a slight tendency to harshness in the upper midrange. Generally though, the AT-12E would have to be rated as a good all-round cartridge.

Concerning the turntable itself, while it certainly operates quietly and smoothly at all times, it did have apparent wow and flutter, particularly on constant tone signals and certain piano music. The actual test result was a fluctuating reading between 0.1% and 0.2% DIN-weighted and this appeared to arise from "hunting" in the platter speed by a few percentage points about a designated setting. This could be observed both in the stroboscope behaviour and in the readings of a frequency meter (set to 0.1-second update times) when playing constant tones. This may have been a fault in the particular unit we tested but time did not permit us to confirm this.

Rumble was certainly low, although we

are unable to quote quantitive measurements. However, we can certainly state that the unusual configuration of the main bearing and its loading (the loading is mainly radial, with little end loading) does not appear to cause any rumble problems.

Well, what is our overall reaction to the Mitsubishi LT-5V? We have rather mixed feelings, as the foregoing review should show. On the one hand, we are (or at least this reviewer is) favourably disposed towards the general concept of a vertical format. On the other, when presented with a realisation of the concept, we recognise that there are drawbacks in practice. Added to that, there were some specific question marks over the performance of the LT-5V.

As far as the construction, finish and presentation of the LT-5V were concerned, well, these were to the usual impeccable Japanese standard.

Further information on the LT-5V linear tracking turntable and other Mitsubishi products can be obtained from selected audio retailers or from the Australian distributors, AWA-Thorn Consumer Products Pty Ltd, 348 Victoria Road, Rydalmere, NSW 2116. (LDS)

## Column 80

. . . ctd from p113

up their hands in horror at the very thought. Why, I'm suggesting that people should actually *lower* their programming standards, rather than raise them! Next I'll be saying that you don't have to write all your programs in a properly structured language like Pascal – where will this heresy end?

Well, heresy or no, I do think that there are probably a lot of occasions when a "quick and dirty" program is by far the most practical approach. In fact I'll even venture to suggest that if you don't adopt this approach on occasion, the odds are that you won't use the computer at all, because the time and effort involved in writing a fully "professional" program will be too daunting. This certainly would have been the case with my filter calculations.

If this isn't enough already to guarantee that I'll never be able to get a job teaching programming (let alone being allowed to join the Australian Computer Society), I'm going one further. Somewhere in this column you should find a listing of the actual "quick and dirty" program that started all this – the filter calculation program – just in case some readers may be able to use it.

As you can see, it was written in plain old unstructured BASIC! Poor old Jim Rowe, he's not only a heretic but sadly behind the times as well . . .

## Vocal Canceller . . .

cancel, speak into the microphone and gradually increase the gain until your voice blends realistically.

If you now want to demonstrate your vocal talent with the speakers, bear in mind that if you turn the microphone gain up too high or put the microphone near one of the speakers, the resulting feedback is not only unpleasant to listen to but may, in extreme cases, damage the amplifier or loudspeakers.

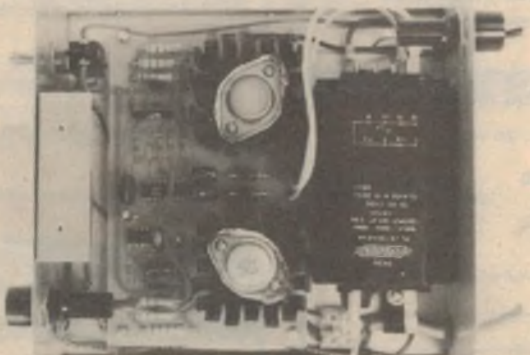
## Notes & Errata

**PLAYMASTER 3-70L LOUDSPEAKER SYSTEM:** (March 1982, File No. 1/SE/60): When is a plinth not a plinth? When it's stuck on top of the cabinet as shown in the diagram on page 39, that's when! The drawing on page 43 is correct.

**ANALOG STORAGE CRO ADAPTER** (March 1981, File No. 7/C/34): The circuit diagram on page 75 shows a 6.8Ω resistor connected from pin 3 of IC26 to ground. This resistor should instead be shown connected to the negative rail. The PC pattern is correct. In addition, pin 10 of IC8 should be shown connected to the channel one output and pin 11 to the channel two output to comply with the Digital Storage CRO adapter circuit of the November 1980 issue.

