DECEMBER, 1974
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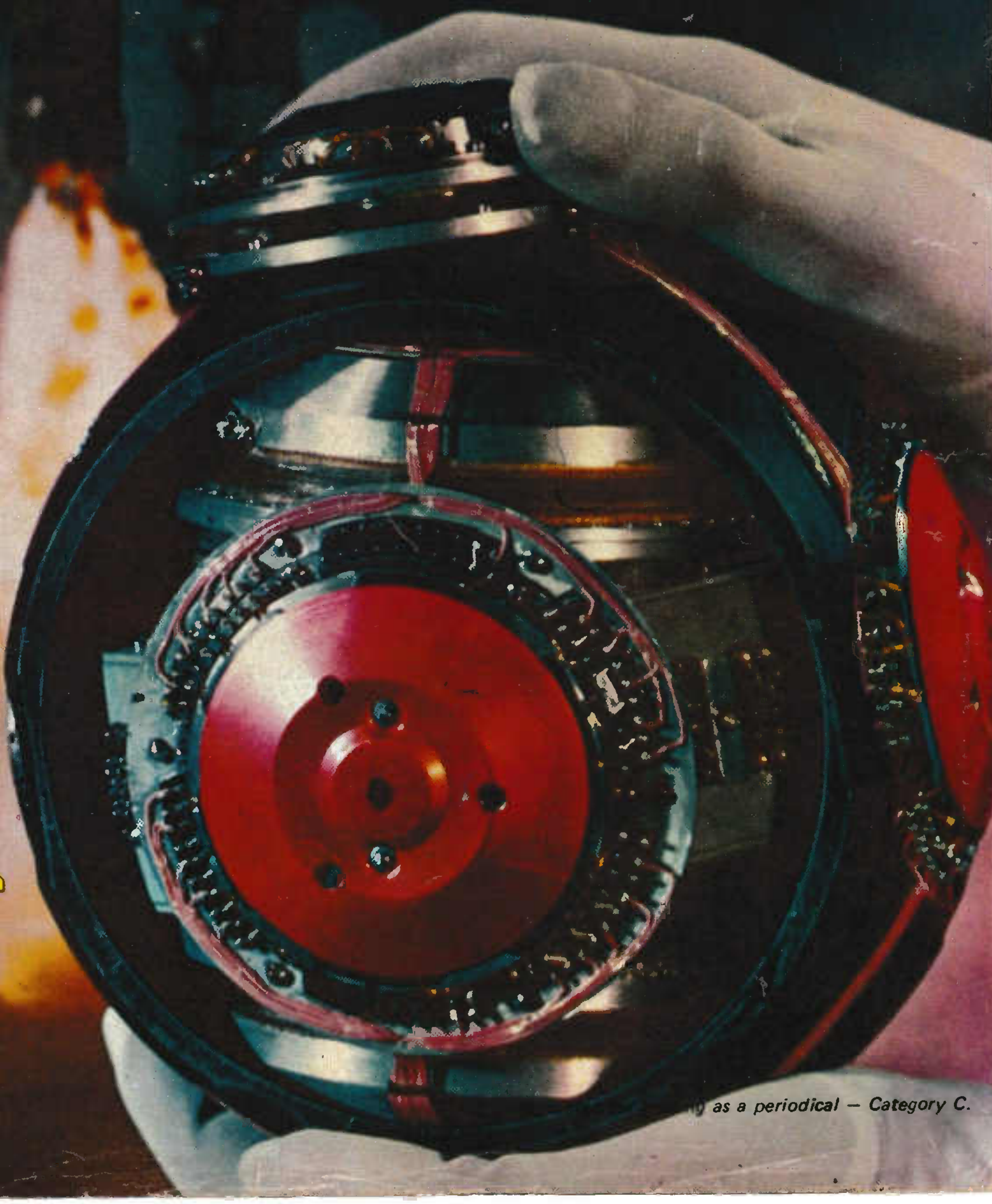
electronics TODAY INTERNATIONAL

HI-FI

SPACE-SHIP NAVIGATION



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DECEMBER, 1974 Vol. 4. No. 9

main features

projects

reviews

news & information

COVER: Gyroscopic transducers such as this form the main data system for space craft navigation. (Photo courtesy Ferranti UK).

NEXT MONTH

MILLIONS IN SPACE

'By 2074, ninety percent of the human population could be living in space colonies'.

MODERN CRYSTAL OSCILLATORS

A practical guide.

THE IDEAL MATCH

Optimize your tone-arm/cartridge combination — manufacturers' recommendations.

PROJECTS

- UNDER $30 DIGITAL CLOCK
- CMOS BURGLAR ALARM
- ELECTRONIC IGNITION
- FLASHER WARNING SYSTEM

The feature articles listed above are included amongst those currently scheduled for our January issue.

However unforseeable circumstances, such as highly topical news or developments may affect the final issue content.

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news digest

THIN LETTER BOMBS

Police and security forces have in the past warned recipients to be suspicious of abnormally thick letters — for fear that they may contain a bomb. (The triggering mechanism of these devices has been too thick for easy concealment).

Recently however a new generation bomb has turned up — fortunately so far most have been spotted — these use the flat 6 V battery pack from the Polaroid SX 70 instant camera. These batteries are made by ESB Inc and are made of 19 cell layers compressed thinly enough to packaged within the film pack.

SUPER BATTERY FOR ELECTRIC VEHICLES OF THE FUTURE

The electric cells in the container (centre) weigh some 52 kg but have a storage capacity equal to the three standard motor car batteries also shown. The new battery, consisting of sodium-sulphur cells, has a capacity of about 180 ampere/hours at 12 volts compared with the capacity of the conventional lead-acid battery of 60 ampere/hours.

Storage units of up to 960 cells have already been operated during research by Chloride Silent Power, a new company set up jointly by the British Electricity Council and the Chloride Group to develop the sodium-sulphur battery. The battery reverses the usual arrangement in that it has liquid electrodes and a solid electrolyte comprising a test-tube shaped vessel of beta alumina containing a liquid sodium anode fed from a stainless steel reservoir. Surrounding the ceramic electrolyte is the liquid sulphur cathode — the whole being housed in a stainless steel tube.

The new super batteries are made from material that is cheap and plentiful and research indicates that they all ultimately have the capacity to store some ten times the energy of a lead-acid battery of similar weight. The 960-cell model has successfully powered an 915 kg van. (See article High Temperature Batteries — page 20).

DEVICE DISPLAYS HEART RATE ON BEAT-TO-BEAT BASIS

A digital computing cardiotachometer, first used by NASA physicians to monitor instantaneously the pulse rates of astronauts performing underwater training activities, is being used in non-space oriented medical applications.

The device was developed originally by engineers at Marshall Space Flight Centre, Huntsville, Ala., to monitor on a beat-to-beat basis the heart rates of astronauts undergoing training in the centre's neutral buoyancy simulator (NBS), an underwater training laboratory used to simulate the weightless conditions encountered in space.

The device, which provides a numerical display of a subject's pulse rate 0.3 seconds after detecting his second heart beat, was used at Veteran's Administration Hospital and University Hospital in Birmingham, Ala., for approximately a year. It is now being used in routine physical examinations given to personnel at Marshall's employee medical facility.

Designed to operate in conjunction with a standard electrocardiographic unit, the device employs an electronic digital system to use the time between two consecutive heart beats to calculate a patient's pulse rate in beats per minute.

The cardiotachometer, which is about the size of an ordinary shoe box and weighs approximately 2.2 kilograms.

It was developed by engineers Hubert E. Smith, John R. Rasquin and Roy A. Taylor of the Marshall Process Engineering Laboratory. Patent rights are held by NASA.

NUCLEAR LASER

Nuclear energy has been successfully converted directly into laser light by the US Atomic Energy Commission.

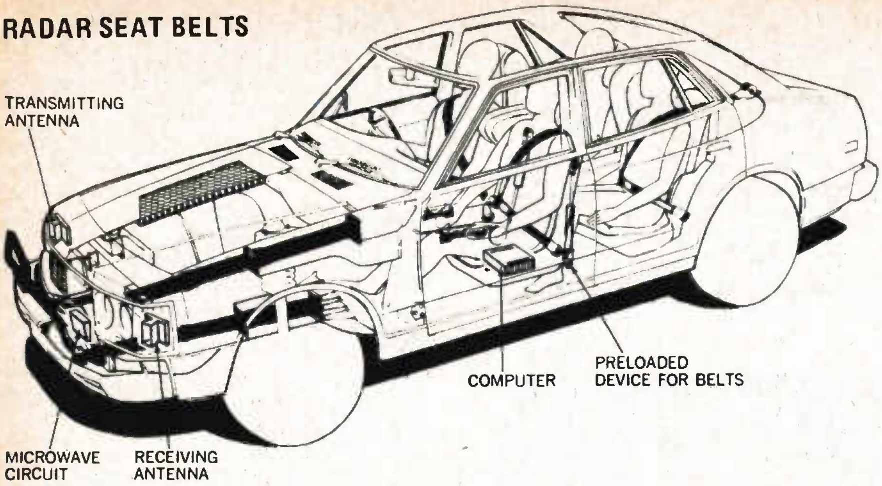
The technique uses a neutron pulse from a nuclear reactor to excite a helium-neon gas laser in what the AEC describes as 'fission fragment excitation'.

Commenting on the achievement, NASA say that the new technique may lead to major advances in long range communications, energy conversion and long distance power transmission.

It will of course also open the door to the long-sought high power laser military weapon.

FM broadcasting will start in NSW and Victoria just after this issue is published. Full story **— page 131 this issue.**

RADAR SEAT BELTS



Car seat belts must be tight to be truly effective in an accident — tighter than in fact than is really comfortable.

The Nissan Motor Company have joined forces with Mitsubishi to produce what they feel may be an effective method of automatically tightening the belts just prior to collisions.

Their system uses a pulsed-Doppler radar in conjunction with a series of logic circuits. The radar and logic circuits sense the distance between the vehicle to which they are fitted and any object that the vehicle approaches. If the circuitry decides that a collision is unavoidable, the system is triggered and the belts automatically tighten and lock a few milliseconds prior to the accident.

BROADCASTING BREAKTHROUGH

A prototype am broadcasting transmitter with a kilowatt range solid-state output has been developed by Westinghouse Electric Corporation (Baltimore Md. USA).

Few specific details are available, however our US office understand that apart from two existing units (of 1 kW and 5 kW output respectively) for am use, the Westinghouse is believed to have developed other devices for vhf fm use.

The initial transmitters are currently being tested at the Federal Communications Commission's Chicago radio station.

If these trials are satisfactory we believe that Westinghouse will demonstrate the new solid-state transmitters at the April '75 convention of the National Association of Broadcasters.

LARGE LIQUID-CRYSTAL DISPLAY

A large scale liquid-crystal matrix display has been developed jointly by Hitachi, Asahi Glass and Dai Nippon Toryo (using a million plus dollars subsidy from the Japanese Govt.)

Work is currently in hand to build a prototype unit about half a metre square displaying 600 alphanumeric characters.

The display uses a nematic liquid crystal in a dynamic scattering mode. Contrast ratio is said to be about 20 : 1 and frame writing or erasure time about half a second.

LATEST ADVANCE IN COLOUR TV

Philips video long play, recorder has suddenly become a reality. The VLP — which uses "records" to play colour television programmes — was first demonstrated by Philips two years ago. But no adequate source of programmes was available.

Now MCA Inc. of Los Angeles, has reached a long-term agreement with Philips for the sale of the VLP and compatible discs in the consumer market. The VLP will be manufactured and marketed by Philips through its worldwide marketing and distributing network. Concurrently, MCA will manufacture and market VLP video disc programmes.

MCA has access to a wide spectrum of entertainment material, including the Universal Pictures film library — one of the world's largest. The company also expect to produce a variety of new programmes especially tailored to meet the VLP's unique characteristics.
It is expected that other programme suppliers will make material available.

The VLP looks like a record player, but when plugged into a normal colour TV receiver it "plays" colour television programmes. It uses discs which resemble long-play phonogram records. Each disc contains a colour television programme which runs for up to 45 minutes. A laser beam is used to pick up the signal, so there is no contact between the record and the playback unit. This means that neither the recording nor the playback system can wear out.

Philips and MCA will establish a licensing organisation to negotiate with others for patents. The licencing policy will be liberal, enabling the entire industry to participate in the video player technologies of Philips and MCA.

This liberal policy is in line with Philips offers to industry regarding two earlier inventions — their audio "Compact" cassette and their videotape cassette recording (VCR) systems.

Philips make these systems freely available to other manufacturers in order to promote world-wide standardisation.

The Philips VLP will not replace the videotape cassette but will supplement it.

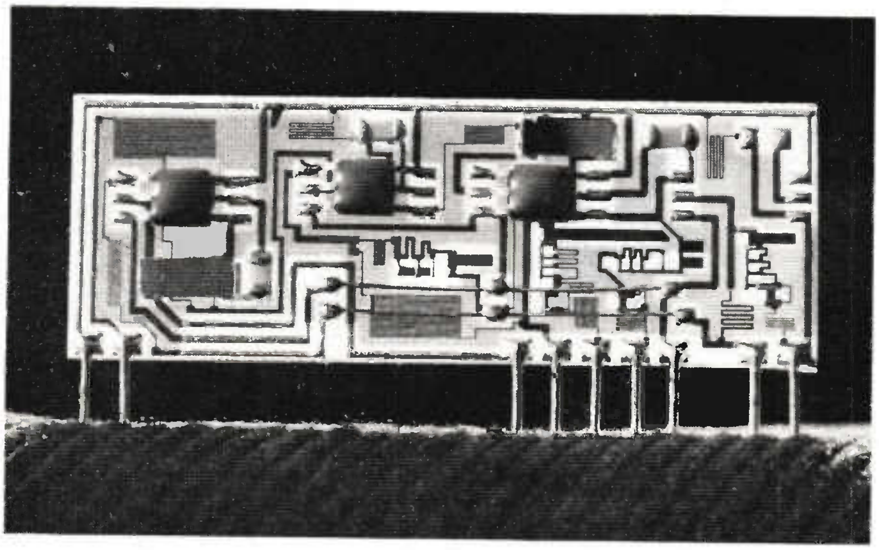
The VLP system is extremely flexible in use. It can, for instance, provide stills, slow-motion or even reverse motion pictures from recorded scenes.

news digest

ACTIVE RC FILTERS.

Active RC filters were demonstrated by Siemens at the Munich 'Electronica '74' exhibition.

These coilless components are made by a tantalum thin-film technique and are combined with operational amplifiers in miniature housings. The desired filter parameters, such as frequency, Q-factor and gain, are set by laser trimming of specific resistors with tolerances better than 1%; the maximum temperature coefficients of the RC filters are 40 . 10^{-6}/K. The new RC filters lend themselves especially for use in communication engineering and also in measuring and control engineering.



TIME OUT

Texas Instruments appear to have postponed their planned entry into digital watch manufacturing. Component orders, previously placed with outside companies, have been cancelled.

CHEAPER H-P 35?

Not definite, but watch out for a lower-priced version of the H-P 35 calculator early next year. It will probably be a two-chip version of the existing unit.

MONITOR ON JAPANESE TECHNOLOGY

Emerging Japanese technology can now be monitored through a unique clearinghouse established by General Electric's (U.S.A.) Technology Marketing Operation in association with the International Technology Information Institute, a Japanese information-gathering firm.

GE's special service, called "New from Japan", provides information on new developments in Japanese technology — previously unavailable from a single source — in a series of bi-weekly reports.

The "New from Japan" reports are

(Continued on page 134)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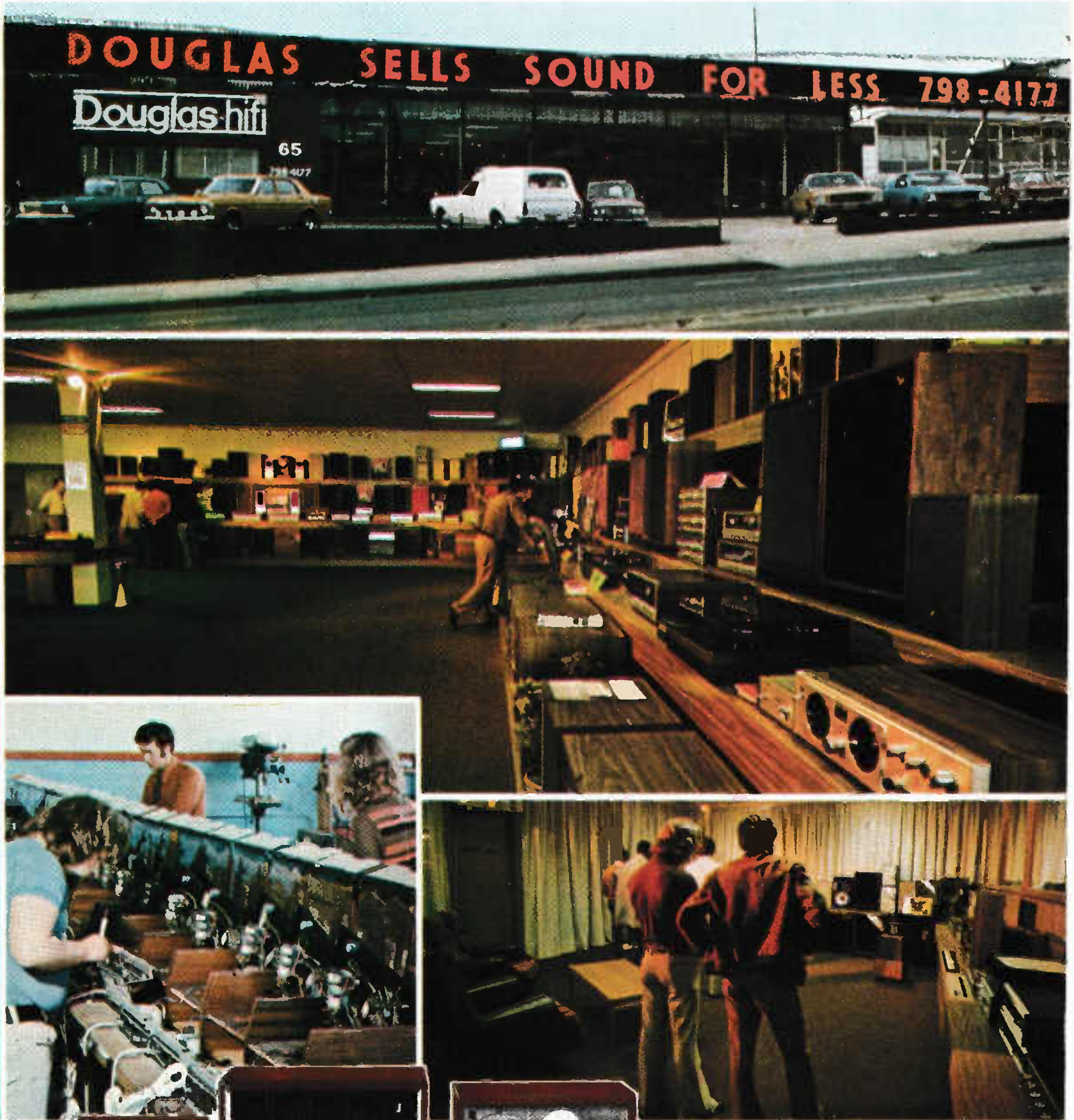
Great news for N.S.W. Douglas Hi-Fi have opened exciting new showrooms in Sydney, Here you can see all the world's leading gear — at Special low prices.
We're the biggest Hi-Fi organisation in Australia, so we buy at better prices than anyone else. We do our own importing — in bulk. Often by the container load. And we pass the savings on to you.
See, hear and compare all the great brands together, in a single showroom. More than 30 top brands, from 4 continents. Hundreds of different models, the most comprehensive range in Australia.
All fully guaranteed, and backed by Australia's fastest, best equipped drive-in service centre. Douglas sells sound for less!



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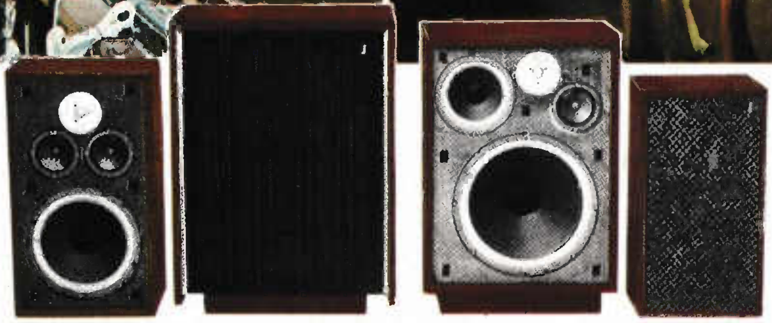
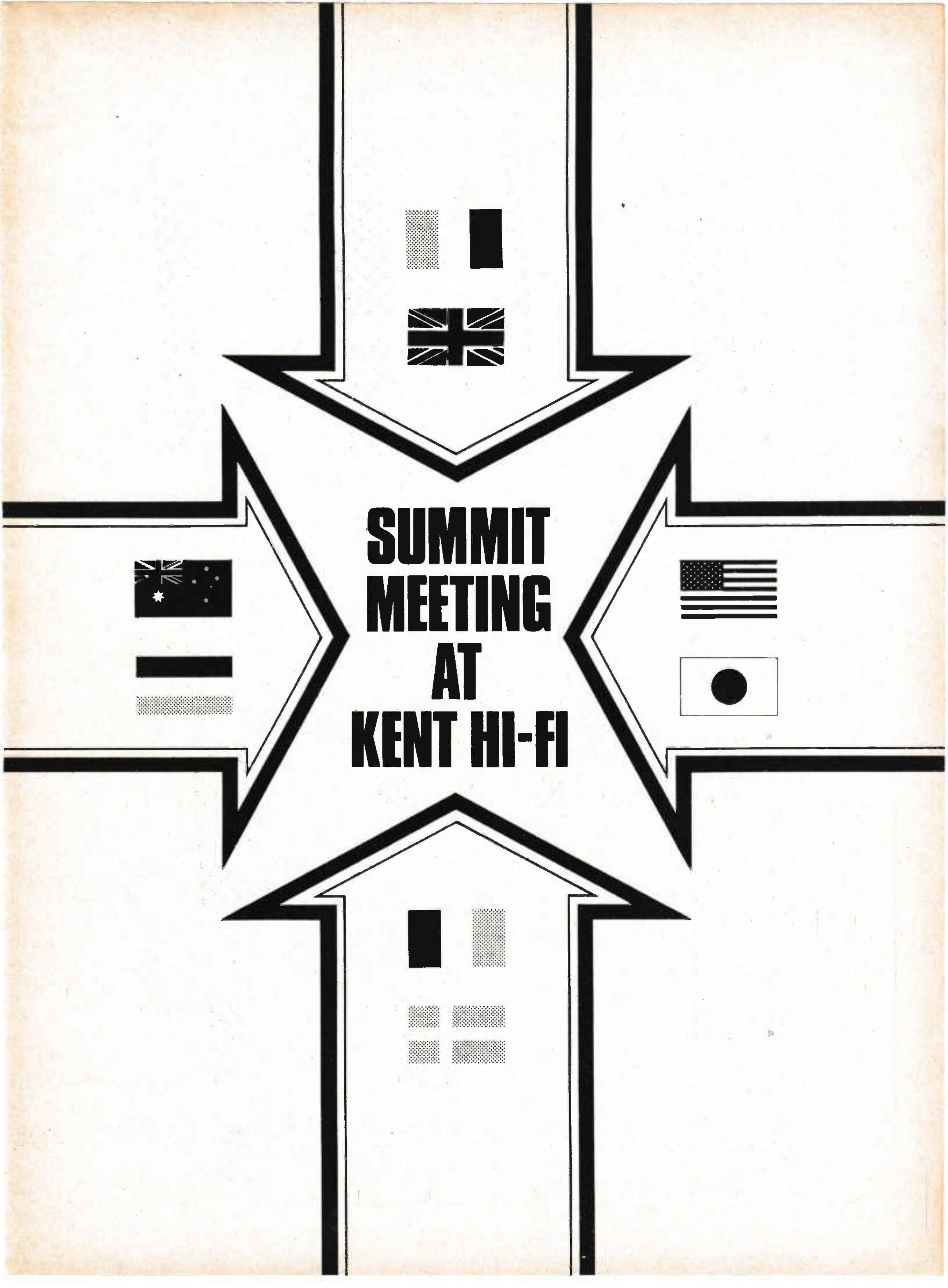
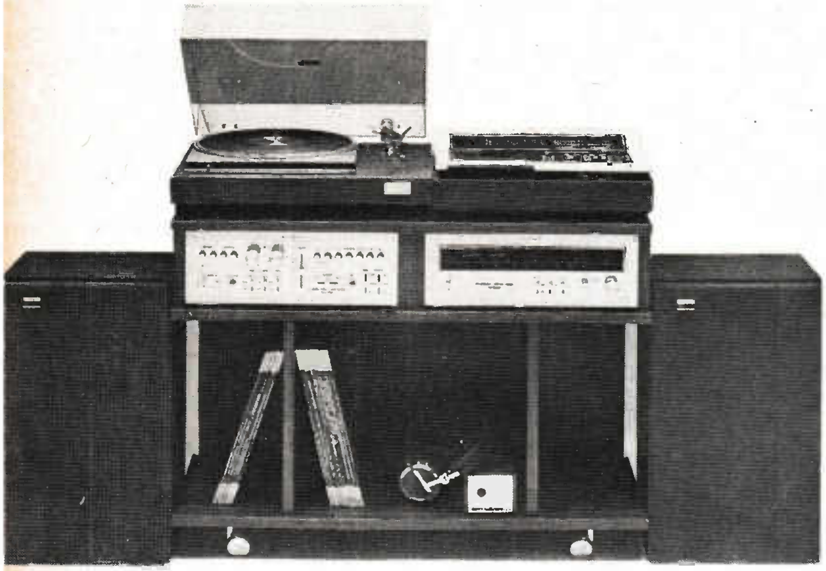


Douglas Hi-Fi have the complete range of the fabulous JENSEN Speakers from **$119 pair to $1199 pair.**


SUMMIT
MEETING
AT
KENT HI-FI

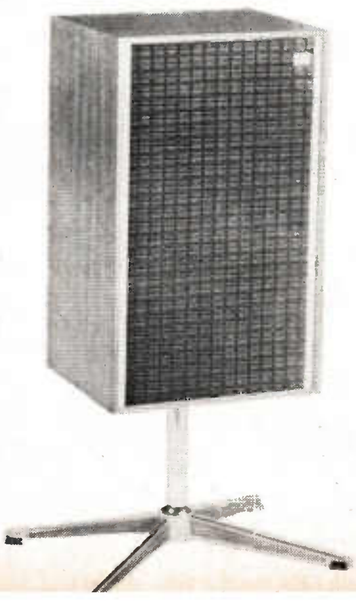
SONY

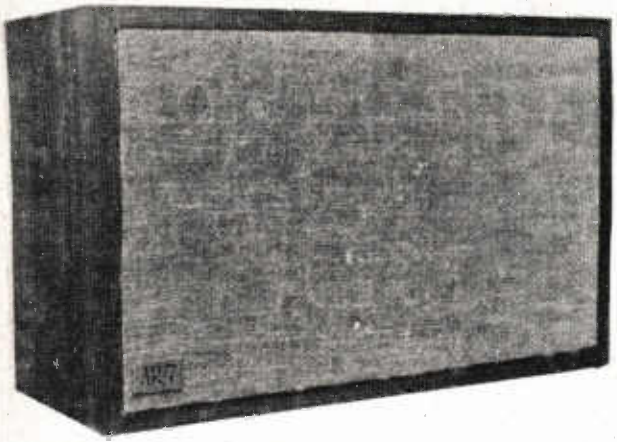


In the Yamata Room the full range of Sony equipment is featured — loudspeakers, amplifiers and tuner amplifiers, turntables, cassette tape decks and electrostatic headphones and microphones. It is definitely a Sony world.

KEF

The Windsor Room displays the fine array of Kef and Garrard equipment. Kef are famous for their craftsmanship in loudspeakers. A full range is on display. Garrard turntables are featured, making the ideal partner for Kef loudspeakers. The top of the range — the Garrard Zero 100SB is prominently displayed.





AR loudspeakers have long since had a reputation for clear, accurate sound reproduction. The Boston Room displaying the full range of AR loudspeakers further exemplifies this fact. AR Models such as the brilliant AR 7 suspension loudspeaker can be heard and enjoyed.

There are other studios at Kent Hi-Fi each designed for easy no-fuss listening and comparison of quality Hi-Fidelity. The Rhine Castle Room featuring Dual turntable and Saba Hi-Fi equipment is an example of one of these studios.

The Summit conference at Hi-Fi is a necessary venue for any audiophile interested in quality Hi-Fi. This is a unique opportunity to sample each superb sound in unusual but pleasant surroundings.

A Japanese atmosphere is dominant in the Mikado Room featuring Kenwood Hi-Fi equipment. Kenwood have been outstanding over the years for their precision in Hi-Fi components, an example of this precision is the Kenwood KP-5002 fully automatic drive turntable. Definitely a turntable for the perfectionist.

WE INTERVIEW PETER DERZ
Proprietor of Kent Hi-Fi on the Summit Conference

Peter Derz

What exactly is the summit conference of Kent Hi-Fi?

Simply — a production by Kent Hi-Fi and several audio companies — a joint effort we are making to raise our standards and improve the image of our trade. What has happened is that a number of audio importers have joined us to produce a permanent Hi-Fi show with an international theme.

At Kent Hi-Fi we now have six studios, each designed as a living room and decorated in the style of the country of origin of the equipment displayed there. A brief description — we have the Mikado Room where we have Kenwood equipment on display. This room has a Japanese atmosphere with exhibits such as Imperial carriages, traditional Japanese drawings and light fittings.

Then we have the Windsor Room for products such as KEF and Garrard, the Boston Room for Acoustic Research, the Philadelphia Room for Bose products, the Rhine Castle Room for Dual and we have a full range of Sony domestic Hi-Fi equipment on display in our Yamata Room.

Why?

I've always wanted to improve conditions for customers buying hi-fi so I've studied how people throughout the world are marketing this product. I want to get away from the old method of selling a loudspeaker or amplifier like a bottle of tomato sauce on a grocery shelf.

Now with our 'Summit Conference' I feel that Kent Hi-Fi has a concept that is individual and unique. We have created an intimate and tranquil atmosphere in which the customer is left in peace to choose the system that is really right for him.

We believe both our clients and our industry will benefit from this approach.

What support is Kent Hi-Fi getting from the wholesalers?

The marvellous professional service of Acoustic Research and Bose immediately come to mind — always very accommodating with any after sales service problem. We find our wholesalers generally have a very high degree of consumer consciousness. By this I mean they are aware of the importance of after sales service for customer satisfaction. Fred A. Falk in particular give excellent service with their Dual turntables. This company really knows how to look after its equipment and usually has any repair job finished and returned within 48 hours or sooner. Other brands we handle — Sony, Kenwood, Sansui, Kef, Wharfedale and Altec Lansing also are most co-operative in terms of after sales service.

How do you view a future of hi-fi equipment in Australia.