# Coming Next Month * * *

## 12-240V INVERTER



You can use our new 12/240V inverter to power mains appliances rated up to 40W, or to vary the speed of a turntable. It will also work backwards as a trickle charger to top up the battery when the power is on.

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

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| 470uF, 40V | 50c |
| 680uF, 35V | 50c |
| 0 015uF, 250V | 25c |
| 1uF, 100V | 25c |
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|---|---|
| 3 5m to 3 5m, 7ft | 75c |
| 3 5m to 6 5m, 7ft | 75c |
| 6 5m, 7ft | 50c |

**MICRO SWITCH**
5A, 250V AC 75c ea

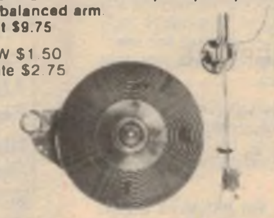
**TUNING CAPS**

| | |
|---|---|
| 2 and 3 gang | $1 ea |
| Min 2 gang | 50c |

## SUPER SPECIAL

**GRAMOPHONE motor and pickup 3 speed stereo balanced arm**
**240 volt $9.75**

PP NSW $1 50
Interstate $2 75
WA $4



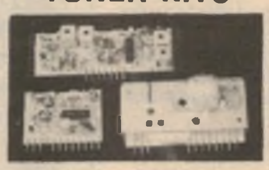
**P&P NSW $1.60 INTERSTATE $2.80**

**COLOUR FRONT END COMPLETE PUSH BUTTON TUNER SECTION**
TO SUIT PHILIPS, PYE, KRIESLER ETC **$25**

**Colour Picture Tube Boards**

**$6.00**

*SUPER SPECIALS*
## FM STEREO TUNER KITS



Sets of 3 modules include FM tuner, decoder and IF detector. Circuit diagram supplied. Can be used with amp modules

**ONLY $22**
**P&P $1.00**

## VU & BALANCE METERS

STEREO VU **$3.00**

12Kn 100uA **$2.00**

**Colour deflection boards to suit Kriesler, Philips, Pye etc $35.**

**PP NSW $1.80**
**Interstate $3.00**
**WA $4.00**

## SPEAKER SYSTEMS
### $29.50 PAIR

2 x 6" Dual Cone Magnavox
Speakers in each cabinet
10 watts RMS

P+P NSW $2 50 INT $4 50 WA $5 50

## BSR DELUX RECORD PLAYER

11 INCH TURNTABLE CUING DEVICE, SHIELDED MOTOR MAGNETIC CARTRIDGE **$50. BASE & PERSPEX TOP $22 EXTRA**

SPEAKERS 2¼ INCH 2 FOR $1

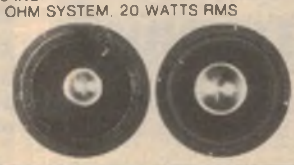
**Colour Power Supply Boards $25**

**PP NSW $2.00**
**Interstate $3.50**
**WA $4.50**

Power Transformers 240V 2 6 3 Windings 0 15 AMP $3.00
Power Transformers 240V 1/30V x 12V 60 Mil $6 00

*SPECIAL*
## MAGNAVOX SPEAKERS

10 INCH WOOFER
10 INCH MID-RANGE **$20 PAIR**
8 OHM SYSTEM. 20 WATTS RMS

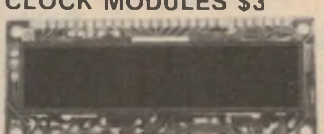


*MAGNAVOX SPEAKERS*
8 INCH DUAL-CONE. 16 OHM. 10 WATT

**$5**

**PP NSW $1.80**
**INTERSTATE $2.75**
**WA, TAS, NT, $4.**

## CLOCK MODULES $3



*SPECIAL*
SPEAKER CROSSOVER NETWORKS 2WAY FREQ 4KHZ 30W 80HM

**$2**

## POTS ROTARY

| | |
|---|---|
| ½ Meg | 30c |
| 1 Meg | 30c |
| 100K | 30c |
| 100K Switch | 50c |
| 50K Double Pole Switch | 50c |
| 7 500 | 30c |
| 10K Switch | 50c |
| 250K | 30c |
| 50K | 30c |
| 20K | 30c |
| 10K Min Pots | 25c |
| 50/ohm | 50c |
| ½ or 1 Meg Switch | 50c |
| ½ 1 meg dual Concentric tapped at 100K | $1 |
| 2 meg ganged double pole switch | $1 |
| 1.5 meg dual oanged | 50c |
| 2 meg ganged log | $1 |
| 1 meg dual ganged | $1 |
| ½ meg dual ganged LIN | 75c |
| 25K, 50K dual ganged Concentric double switch | $1 |
| 200K single line | 30c |
| 20K wire wound | 75c |
| dual log 10K | 75c |
| 100K dual ganged linear pots | 75c |
| 10K sub min log pots | 50c |
| 250K ganged pots | 75c |
| 25K lin ganged pots | 75c |