I believe the market is expanding. I would advise anyone who thinks he'd find satisfaction selling audio equipment to get into this field now as I think that sales will at least double each year. The introduction of stereo FM will accelerate business. The market is there, success will follow for retailers with a positive approach.

The introduction of colour TV . . . has it enhanced or badly affected your weekly turnover.

I feel it has complemented our activities — so much so that in recent weeks sales have been better than ever.

I think that people are now spending more and more on their homes, improving their home environment. Of course this means they also want to improve their audio system. I know there has been wariness on the part of some dealers about the introduction of colour TV but I feel such wariness is unjustified.

BETTER THAN BOSE!

That's right. Even though Bose are the most highly reviewed speakers in the industry; even though critics proclaim "Bose is best, big or small, high or low"—now there are two speaker systems better than Bose 901 and Bose 501!

BOSE 901 SERIES TWO

Introducing the Bose 901 Series Two—it's everything that the original 901 was, and more: • Multiplicity of acoustically-coupled full-range drivers • Flat power radiation • Completely new Active Equalizer design, suited to program source variations never available before, and adapted to a much wider range of room environments (even drapes) • and SYNCOM™ II Speaker Computer quality control testing.

BOSE 501 SERIES TWO

Also introducing the new Bose 501 Series Two—the other speaker with direct and reflected sound, and flat power radiation, at a price far lower than you'd expect to pay.

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We invite you to challenge us! Compare the Bose 901 Series Two to any other speaker, regardless of size or price; and compare the Bose 501 Series Two to any speaker up to the price of the 901 Series Two. You be the judge. If we have done our homework correctly, the comparison will be interesting and short!

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SPACE CRAFT GUIDANCE

— how inertial navigation works, ETI Technical Editor, Brian Chapman, reports.

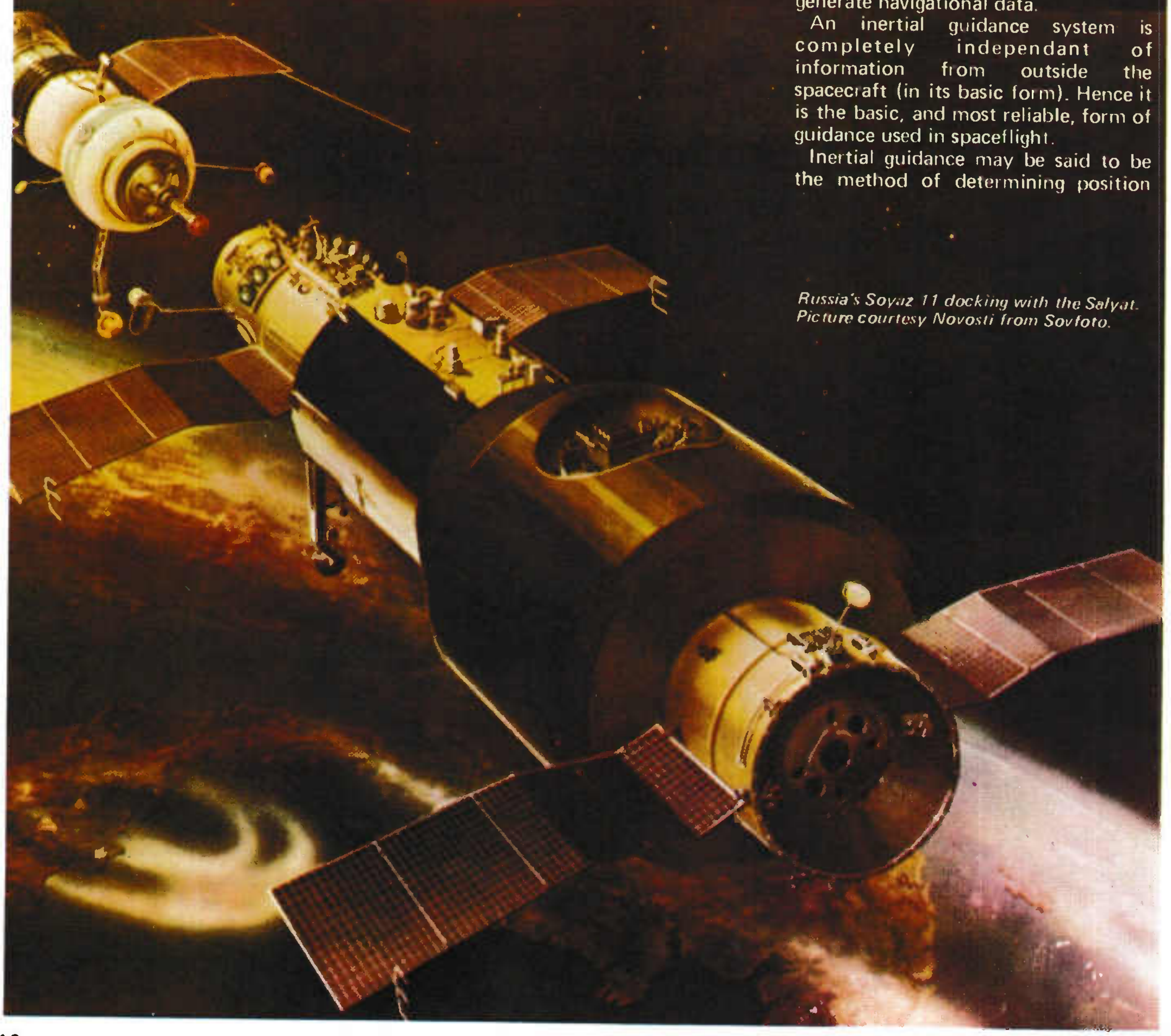
SPACE EXPLORATION has necessitated the development of many types of sophisticated guidance and navigation systems. The type actually used depends very much on the specific application.

The basic forms of guidance may be classified as INERTIAL or PROGRAMMED; SEMI-INERTIAL, that is, basically inertial but incorporating some other outside guidance system; RADIO or COMMAND; CELESTIAL or STAR-TRACKING; and INFRA-RED.

Advanced systems may well use combinations of some or all of these. For example a scientific satellite once in orbit, may well use infra-red guidance to lock on to the sun, then celestial guidance to find a reference star. These provide the basic data for orientating the spacecraft in space. Once this has been established an inertial guidance system may be used to maintain the desired attitude and to generate navigational data.

An inertial guidance system is completely independant of information from outside the spacecraft (in its basic form). Hence it is the basic, and most reliable, form of guidance used in spaceflight.

Inertial guidance may be said to be the method of determining position



Russia's Soyaz 11 docking with the Salyat. Picture courtesy Novosti from Sovfoto.

and velocity without referring in any way to the world around the vehicle. The system does **not** depend upon receiving radio signals, or upon a measurement or count of any kind. Its fundamental devices are accelerometers, and gyroscopes used in conjunction with some form of computation.

Such a system measures the **acceleration** of the vehicle by measuring the force on a body within the vehicle due to this acceleration — in much the same way that we feel the pressure of the seat against our back when our car accelerates. The device that performs this measurement is known as an **accelerometer**.

We also wish to know the **attitude** of our spacecraft, etc, with respect to some predetermined orientation — this is determined by **gyroscopes**.

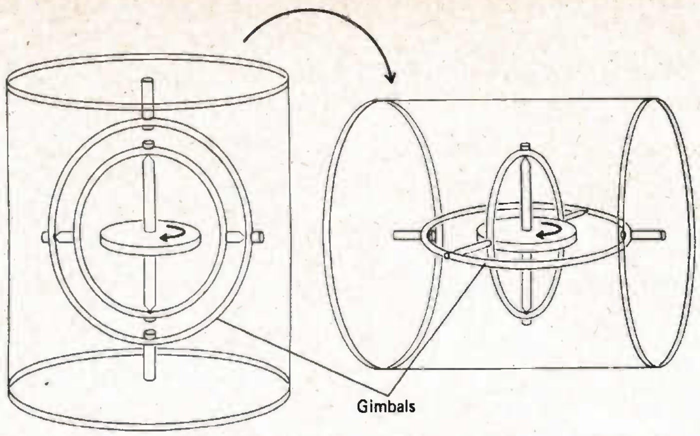


Fig. 1. This gyroscope is mounted in gimbals so that the rotating mass always points in the same direction — regardless of 'container' attitude.

THE GYROSCOPE

The gyroscope (hereafter called a gyro) was used as early as 1744, to provide a stable platform for sextants. A stable platform was necessary so that the rolling and tossing of the ship did not affect measurement. The principle of operation is as follows.

If a heavy wheel is spun at high speed it tends to maintain its axis of rotation in the initially set up direction. In fact, if we push on the axle, it strongly resists any attempt to change position. Thus if such a wheel is mounted within pin-bearing frames (called gimbals) as shown in Fig.1, it will maintain its position regardless of the way that the container is turned. Such a gimballed wheel forms a basic gyro.

The term "inertial guidance" comes from the axial-inertia characteristic of the gyro — that is, its resistance to having its axis of rotation changed — because this gives it the ability to act as a directional pointer. Once pointed at a given star, a gyro will *remain* pointed at that star regardless of spacecraft manouvering. Thus, using the gyro as a reference, the spacecraft may be navigated to any point in the universe.

To put the gyro to work in a guidance system we need to obtain an output from it whenever the spacecraft changes orientation. Another characteristic of the gyro known as *precession* is used for this purpose.

GYROSCOPIC PRECESSION

If the gyro is mounted on a platform with a single gimbal, so shown in Fig.2, and its axis is, for example, pointed to the north it will try to maintain its northerly direction. If the platform is now turned horizontally away from north, the gyro axis will move in a vertical plane.

This tilting of the spin axis is a basic principle of the gyro called precession, and may be used to measure the deviation of the platform from its preset direction. The gyrocompass, invented by Sperry around 1896, is based upon this principle, as indeed are all modern inertial guidance systems.

There are many interesting examples of precession in everyday experience. For example, when a car turns a curve, a rotational force is applied to the car flywheel axis (which is in effect a gyro), and as a result, a precessional force is generated on the car. If the flywheel is rotating counterclockwise, as seen from the rear of the car, the front of the car will be pushed downwards when making a left-hand turn, and upwards when making a right-hand turn. Hence racetracks for cars tend to have left hand circuits in order that higher cornering speed may be obtained with safety.

Similarly an aircraft will tend to fall when banking to the left, and rise when banking to the right.

ACCELEROMETERS

We have established the value of the gyro as a means of relating spacecraft attitude to a predetermined axis but, this is not sufficient information to navigate by — we also need to know any acceleration to which the spacecraft is subjected. That is, the gyro doesn't care whether the spacecraft speeds up or slows down, so long as it always points in the same direction. An instrument which *does* provide this very necessary measure of acceleration is known as an accelerometer.

There are many types of accelerometer but perhaps the most basic — is the simple pendulum. When a pendulum system is accelerated in any direction the pendulum will be deflected, in the opposite direction, by an amount proportional to the acceleration. Obviously, however, once the acceleration ceases the pendulum would oscillate back and forth. Hence the system requires some form of damping to eliminate these unwanted secondary swings.

In addition an ordinary pendulum would not work too well in space and sprung mass systems which don't rely on gravity would be more practical (Fig.3).

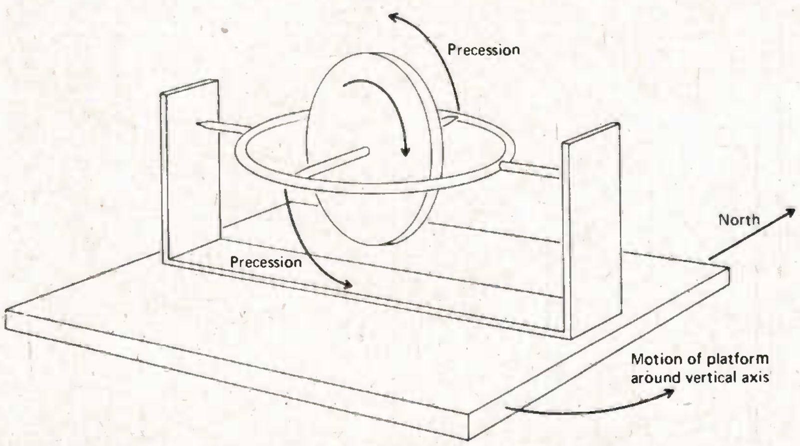


Fig. 2. How a gyrocompass works. If the assembly is caused to change direction in the horizontal plane, the rotating assembly 'precesses'. This so-called 'precession' is measured, thus providing data about the amount of directional change.

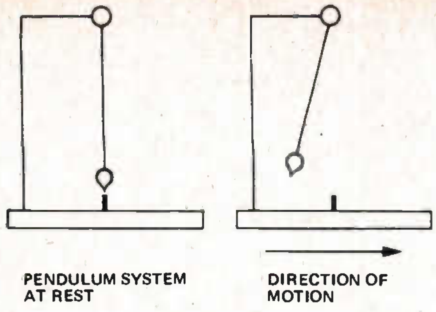


Fig. 3a. Simple pendulum.

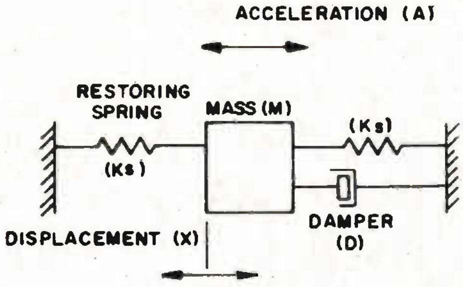


Fig. 3b. Translation system.

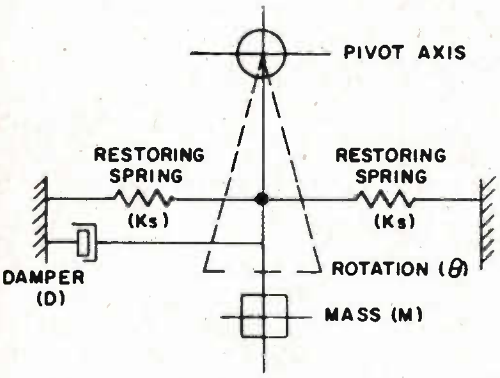


Fig. 3c. Rotational system.

Accelerometers use a variety of transducers to detect the deflection – piezo-electric crystals, strain gauges vibrating wire and variable-reluctance transformers etc are all used. The design of accelerometers is very demanding for, in applications such as ballistic missiles, accurate velocity determination is of prime importance. For example an ICBM having a range of about 5000 nautical miles and travelling at a rate of more than 6000 metres per second would miss the target by almost two kilometres if the velocity error was only 0.3 metres per second.

The accelerometer may rightly be said to be the essential element of an inertial guidance system, the gyros being used merely to establish a space-stable platform for the mounting of these devices.

THE INERTIAL PLATFORM

The first use of a gyro in an inertial guidance system was made in 1896. A gyro, mounted with a torpedo was used to maintain the torpedo's course regardless of wave motion and ocean currents. Mechanical linkages to the rudders corrected any deviation of the torpedo from the direction pointed by the gyro.

In the modern world of ballistic missiles and spacecraft, a straight line course is seldom, if ever, required. For example the ICBM describes a parabolic curve. A spacecraft may undergo any number of complex manoeuvres. Thus the gyro in such applications is not used to directly control the spacecraft. It is used, however, to establish a space-stable platform upon which the accelerometer and star trackers etc are mounted.

Figure 5 illustrates how such a platform is mounted in a missile or spacecraft. Gyros are fitted to the inertial platform on three, mutually-perpendicular axes. By using three axes the motion of the vehicle may be accurately defined in three dimensions. These axes are defined universally as the ROLL, PITCH and YAW.

Imagine a missile in flight. It may **spin** as it flies – this is the roll axis. It may **deviate** left or right – this is the yaw axis, and it may **deviate up or down** – this is the **pitch** axis. Regardless of any missile motion, the gyros on the inertial platform maintain it in the same spatial plane.

Mounted on the same platform are three accelerometers, also aligned with the roll pitch and yaw axes, which measure any acceleration of the missile or spacecraft in the direction of these axes.

The continuous, three-axis acceleration data is fed to a digital computer which calculates, using the equations of motion, the instantaneous vehicle velocity and position.

A guidance law pre-programmed into the computer determines the optimum vehicle attitude and velocity required to attain the desired course, or orbit etc, with the least expenditure of fuel. This *required* velocity and attitude is compared by the computer with the *actual* parameters derived from the inertial platform. By this means error signals are generated, which (via the vehicle auto-pilot), control engine power and/or gas-jets to correct the velocity and attitude.

USE IN SPACE TRAVEL

In a ballistic missile, or aircraft, the gyro platform is set up and orientated with reference to terrestrial planes of reference. But in space travel we must fix our planes of reference on the universal scale. Hence, once the spacecraft achieves parking orbit, a star tracker mounted on the inertial tracker is used to establish the spacecraft position by sighting on two or more known stars. Then if necessary the inertial platform is realigned to a more suitable orientation and the computer fed with the present position and the desired future position (plus many other factors such as gravitational forces etc). From this data the computer determines the optimum attitude and time for the spacecraft to depart from orbit and thus – we are on our way to the stars. ●

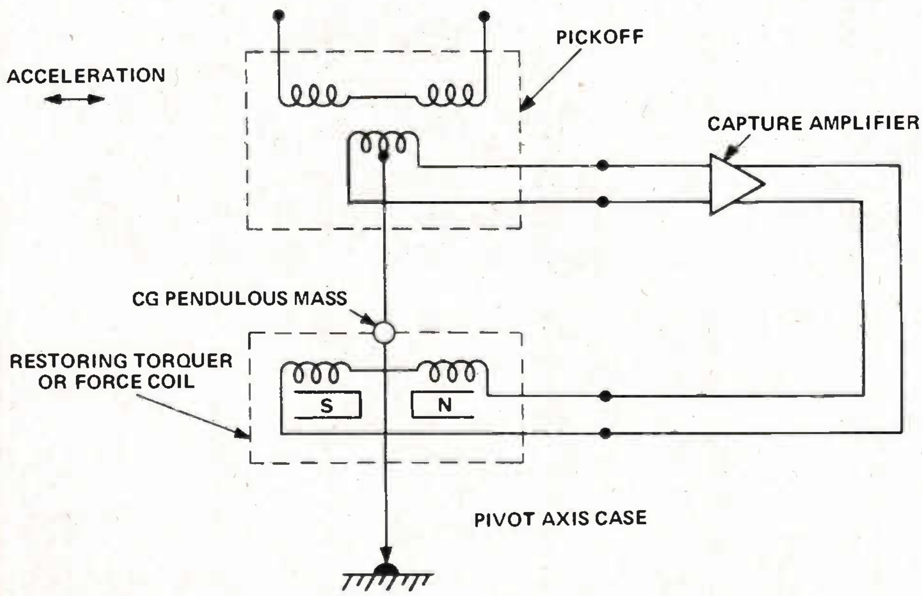


Fig. 4. This typical force balance pendulous accelerometer utilizes a differential transformer type pick-off, a high gain capture amplifier, and a dc permanent magnet force coil. These features typify many of the high precision force-balance accelerometers currently manufactured.

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HIGH TEMPERATURE BATTERIES

Batteries using liquid electrodes and electrolyte have been under development for the past ten years. Their very high temperature operation has caused problems but now they are about to be made commercially.

Here, Dr. Sydenham reports on European and American developments in the design and projected use of high-temperature batteries for transportation and power system storage.

A LARGE PROPORTION of our energy needs can be met with direct heating — coal, oil and gas being burned to produce heat — nevertheless the flexibility of energy in electrical form takes some beating. Electricity, being easily controlled, suits a large variety of needs better than the other basic forms of energy. Electricity, however, suffers one great disadvantage: it is generally uneconomic to store. This problem has been with us since the dawn of electrical knowledge and has still not been solved entirely adequately.

When very large amounts of energy are involved, the only really satisfactory storage method is to use the electricity to pump water to a higher elevation. When the energy is needed again, the water is used to drive turbines as it descends, thus regaining the electricity available earlier (but with some loss in the overall process).

Clearly, although on economic grounds pumped-storage *is* the cheapest and most efficient way to store electric power, it is only practible where the amount of energy is extremely large and where suitable geographical places exist to store water at two levels.

On the face of it, it would seem better to generate power only as it is needed — but economic factors dictate that power generators should run at quite high outputs all the time. Unfortunately the demand for electric power fluctuates widely throughout the day and season. To obtain cheapest operation of the system, power system operators ideally desire economic storage facilities to absorb and smooth out fluctuations, and with (virtually) only pumped-storage being feasible at this time they are generally forced to make do with machine switching and variable loadings.

A better solution, if it could be found, would be to add electrical storage batteries to the transmission system at the points where the load needs smoothing. As yet this is not done in any significant way because the cost of storage batteries is prohibitive, nevertheless some developments have been made and the concept is now well worth serious consideration.

The advantages of such a scheme are manyfold, modules of batteries could be placed just where the load problem exists; the capacity can be changed with comparative ease by adding or removing units. A second and quite relevant parameter in favour of battery energy storage is that a battery can be manufactured very rapidly, contrasting sharply with the time needed to build a pumped-storage installation. Batteries can also be moved around at will to suit changing conditions; pumped-storage plants cannot. Direct electrical storage would also be compatible with many of the various forms of generation. It produces no pollution, contains little hazard and is straight-forward in concept.

If a cheap battery with high specific energy (measured in watt-hours per kilogram of weight) were devised, this concept of power storage could be implemented. However, battery designs have, until now, not been suitable. The common lead-acid battery used in cars, industrial electric vehicles and the like, costs around $40 per kW/h stored and has a life of around three years. Experts have assessed that the economic battery for power system use would have to be producable at around $12 per kW/h. and have a five year life. This cost point is just being approached with new battery forms.

No storage battery is made as prolifically as the lead-acid unit. Its design has been continually improved and its cost reduced to the minimum. However a major breakthrough would be needed in lead-acid design to provide the much less expensive units required. We can, therefore, expect little improvement with the traditional cells. The cost of lead and its relatively scant supply precludes it for massive use on power systems.

A second major use for storage batteries is as the power source for electric transportation. Battery vehicles are already used extensively in mines, warehouses, ships, submarines and on roads in the form of milk carts and other small delivery vehicles.

With the interest in reduced-pollution transportation considerable effort has been expended in the attempt to produce an economic non-polluting road vehicle for general use — to replace the oil-driven motor car, bus and train. Electric cars are not new — Porsche built one at the end of the last century — but the cost and weight disadvantages of currently available storage batteries have always existed to dampen the case for electric drives, except, of course, in cases where low-pollution levels are a must.

Electric golf buggies, boats, courtesy cars, bicycles, to name a few of the

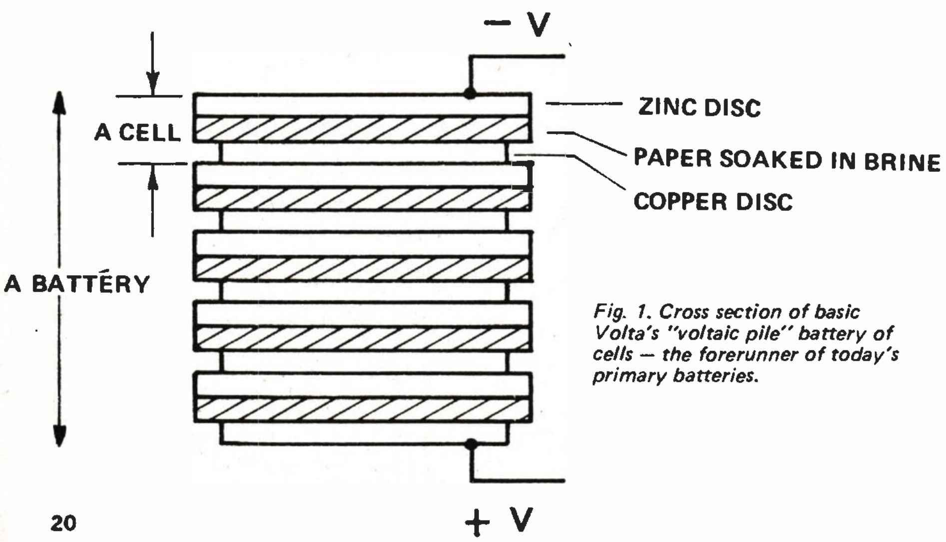


Fig. 1. Cross section of basic Volta's "voltaic pile" battery of cells — the forerunner of today's primary batteries.

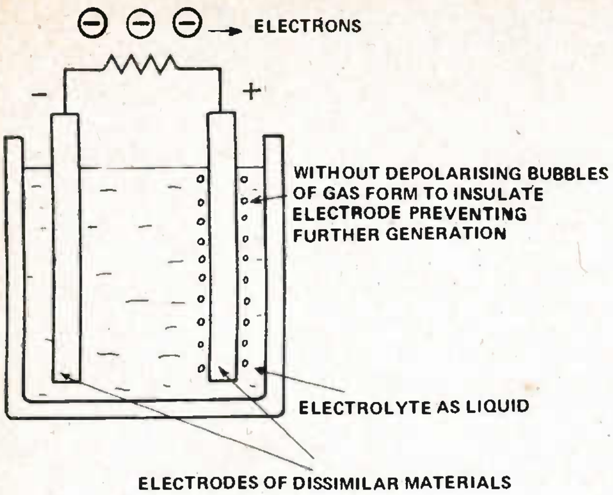


Fig. 2. Electrical cells can also be made with liquid electrolyte but means are needed to depolarise the electrode if it is to work for long.

vehicles where low cost is not vital, are now available but the main problem still holding up serious consideration of electric transportation with inboard storage is the cost of the battery, and its sheer weight.

Each year the margin by which stored electricity fails to be economic in transport is reduced a little further. Lighter batteries resulted when more exotic materials – silver-zinc, mickel-cadmium, for instance, are used, but the cost has risen sharply to achieve this. If you can afford ten times the price of a lead-acid battery you can gain a very considerable reduction in weight – but only military and other vital needs where cost is not the prime factor can afford this solution.

A new generation of storage batteries is however emerging. These operate at high temperatures (up to 400°C in design) but offer about four times as much storage as lead-acid batteries whilst retaining the same weight and price.

High-temperature arrangements tried to date include lithium and sulphur electrodes, sodium and sulphur, and lithium and chlorine. Of these the sodium-sulphur Na-S combination appears to be gaining favour now that one group has produced large-size cells that can be made and used commercially. Before we look into the technology of these recently developed storage cells we need to understand how an electrical cell produces electricity.

Electrochemical batteries come in different forms

The discovery and invention of the first electrochemical battery was the result of Alessandro Volta's work of 1800. Volta was inspired by the findings of Galvani who had previously demonstrated that chemistry and electricity were compatible concepts. Volta first discovered that two dissimilar metals touching together produced a voltage difference across them. Later he realised the very significant fact that certain solutions (he used brine and acidulated water) placed between the two different metals greatly increased the potential. Armed with this new knowledge he went on to build a battery of cells (depicted in Fig 1), made from zinc and copper disks which were separated with common-salt solution soaked paper. These were stacked to form a 'pile' of disks. This seems simple to us now, but in Volta's time it had not yet been fully appreciated that electricity could be produced by any other means than by frictional generation . . . the invention of a battery revolutionised man's thinking.

Volta also built cells (we do call a single cell a battery but strictly a battery is a collection of cells) using metal plates (the electrodes) placed in solution (the electrolyte) in the manner shown in Fig 2. It was not until later, however, that the true significance of the electrolyte was appreciated: originally it was regarded merely as a separating fluid.

Cells that produce electricity from electrochemical action without charging are denoted primary cells. They produce electricity as the result of the chemical reaction taking place between the electrodes and the electrolyte. Eventually the reactants run out and electrical generation ceases. Certain combinations of electrodes and electrolyte can be 'recharged' by passing electricity through them, a condition which recycles the reactants back to their initial state. In practice there is a limit to the number of times this recycling can be achieved with reasonable efficiency and only certain electrode-electrolyte combinations will recycle in a worthwhile manner. Cells that are made deliberately as rechargeable units are called storage or secondary batteries.

To illustrate what happens inside a typical battery let us look at the electrochemical behaviour of Volta's wet cell – zinc and copper electrodes in dilute sulphuric acid. The electrolyte in this case is dilute sulphuric acid and, as is the case with all electrolytes by definition, it consists of molecules that are individually charged because of additional or removed electrons. Such charged molecules (and atoms) are known as ions. Normally the overall nett charge of the solution is neutral but when electric current is passed through the electrolyte, or allowed to flow in an external circuit, from the electrodes, the ions move freely in the solution travelling to whichever electrode for which they have charge affinity. In this particular battery, at the zinc electrode, sulphate ions combine with zinc from the electrode to produce zinc sulphate liberating electrons at the zinc electrode. This negative charge, if the external circuit is completed, flows around to the copper electrode and back into the electrolyte to neutralise free hydrogen ions of the solution forming non-ionised hydrogen gas. The process continues in this way until the hydrogen gas completely clouds the copper electrode with an insulating coat of bubbles and electric current ceases. This effect is known as "polarisation" of the cell. It prevents the simple cell from producing electricity for long, and successful primary cell designs employ means whereby a *depolarising* action is included to absorb the gas as it is produced. The electrochemical process

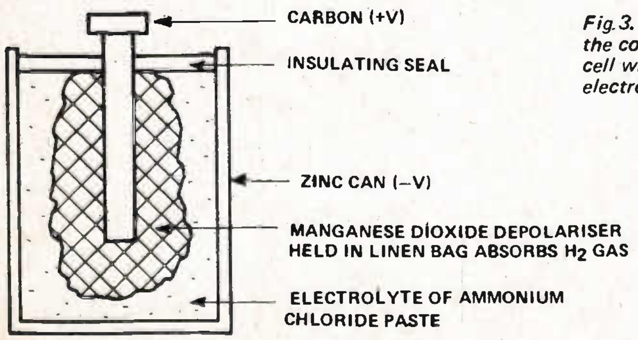


Fig.3. Cross section of the common tubular dry-cell which uses a paste electrolyte.

HIGH TEMPERATURE BATTERIES

also results in the material of one electrode being plated upon the other — zinc onto the copper in the Voltaic cell. Consequently, even though depolarising a cell enables the reaction to continue longer, the cell eventually stops producing electrical energy due to the lack of material on one electrode.

The so-called dry-cell that is used commonly in a flash-light or transistor radio is similar to the wet cell. The difference is that the electrolyte is used in a paste form. A central carbon rod (see Fig 3), surrounded with a manganese dioxide depolariser, is placed into a zinc cylinder filled with ammonium chloride paste. This is a modified form of a cell originally devised by Georges Leclanche in the latter part of the nineteenth century.

Other forms of battery cell exist — the Daniell cell (which is a Voltaic cell with added copper sulphate to depolarise the hydrogen), the Clerk cell (that uses zinc, mercury sulphate and mercury), and the Weston Standard cell are each historically important.

Cells incorporating depolarisers are not usually rechargeable in an efficient way because the depolarising action is not reversible. If a secondary rechargeable cell is desired, the design consists generally of little else than the two suitable electrodes immersed in an electrolyte. The lead-acid storage battery shown schematically in Fig 4, uses lead and lead-dioxide plates with dilute sulphuric acid as the electrolyte. The negative plate is made of a spongy form of lead to increase its surface area; the positive plate is coated with lead dioxide. When the cell is discharging, the lead and lead dioxide plates combine with the sulphuric acid to form lead sulphate, liberating water to the electrolyte, and removing sulphuric acid from the electrolyte. Eventually both plates become totally coated with lead sulphate and energy production ceases. The process is reversed in recharging — lead and lead dioxide reform on the plates and sulphuric acid is remade in the electrolyte.