2 Min Transistor 450 IF KC Coils Plus 1 Min Oscillator Coil 3 for $1

**TV EHT Leads**

| | |
|---|---|
| 4'6" in length | 50c each |
| Transistor sockets | 20c each |

MIXED SCREWS, SELF TAPPERS, BOLTS, NUTS, ETC 200 **$1. PP — $1**

| | |
|---|---|
| Pick up Cartridges BSR universal type Ceramic Stereo | $5 |
| Diamond stylus stereo magnetic | $12 |

Cable 4 Strand 5 Metres 50c

## DIODES

| | |
|---|---|
| OA 626 | 4 for $1 00 |
| OA 662 | 4 for $1 00 |
| EM 410C | 4 for $1 00 |
| DS 150A | 50c |
| DSY 130YO | 50c |
| OA 636 | 50c |
| HR 15 | 50c |
| Diodes BYX 55, 300 | 30c |
| BY 188 | 30c |

**DIODES BAV20 10 for $1**

| | |
|---|---|
| Valve sockets 7 pin | 10c |
| Valve sockets 9 pin | 10c |
| OCTAL | 10c |
| 09478 | 5 for $1 00 |
| BZX79 | 5 for $1 00 |

**Power transformers 240V, 117V, 2/25V Tapps 6.3 — $7.00**

SPARK GAPS 500 volt 20 cents
THERMISTERS 20 cents

| | |
|---|---|
| Transistors AD161-162 | $2 50 pair |
| Transistors AD149 | $3 pair |

**PICK UP ARMS**
Mono $3 50
Inc Ceramic Cartridge & Stylus

**TRIMPOTS**

| | |
|---|---|
| 200 ohm | 10c |
| 5K | 10c |
| 100K | 10c |
| 47K | 10c |
| 10K | 10c |
| 470 ohm | 10c |

**Miniature speaker and drive output transformers** $1 pr

**Special mixed tag strips** 10 for $1

## SPEAKER SPECIALS

| | |
|---|---|
| 5 inch in 3 5, 8 or 15 ohms | $3 50 |
| 15 ohm 4" | 2 for $2 |
| 6 x 9 15 ohm | $5 ea |
| 5 x 7 15 ohm | $4 ea |
| 8 x 4 15 ohm | $4 ea |
| 6 x 4 15 ohm | $3 ea |
| 6 x 4 27 ohm | $4 50 ea |
| 6 x 3 27 ohm | $3 50 ea |
| 5 x 3 27 ohm | $3 50 ea |
| 5 x 3 47 ohm | $3 50 ea |
| 2¼" | 2 for $1 |
| 6 x 4 3 3 ohm | $3 50 |

**Power leads and sockets** 240 volt, suit most tape recorders, radios, etc, $1 each

**455KC IF Transformers** for valve radios, $1 each. Also OSC coils 75 cents each.
Aerial coils 75c

| | |
|---|---|
| HOR Drive 3021 transformers for colour TV | $2 |
| TV Colour Convergence Units 11270 44 x 6 | $3 |

**PILOT LIGHTS**

| | |
|---|---|
| Screw in 6 3V | 10 for $1.50 |
| Pilot light holders | 10 for $1 00 |
| 12V | 10 for $1 00 |

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125 York Street,
Sydney, 2000.
Telephone 290 3377.
DSE also has branches and resellers throughout Australia.