Another commonly used storage battery is the nickel-iron cell invented by the Edison company. Its plates are oxides of nickel and iron immersed in potassium hydroxide electrolyte. Its advantages are lighter weight for a given energy stored and it is more robust than the lead-acid battery. Another feature is that its chemical cycle can be sealed — no vents are needed to allow gases to escape. It is, however, more expensive.

The lead-acid battery is so common that it is easy to assume that batteries of all forms would be similar. Nothing is further from the truth now that the high temperature batteries have been developed. They must operate at high temperature (300 – 500°C), are sealed and can have a solid electrolyte with liquid electrodes — an inside-out battery by the standards we have grown to accept over the past century of battery use.

Enter the high temperature storage battery

Just what prompts designers to breakaway from traditional ideas is always hard to define, but the idea to try storage batteries running at greater than ambient temperature probably arose out of experience with thermally regenerative calls which began back in 1961 in the U.S. Atomic Energy Commission, (AEC). It is also known that improved chemical reaction occurs at higher temperatures. Standard Oil, Ford Motor Co., General Motors and Argonne National Laboratory were each actively involved in high-temperature battery development from 1966 onward. These, plus a number of other groups who entered the field later, invested considerable finance into research for ways to provide more punch from a given weight and size of battery with the view to power-system smoothing and vehicle transport power applications.

A number of early design ideas were reported in glowing terms but few have resulted in continued interest right through to the marketing stage. Today the only battery now being considered seriously appears to be the sodium and sulphur electrode arrangement — it is the only one developed, rigorously tested in an electric vehicle, and about to be commercially produced at this time.

Most, but not all, high-temperature cells are electro-chemical arrangements involving chemical reactions but there is one approach — that of ESB Inc. in the U.S., for instance — that makes use of porous carbon plates to form a very large capacity capacitor when fused salts are run between the plates. Each specially made carbon plate, measuring about 150 by 300 mm, has an effective area of $10^5 m^2$! This design runs at around 250°C in order to keep the electrolyte (really a dielectric material) fluid in order that mobile ions are available.

The main contenders for large-scale battery storage are the traditional ambient temperature lead-acid units, nickel-cadmium, silver-zinc and zinc-air, and the sodium-sulphur, lithium-sulphur and lithium-chlorine high temperature designs. Figure 5 shows the theoretical merits of each type. Although there seemed the possibility that batteries using relatively exotic and specially compounded materials might provide a greater economic yield — lithium-selenium cells with sulphur and thallium additives in the cathode plates is one example — the cell that appears to have made it turns out to be one that is straightforward and uses abundant and easily refined elements; sulphur which is mined in an almost pure state and sodium that is extractable from sea water at a mere 30c per kilogram.

The lithium sulphur cell

Originally the greatest emphasis was on lithium-sulphur battery research. This was largely because on theoretical grounds it can pack the greatest amount of energy on a weight for weight basis. Estimates of the need for raw materials to make the batteries

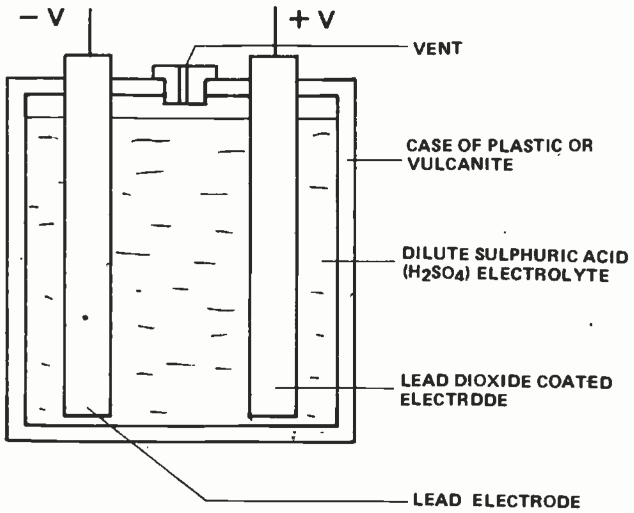


Fig.4. Schematic of the common lead-acid storage cell. They are made in flat parallel plate and tubular forms depending on the application.

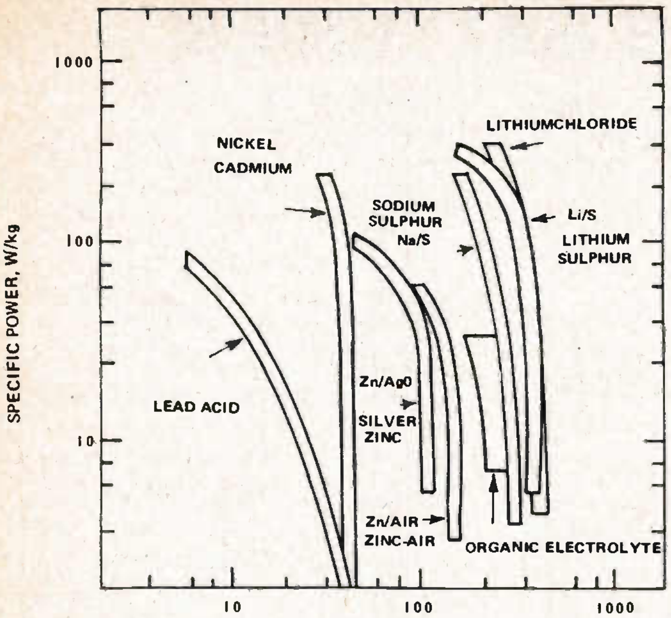


Fig.5. Comparative chart of the main forms of high-temperature battery designs.

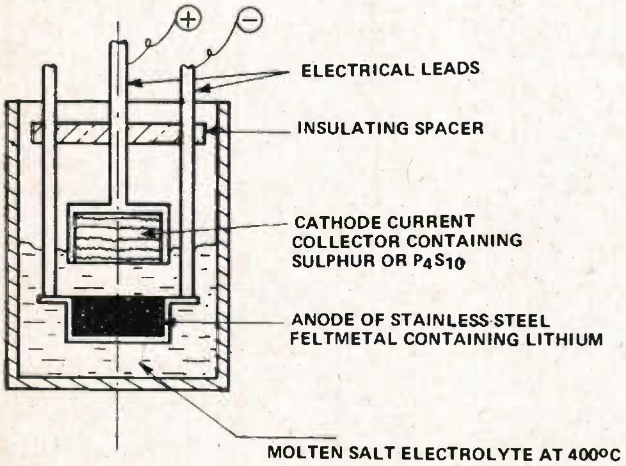


Fig.6. Rudimentary lithium-sulphur cell design for use in laboratory test chambers — it is unsealed and lithium reacts with moisture explosively. (Argonne Lab.).

required ran to 180 000 tonnes of lithium against a known supply of 24 million, so there would be no supply problem. It must, however, be extracted from rock mineral and current supply runs at only 3000 tonnes per year.

A typical early Li-S experimental cell is shown in Fig 6. Its design uses a molten salt electrolyte and special electrodes that are designed to hold the electrode materials when they become molten at the elevated 400°C temperature used.

Another design of so-called "super battery" with these electrodes is shown in Fig 7. It is how the production version might look.

An Argonne National Laboratory advanced design of cell is shown in Fig 8. It is a sealed cell, a must in practice — for lithium reacts explosively with water vapour — in which the lithium cathode is enclosed in a quite complex electrolyte. It shows the sophistication that was found necessary to obtain a workable cell with long life and close to theoretical power storage ability. Plans currently exist to use these cells in mammoth arrays to act as mains power back-up supplies.

Chlorine cells

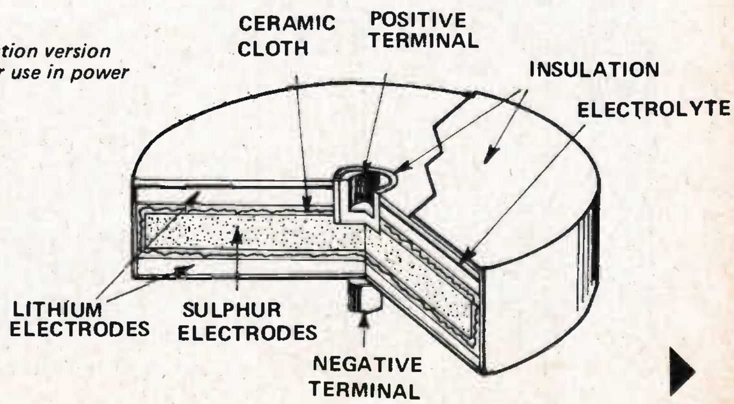
Heading the chart of potential high-temperature cells given in Fig 5 are those using chlorine gas as the positive electrode. This is because chlorine has a great affinity for electrons. In practice, although chlorine cells have been made and demonstrated — such as in the Vega Hatchback test car which used the Udylite Co. system shown in Fig 9 — chlorine is particularly nasty to handle due to its toxicity. Pumps and other ancillary equipment are also needed to circulate the gas through the zinc plates and this considerably adds to the cost and spoils the modular concept that is enjoyed with the lead-acid battery.

Sodium sulphur wins through

Although the Na-S cell combination is, in theory at least, less attractive to chlorine or lithium electrodes, the practice has now yielded a cell that will be cheap to build — the same cost for a lead-acid cell of the same weight but with as much as four times the storage capability. It uses cheap materials — stainless steel, sulphur, fibrous carbon and sodium.

In 1966 Ford Motor Co. reported that a Na-S cell had been produced in a laboratory glassware form. The following year the Electricity Council Research Centre, ECRC, situated near Liverpool in England, began its own programme of research leaning somewhat on what Ford had found. By 1970 their efforts had produced a prototype research design that could be further developed into a large-size traction battery. Two years after this an electrified Bedford delivery van — see Fig 10 — was used to put the Na-S traction battery through its paces. An authoritative report (made by Argonne staff and listed at end) of world effort compiled in late 1972 on super-battery research credited the ECRC work as the most advanced Na-S programme (and perhaps the best of all types?) for ECRC research workers had produced and used high-temperature cells in a practical situation. The ECRC battery was subsequently reduced in size in 1973, retaining the same storage capacity. This year (1974) they combined with the Chloride Group Ltd. to form a company, Chloride Silent Power Ltd., who will ready the first production line for the manufacture of commercial Na-S cells by licensed companies in a year or so.

Fig.7. Envisaged production version of Li-S cells for modular use in power system load-levelling.



HIGH TEMPERATURE BATTERIES

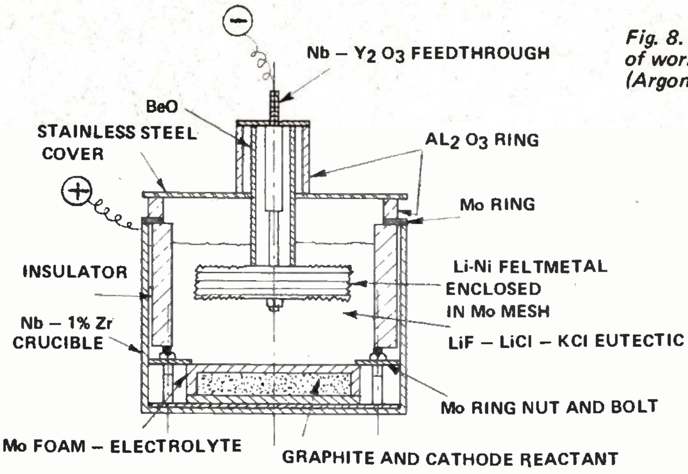


Fig. 8. An advanced form of workable Li-S cell (Argonne Laboratory).

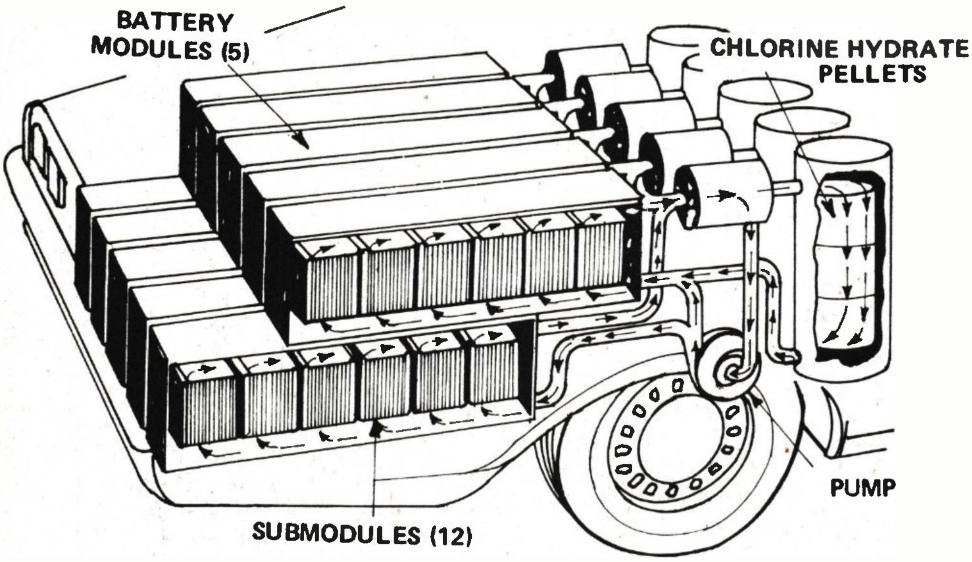


Fig.9. Layout of chlorine-zinc battery installation in a vehicle.

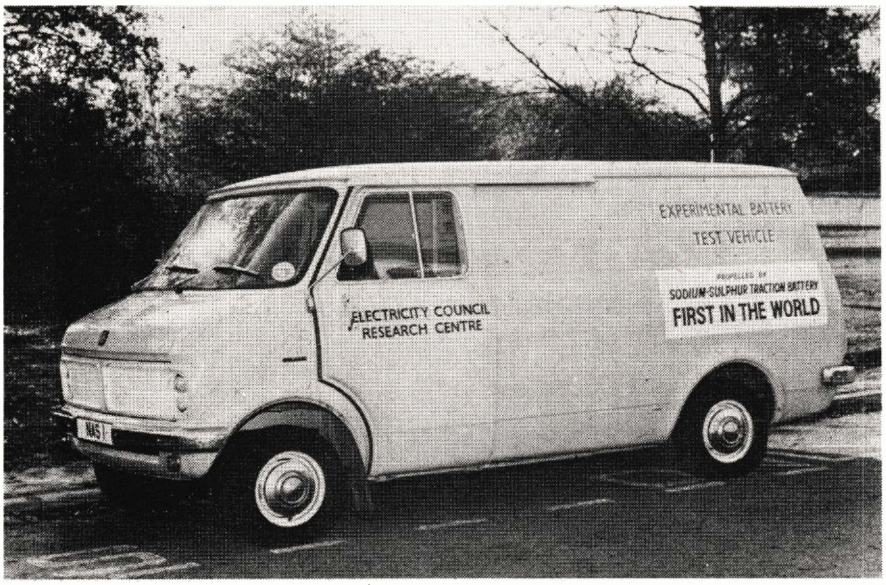


Fig.10. This modified Bedford van was run around the streets of London to prove the first large battery of Na-S high temperature cells.

Chloride Silent Power design is inside-out

Most batteries use a liquid electrolyte and solid electrodes. Not so the Na-S batteries to be marketed by Chloride Silent Power. Figure 11 shows a schematic cross-section of the cell. A stainless-steel case, the current collector, contains sulphur which is absorbed in fibrous carbon material. In the middle of this is a tube of Beta-alumina ceramic which contains pure sodium.

The ceramic tube serves to separate the sodium from the sulphur and performs as an electrolyte enabling ions to be transferred between the electrodes and preventing the electrode liquids mixing. Although the highest melting point of either of the electrodes is only 119°C the unit must be operated at at least 250°C to ensure that the reactant product (sodium sulphide) remains molten. If this is not kept fluid the electrical action ceases due to onset of polarisation because of the solids formed on the electrode surface.

Porous carbon is used to contain the molten sulphur (sulphur is a good insulator) and provides better electrical contact.

Another practical problem to be considered was that the amount of sodium needed requires more volume for a given amount of sulphur so a reservoir has been engineered to accept the excess sodium as it is liberated back from the sulphur on discharge. Figure 12 shows a typical cell used to drive the Bedford van. An efficient seal is vital for sodium is also explosive when contaminated by moisture.

The open-current voltage is 2.08 volts falling to 1.75 volts with an average load. The cell shown weighs 330 gm and stores 30 Ah (52.5 Wh). Discharging at 10 amps it holds up at 1.75 volts for close to 3 hours.

In the first demonstration battery 24 (later up to 48 in the same space) such individual cells were packaged into a module, as shown in Fig 13. Forty modules were then wired together to provide a unit delivering 100 V with 50 kW/h capacity in a volume of 1.52 m^3 (including heaters and insulation). The all up weight was 800 kg. The unit thus provided 63 W.h/kg and 33 $kW.h/m^3$.

At the time of our visit to Chloride Silent Power (August 1974) some details of a new projected design had just been released. It will use larger individual cells that lie horizontally as shown in Fig 14. It is envisaged that this unit (for which many of the details are closely under wraps) will store the same 50 kW/h but with a weight of 250 kg and a volume of 0.25 m^3.

Keeping the batteries hot

Maintaining these batteries at the 250°C-400°C needed may seem a formidable waste of power. In practice, however, the heating only consumes 500 W of the 50 kW available. Quite thin thermal insulation is adequate.

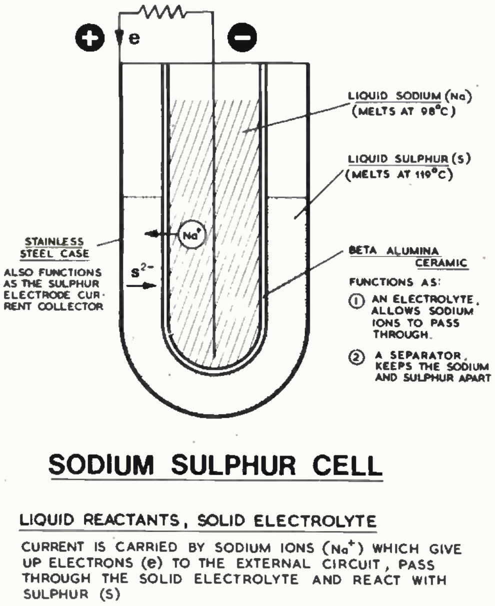


Fig. 11. Cross section schematic of the inside-out Na-S-cell.

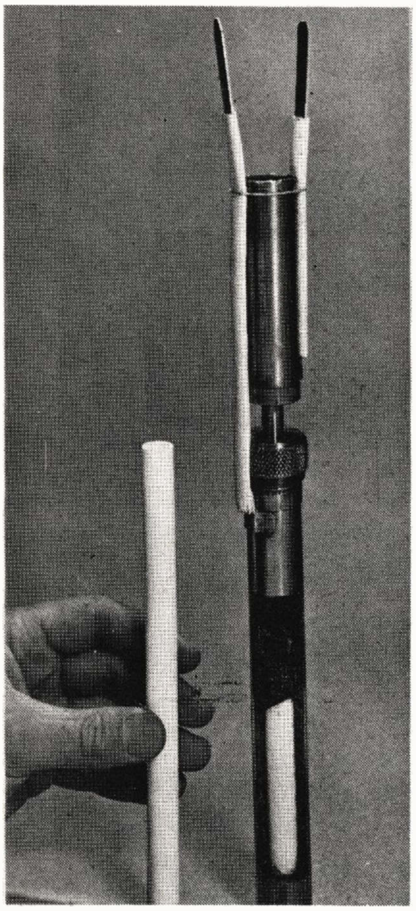


Fig. 12. Actual cell of ECRC Na-S cell showing the Beta-alumina tube used as a solid electrolyte.

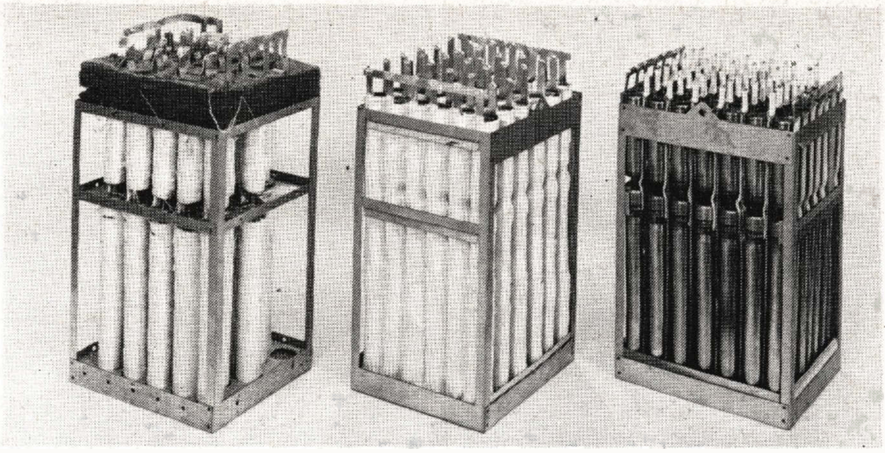


Fig. 13. Three stages of development increased packing density of the ECRC cells into the battery module. They must be electrically insulated from each other at an operating temperature of around 350°C.

Once the unit is hot and operating, its own losses provide enough heat to keep the temperature up (and even provide some external heating if need be). To get the system going, however, an auxiliary heater is needed inside the insulated container. This is used to heat up the unit from the mains, usually via the charger provided to charge the cells. When the cells go cold the electrical action ceases without defect. Upon heating the energy again becomes available. A newly made cell is a primary cell and, therefore, can provide the current on demand once heated — eliminating the need to precharge it before use.

Although there was some initial concern that the cells in a module would not share the heat loss evenly, tests have since shown that there is no fear of thermal instability and that the cells can be packed as close as is electrically convenient. Interconnections are made using series paths for safety reasons: cells can fail in the short circuited condition which could damage the bank.

Safety

Due to the high temperature and toxic nature of sodium the designers have been careful to study the various mechanical failure mechanisms of a unit. Although risk does exist — as it also does with the lead-acid unit — the Na-S cells appear safer than currently acceptable lead-acid units. The main safety risk of a car battery is not considered to be the material toxicity but the sheer mass of the battery in high-g collision conditions.

The future

The projected design of this battery reaches the 200 W.h/kg estimate needed for economic power-system purposes so we might well see the new batteries being deployed on power systems in the not too distant future. The case for the electric car is also made stronger. Once the production volume rises the cost of a given energy capacity will fall to less than for lead acid batteries.

Clearly, high temperature batteries offer little for small energy needs, especially where the demand is for infrequent on-off use, but in transport and power uses the potential is vast.

Further reading.

"Lithium/sulfur batteries for off-peak energy storage." M.L. Syle et al. Argonne National Laboratory, Argonne, Illinois, 1973 — available from National Technical Information Centre, U.S. Department of Commerce, 5285 Port Royal Road, Springfield. Va. 22151.

"Sodium sulphur batteries for electric vehicles." Research Council Research Centre, Capenhurst, Chester. CHI 6ES. 1974.

"Battery power for electric vehicles." M. Barak "Electric Vehicles" part 1, Dec. 1973, part 2, March 1974. ●

Fig. 14. Design model of projected 50 kWh Na-S module.

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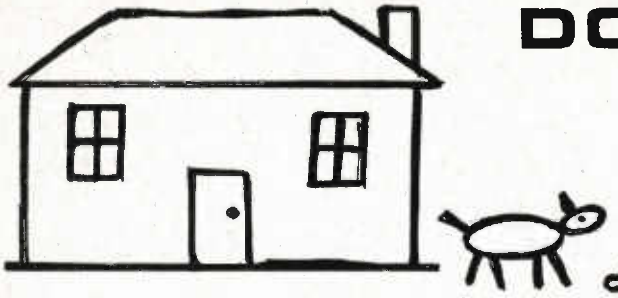

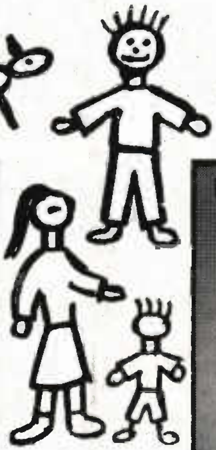

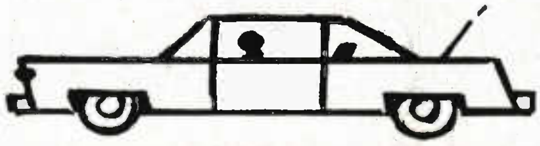

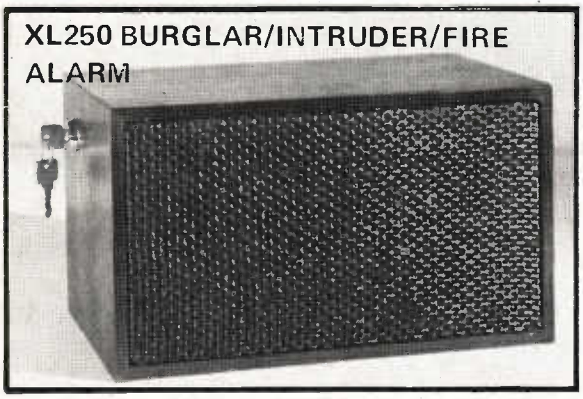

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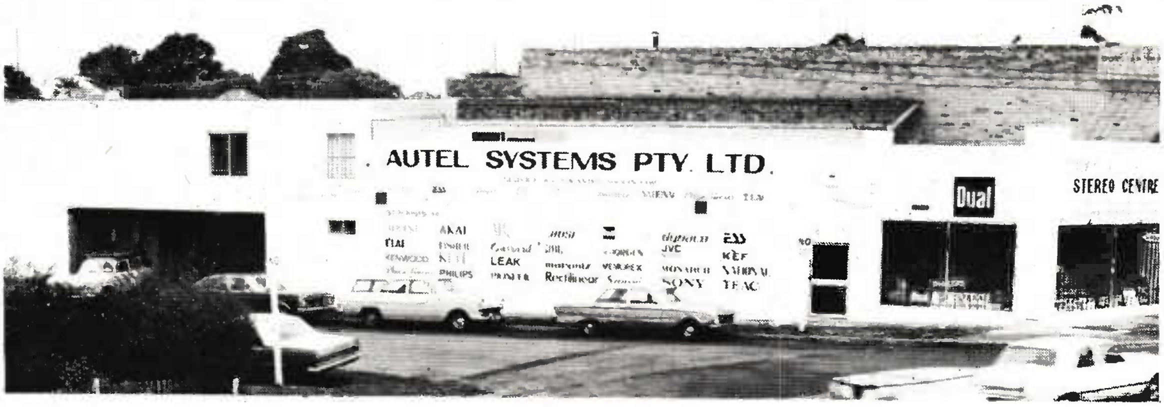

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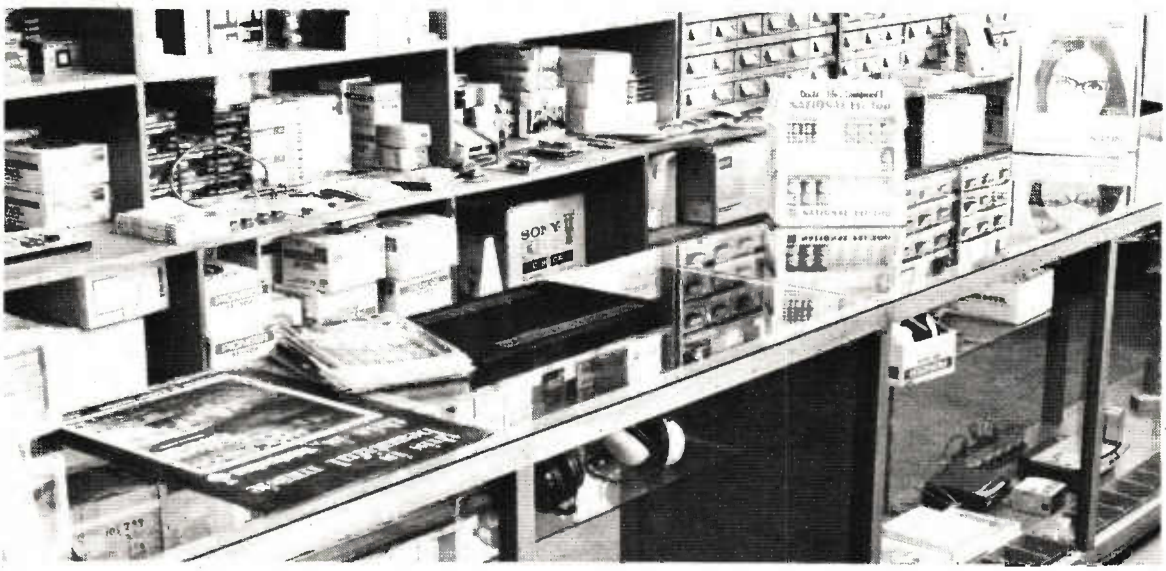

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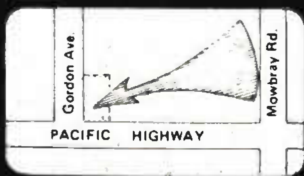

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THE LM380N INTEGRATED CIRCUIT

How to use the most versatile audio IC yet made. J. Brian Dance explains.

MANY audio power-amplifier integrated circuits are now available and each has its own particular characteristics. Of these, the type most suitable for use by a beginner is the LM380N (unless a high power level is required). Very few additional components are required and internal protective circuits are included which will usually prevent damage if the IC is mis-used.

Internal Protection

The LM38ON contains a circuit which protects it from damage if the output leads are accidentally shorted together. In unprotected devices, this would result in a very high output current and permanent internal damage, but protection circuitry in the LM380N limits output current to about 1.3 A. This is a most valuable feature, since one can easily short the output when experimenting with the device.

Other internal circuits prevent the device from being damaged by excessive thermal dissipation. As the silicon chip containing the circuit heats up to about 150°C, the output current is automatically shut off and internal dissipation reduced. As soon as the device cools, it operates normally again. This protection enables one to employ a smaller heat sink than would otherwise be needed. (in most applications no heat sink at all need be used).

About the only ways in which one is likely to damage an LM38ON (other than using a hacksaw!) are by applying a supply voltage exceeding the maximum permissible value of 22 V or by applying a supply voltage of reversed polarity. Further advice about these points will be given later in this article.

Encapsulation and connections

Connections of the LM380N are shown in Fig. 1. The device is encapsulated in a standard 14 pin dual-in-line plastic package. One can solder directly to the pins of the device, but if used experimentally, it is much more convenient to use a 14 pin socket.

Basic Circuit

The basic circuit for using the LM38ON is shown in Fig.2. Its simplicity is most striking.

The input signal can be fed to the non-inverting input at pin 2. If the mean potential of the input signal is equal to the ground potential, no capacitor in series with the input is required. Otherwise a 0.1 μF capacitor should be placed between the source of the input signal and pin 2.