**Electronic Agencies,**
115-117 Parramatta Road,
Concord, 2137.
Telephone 745 3077.

**Jaycar Pty Ltd,**
380 Sussex Street,
Sydney 2000.
Telephone 264 6688.

**Radio Despatch Service,**
869 George Street,
Sydney 2000.
Telephone 211 0816.

**RCS Radio Pty Ltd,**
651 Forest Road,
Bexley, NSW 2207.
Telephone: 587 3491

**VIC.**

**Rod Irving Electronics,**
425 High Street,
Northcote, 3070.
Telephone 489 8131.

**Kalextronics,**
101 Burgundy Street,
Heidelberg 3084.
Telephone 743 1011.

**Sunbury Printed Circuits,**
10 Counihan Street,
Sunbury 3429.

**SA**

**James Phototronics,**
522 Grange Road,
Fulham Gardens, 5024.

**WA**

**Altronics Distributors,**
105 Stirling Street,
Perth 6000.
Telephone 328 1599.

**Jemal Products,**
8/120 Briggs Street,
Welshpool, 6106.

**N.Z.**

**Marday Services,**
PO Box 19 189,
Avondale, Auckland.

**Mini Tech Manufacturing Co Ltd,**
PO Box 9194,
Newmarket.

**Printed Circuits Limited,**
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Christchurch.

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## ADVERTISING INDEX


| ADVERTISER | PAGE |
|---|---|
| AMS Systems | 32 |
| Ace Radio | 87 |
| Acoustic Electronic Developments Pty Ltd | 112 |
| Adaptive Electronics | 7 |
| Altronic Distributors Pty Ltd | 90, 91 |
| Ampec Electronics Pty Ltd | 41 |
| Amtex Electronics | 59 |
| Applied Technology | 72, 73 |
| Australian School of Electronics, The | 104 |
| Boffin Microcomputer Design & Systems | 88 |
| Bright Star Crystals | 109 |
| Chapman, L. E. | 119 |
| Christie Rand Pty Ltd | 15 |
| Computer Country Pty Ltd | 24, 45 |
| Cunningham R. H. | 116 |
| D Q Communications | 118 |
| Daneva Controls | 49 |
| David Reid Electronics Ltd | 96 |
| Defence Force, Recruiting | 83 |
| Dick Smith Electronic Group | 16, 17, 30, 31, 94, 95, Catalog |
| Direct Computer Sales | 112 |
| Edible Electronics | 107 |
| Electrocraft Pty Ltd | 23 |
| Electronic Agencies | 84 |
| Elmeasco Instruments Pty Ltd | 48 |
| Hagemeyer (Aust) Pty Ltd | OBC |
| Hy Tech Distributors | 88 |
| Jaycar Pty Ltd | 11, 50, 51, 62 |
| K C Electronics | 102 |
| Kalextronics | 33 |
| Looky Video | 115 |
| Marantz (Aust) Pty Ltd | IBC |
| Parameters Pty Ltd | facing 61 |
| Paris Radio Electronics | 111 |
| Pre-Pak Electronics | 25 |
| Prentice Hall | 103 |
| Q T Computer Systems | 118 |
| Radio Despatch Service | 102 |
| Rakon Industries | 84 |
| Ralmar Agencies Pty Ltd | 43, 105 |
| Rod Irving Electronics | 20, 57, 97 |
| Royel International | 35, 75 |
| S M Electronics | 81 |
| Sanyo (Aust) Pty Ltd | centre of magazine |
| Scientific Devices | 15 |
| Scientific Electronics | 95 |
| Software Source | 115 |
| Sony (Aust) Pty Ltd | IFC |
| Standard Components | 43 |
| Stotts Technical Correspondence College | 67 |
| Tandy Electronics | facing 60 |
| Technical Book & Magazines Co | 99 |
| Vicom International | 29 |
| Warburton Franki | 2 |
| Wireless Institute of Australia | 85 |

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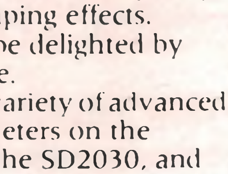
The Marantz SD3030 Cassette Deck features the new Dolby C system to provide recordings with far less tape hiss than those made using standard Dolby B.




Unlike some other noise reduction systems, Dolby C recordings can be played back on a deck equipped with standard Dolby only without audible distortion or pumping effects.

Recording enthusiasts will be delighted by the other models in the new range.

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All feature Dolby B noise reduction, compatibility with metal tapes, soft touch controls and DC Servo motors to ensure constant tape speed and silent operation.

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See your local stockist and listen to the future. Listen to Marantz.

**marantz**
*Now you're listening.*


*Decks shown in stack (from top): SD1030, SD3510, SD2030, SD3030 and SD5010*
*All decks shown with TDK Metal tapes.*

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