The potential at pin 8 has an average value of about half of that of the positive supply line. A series capacitor, C1, must therefore be employed to prevent a steady current from flowing from pin 8 through the loudspeaker coil. Capacitor C1 must be adequate to pass the lowest bass frequencies one requires to the loudspeaker. If a smaller value than that shown is used, the bass response will suffer if a reasonably good quality loudspeaker is connected. On the other hand, however, a somewhat smaller capacitor may be used for C1 if a small, cheap loudspeaker is used, since the latter will not be able to reproduce low bass frequencies in any case.

It is advisable to include capacitor C3 if the leads between the LM38ON and the power supply capacitor are more than 50 or 60 mm in length. This capacitor should be soldered directly between pin 14 and the grounded pins for optimum stability.

The components R1 and C2 may be included to prevent a low amplitude oscillation (5 MHz – 10 MHz) which can occur during the negative swing into a high current load. However, R1 and C2 are unnecessary in many applications.

The comments about the components shown dotted in Fig.2 apply to all circuits discussed in this article.

Power Supply

The LM38ON will be destroyed almost instantaneously if the power supply is accidentally connected with a reversed polarity. Readers experimenting with the circuits discussed in this article may therefore wish to connect a small diode (such as the IN4001) in the positive line. This diode (D1) allows current to flow to the LM380N only in the desired direction. It is essential that it is connected It is essential that it is connected the

LM 380 FEATURES

* Ultra-simple circuits
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* Thermal overload protection
* Low quiescent power drain
* High input impedance
* Low distortion
* 40 dB hum rejection
* Self-centreing bias
* Ideal for the beginner or the professional.

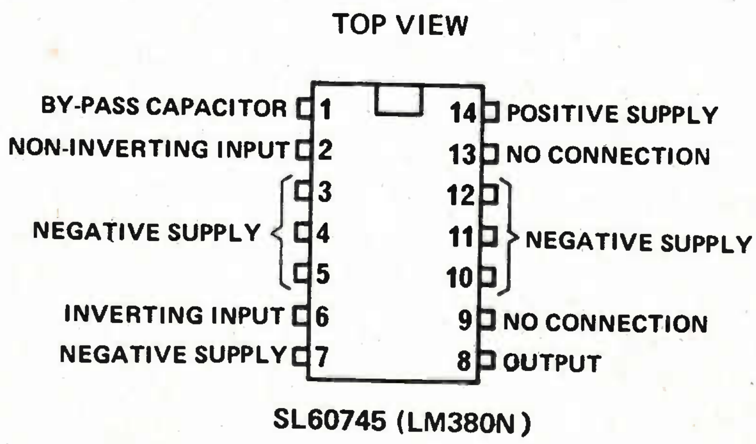


Fig. 1. LM380N connections.

correct way around. It may be removed when experiments have been completed – if there is no longer any possibility of the power supply leads being incorrectly connected.

It is wise to use a power supply voltage not exceeding 18 V for the LM38ON variations, etc. below the absolute maximum permissible value of 22 V.

Output Power

All LM38ON devices can feed up to at least 2.5 W of audio power into an 8 ohm loudspeaker when operated from an 18 V supply at a total harmonic distortion of about 3%. At 2 W output, the total harmonic distortion is about 0.2% when using an 18 V supply. This value of 0.2% is typical of most operating conditions.

The device will function satisfactorily at lower supply voltages, but the maximum output power is considerably reduced. Reasonable volume can be obtained when an 8 V power supply is employed with a 4 ohm loudspeaker in a portable radio receiver.

The graphs shown in Fig.3 provide more detailed information about the variation of the maximum output power with the supply voltage, V_s. The 3% distortion line corresponds approximately to the onset of waveform clipping.

It can be seen that more power can be obtained with an 8 ohm loudspeaker than with either a 16 ohm or 4 ohm component. However, at low supply voltages, a 4 ohm loudspeaker may give the best results.

Heat Sinks

Most readers will find it unnecessary to use a heat sink with the LM38ON unless they use a loudspeaker of less than 8 ohms impedance or require maximum power output. If a heat sink is not used in applications where one is really needed, the worst that can happen is that the internal protective circuitry will temporarily shut down the device.

The LM38ON device can itself dissipate up to 1.25 W when operated without any heat sink provided the ambient temperature does not exceed 25°C. At higher temperatures, this value should be de-rated, as shown in Fig.4. Note that this is the power dissipated in the device itself, not the output power delivered to the loudspeaker.

As shown in Fig.3(a), if a 16 ohm loudspeaker is used, the power dissipated in the LM38ON will not exceed about 1.25 W unless the power supply voltage exceeds about 20 V. Thus no heat sink is needed with a loudspeaker of this impedance.

Similarly, the 1.25 W level will not be exceeded with an 8 ohm loudspeaker unless the power supply voltage exceeds 14 V or so. In practice one can use a power supply of 16 V or so with an 8 ohm loudspeaker without any heat sink, since the maximum dissipation will occur only for a very short time (unless one likes listening to sine waves!). A heat sink is desirable with power supply voltages of 18 V or more with such a loudspeaker.

For 4 ohm loudspeakers heat-sinking is necessary. The level of 1.25 W can be reached even with a 10 V supply. A heat sink should therefore be used if the supply voltage exceeds about 11 V.

If a heat sink *is* to be used, the centre pins 3,4,5 and 10,11 and 12 on each side of the device should be soldered to a few square inches of copper foil. This copper foil can be fixed to the circuit board.

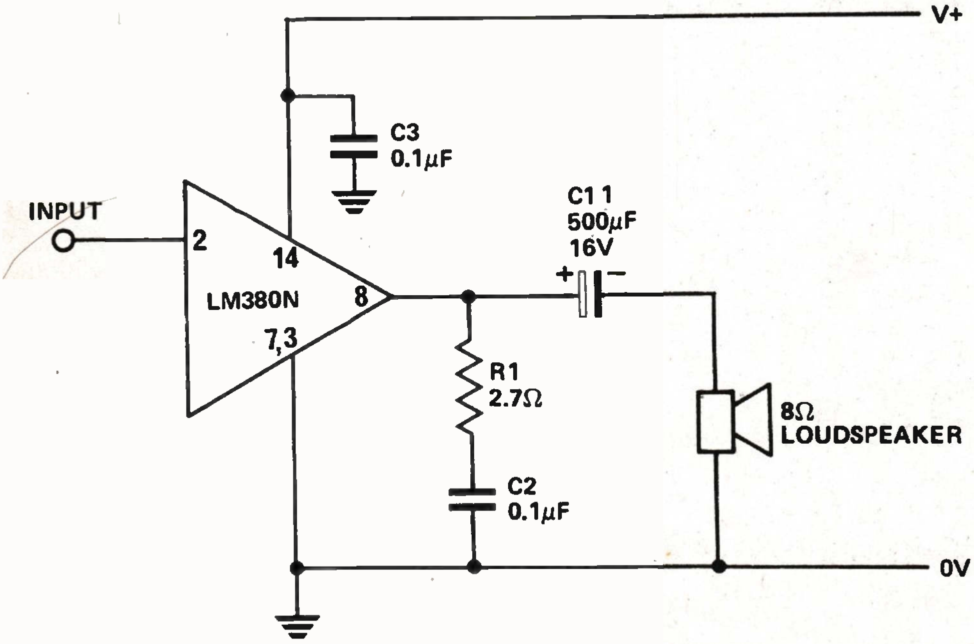


Fig.2. LM38ON basic amplifier circuit.

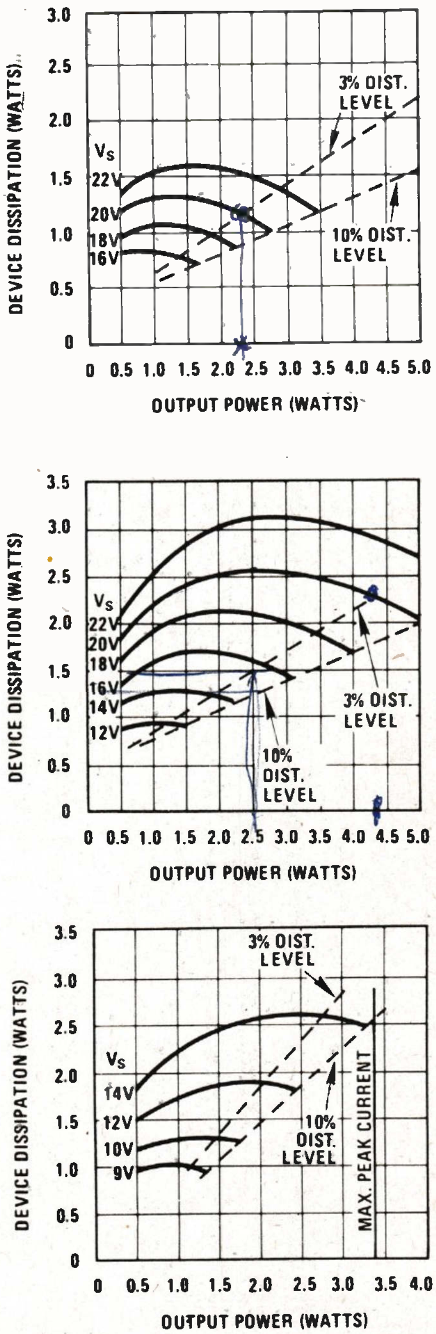


Fig.3. Device dissipation and output power at various supply voltages for (a) 16 ohm, (b) 8 ohm and (c) 4 ohm loads.

THE LM380N INTEGRATED CIRCUIT

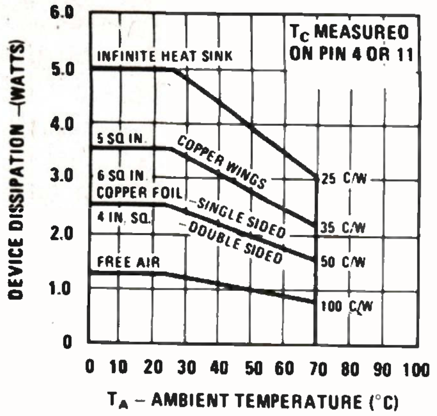


Fig.4. Maximum device dissipation at various ambient temperatures, with and without heat sinking.

As shown in Fig. 4, if the centre pins are connected to 200-300 sq mm of copper foil, the internal dissipation can be as high as 2.5 W at ambient temperatures of up to 25°C. With a very large area of copper foil (an 'infinite' heat sink), the device dissipation can be up to 5 W.

Input Circuit

The input signal is normally fed to the non-inverting input at pin 2 of the device. In this case the inverting input can be left unconnected.

Alternatively, the input signal can be fed to the inverting input at pin 6. In this case a capacitor or resistor should be connected between the non-inverting input and the negative (earth) line to prevent possible instability. Such instability can arise through stray coupling from the output to the non-inverting input. If the input signal is obtained from a high impedance source, a small capacitor (a few hundred pF) between pin 2 and ground is preferable. A resistor approximately equal to the signal source impedance should be connected between pin 2 and ground for signal sources of moderate impedance, whilst pin 2 may be connected directly to ground when the signal source feeding pin 6 has a low impedance. The input impedance is 150 k.

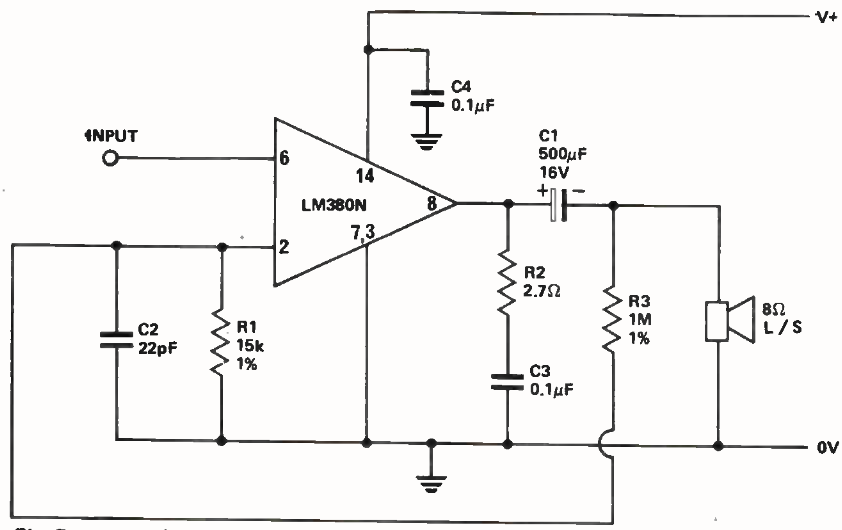
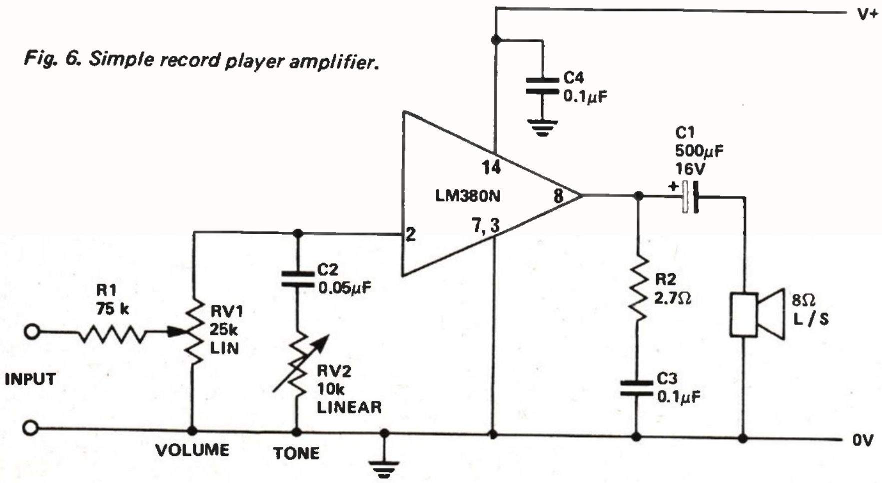


Fig. 5. Increased gain can be obtained by using this circuit.

Fig. 6. Simple record player amplifier.



Hum

The effect of hum and noise on the power supply line can be reduced by connecting a capacitor from pin 1 to ground. For example, a capacitor of about 5 μF will provide about 40 dB hum rejection, whilst a smaller capacitor will provide a smaller (but very useful) amount of hum rejection. No connection is normally made to pin 1 when a battery power supply is used.

Gain

The voltage gain of the LM38ON is fixed at 50 (or 34 dB) by the values of the feedback resistors in the device. Thus an input of 80 mV rms will produce an output of 2 W in an 8 ohm load.

The incorporation of the feedback resistors in the integrated circuit reduces the number of external components required, but limits the versatility of the device, since the gain cannot easily be altered. One way of obtaining a higher gain from the LM38ON involves the use of the type of circuit shown in Fig.5. This has a voltage gain of 200 (46 dB) with the values shown.

In this circuit, positive feedback is taken from the output through R3 to the non-inverting input at pin 2. The capacitor C2 produces a high frequency roll-off. The maximum gain obtainable using this type of circuit is about 300, since any attempt to obtain a higher gain will result in oscillation.

Record Player Amplifiers

A simple record player amplifier is shown in Fig.6. This is essentially similar to the basic circuit of Fig.2, but a volume control has been added in the input circuit together with a 'tone control' which reduces the high frequency response.

The circuit of Fig.7 shows a 'common mode' volume and tone control circuit. The advantage of this type of circuit is that the input impedance is much higher than that of the circuit of Fig.6. The whole of the input signal is fed to the non-inverting input at pin 2 and as the value of RV2 is reduced, more of the input signal appears at the inverting input at pin 6 to partially cancel the signal at pin 2.

In the circuit of Fig.7, the tone control consisting of RV1 and C1 can be omitted, if desired. The smaller the value of RV1 the greater the amount of the high frequency signal which passes through C1 to the inverting input to reduce the high frequency response. The effect of this tone control is shown in Fig.8.

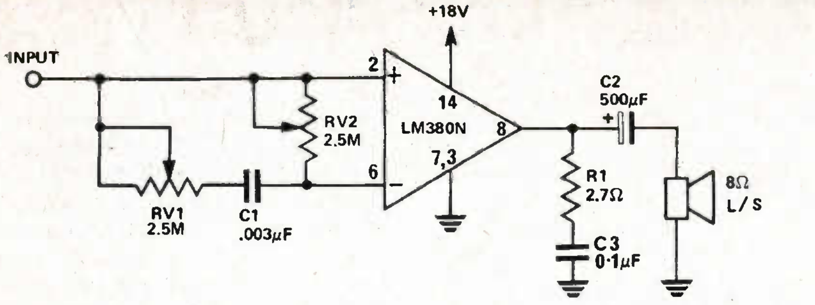


Fig. 7. High input impedance circuit with "common mode" volume and tone control.

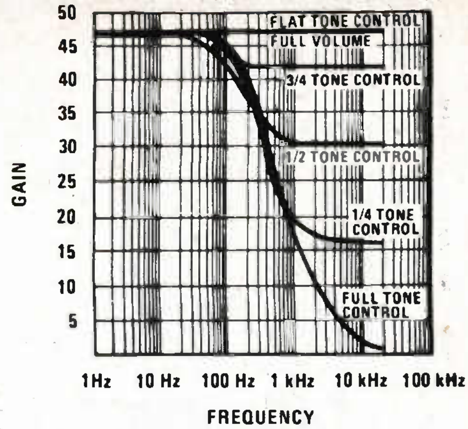


Fig. 8. The effect of the tone control circuit shown in Fig. 7.

The circuit shown in Fig.9 has the standard RIAA record player equalization characteristic. This is produced by the feedback loop.

High Input Impedance Circuit

An amplifier with a high input impedance can be constructed by placing a field effect transistor (FET) in the input circuit of the LM38ON. For example, the circuit of Fig.10 has an input impedance of about 22 megohm at audio frequencies, falling to about 3.9 megohm at 20 kHz. The gain is typically 50.

Bridge Amplifier

Two LM38ON amplifiers may be connected in a bridge circuit of the type shown in Fig.11 when more power is required. In this circuit one can obtain twice the voltage swing across the load which a single LM38ON would provide, since the output voltage of the one amplifier increases as that of the other decreases. One might therefore expect to obtain an increase in output power of about four times that of a single LM38ON driven from the same supply. In practice, however, the power dissipation in the devices may limit the output power obtainable. The curves of Fig.12 for an 8 ohm load show the dissipation in each LM38ON at various levels of output power and supply voltage. More power can be obtained with a 16 ohm load with the bridge circuit, a little over 6 W being obtainable with an 18 V supply at a dissipation of 2.1 W in each LM38ON.

Economical Dual Supply

A very different type of application is shown in Fig.13. A dual voltage supply balanced with respect to ground is obtained from a single supply using this circuit. If the input voltage is 20 V, the outputs will be ± 10 V and a change in one of the output current of 100 mA will cause only a 2% change in that output voltage.

Potentiometer RV1 enables the two outputs to be accurately balanced with respect to ground. It is shown dotted,

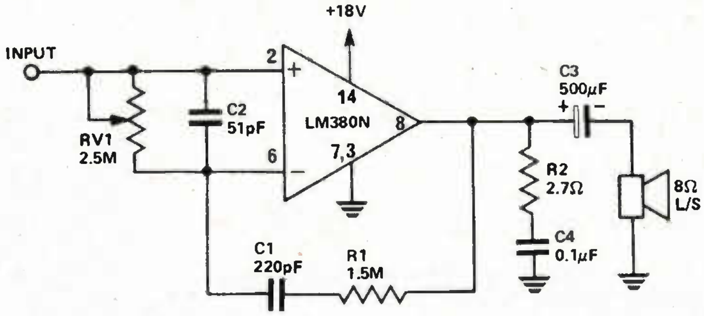


Fig. 9. The RIAA record player characteristic can be obtained with this circuit.

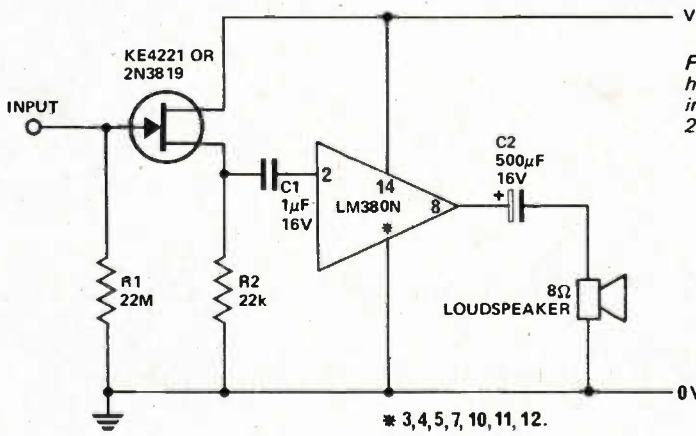


Fig. 10. This circuit has an input impedance of about 22 MΩ.

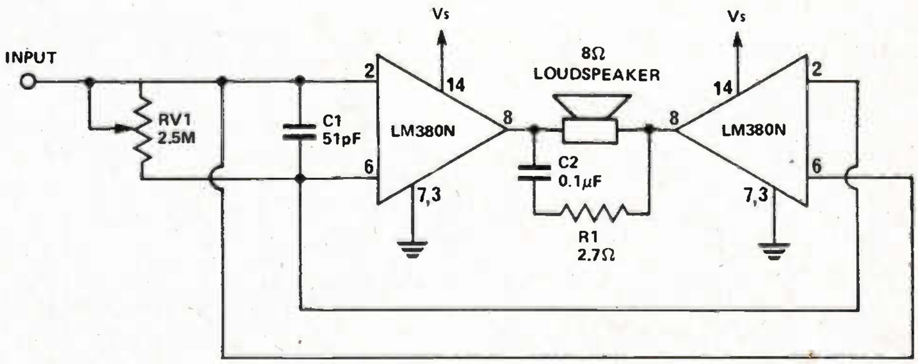


Fig. 11. Bridge amplifier.

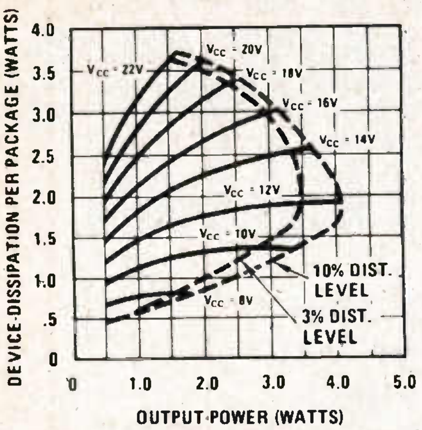


Fig. 12. Output power and dissipation of circuit shown in Fig. 11

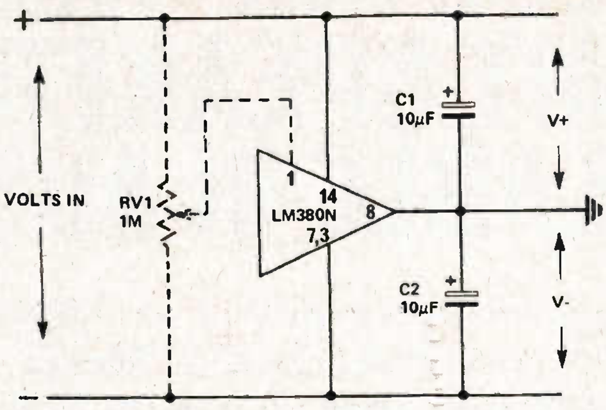


Fig. 13. Balanced output power supply

since it can be omitted if accurately balanced supplies are not required.

If a short circuit occurs, the LM380N output current automatically limits at about 1.3 A until thermal shut down occurs when the chip becomes hot or until the short circuit is removed. This obviously applies only when the short circuit is from either output to earth.

One advantage of this circuit is that little current is taken from the input when the output current is small.

Simple Intercom

A simple intercom system using only one LM38ON is shown in Fig. 14. The transducers are used as a microphone or as a small loudspeaker, depending on which station is the 'listener' and which is the 'talker'.

The transformer ratio of 25:1 multiplied by the voltage gain of the LM38ON produces a loop gain of 1250. A common mode volume control is employed. A series resistor at the remote station can reduce the volume there.

The switch S1a is normally ganged to that of S1b and is 'biased' so that it automatically springs back to the 'listen' position at the master station. Any speech signals at the remote transducer are then heard at the master unit. The operator at the master unit holds the switch S1 in the 'talk' position if he wishes to speak with the person at the remote unit.

A constructional projects based around the LM380 IC is published elsewhere in this issue. ●

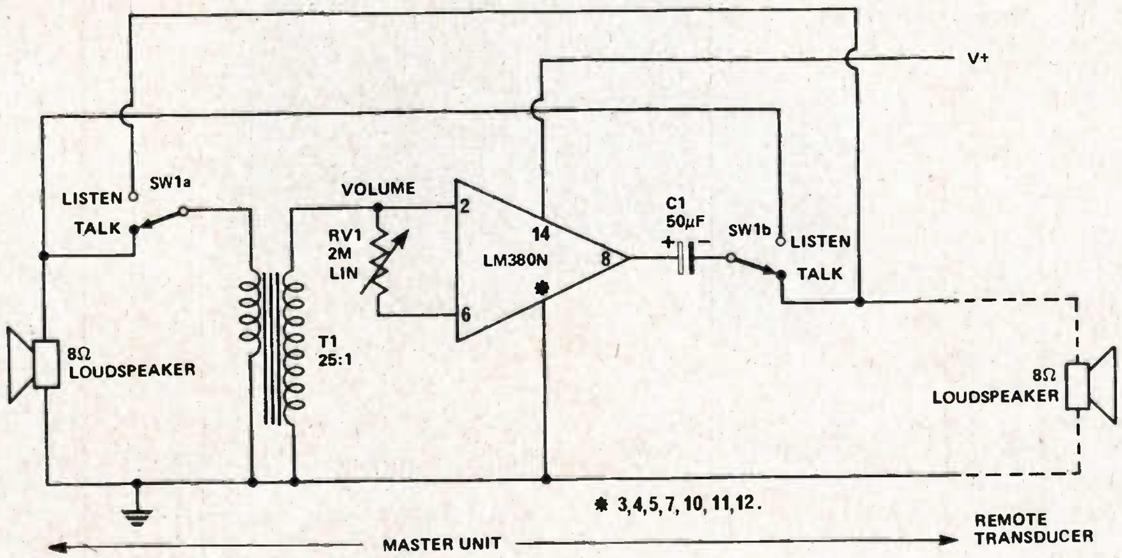


Fig. 14. Simple intercom circuit.

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My present cartridge is ....

My listening room dimensions are approximately ....

I judge my listening room to be ☐ bright ☐ average ☐ dead.

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SIMPLE STEREO AMPLIFIER

ETI PROJECT 429

Ideal beginner's amplifier suits simple record players.

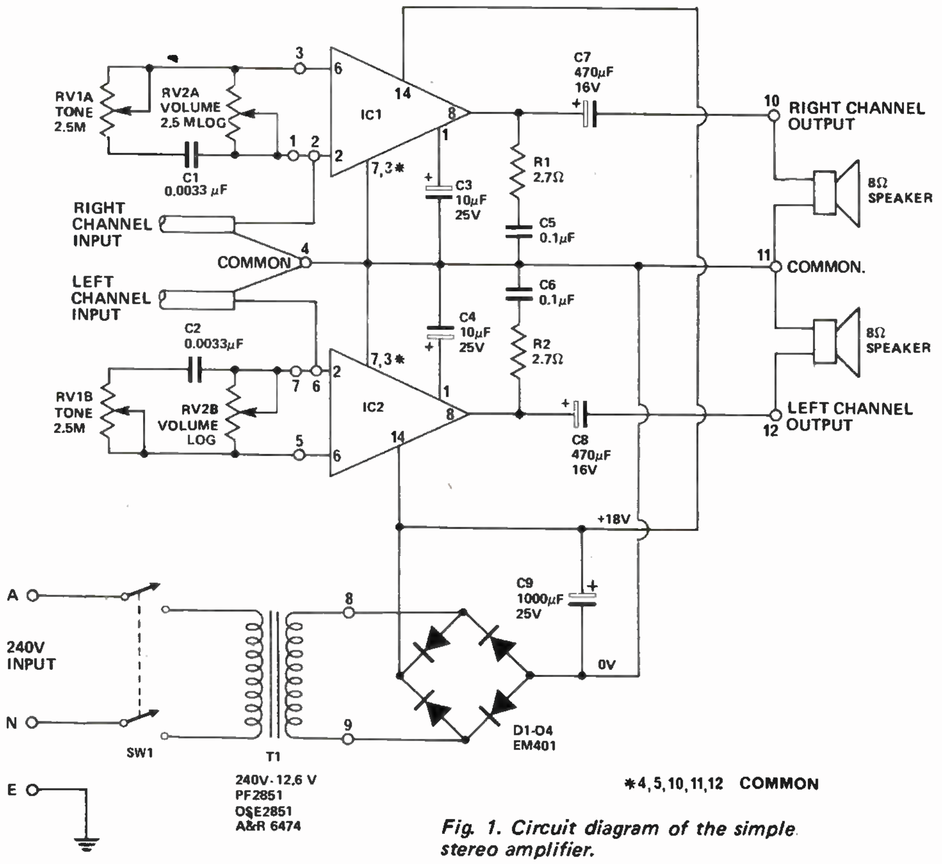


Fig. 1. Circuit diagram of the simple stereo amplifier.

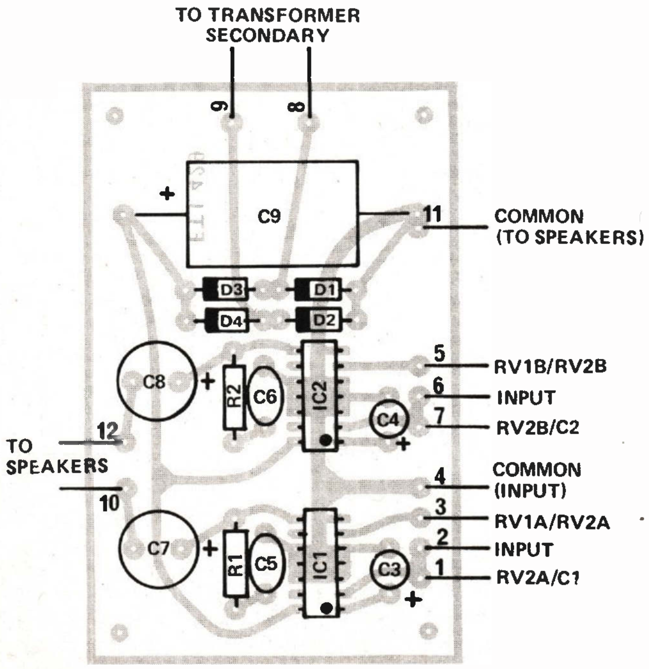


Fig. 2. Component overlay.

THIS SIMPLE stereo amplifier uses two LM380 IC's (or the SL60745's of our special offer), and a minimum of external components, it can easily be assembled in only one or two evenings. It is designed to match the *crystal* cartridges found on most simple record players and gives surprisingly good results.

CONSTRUCTION

Check the orientation of the ICs on the PC board with the aid of the component overlay and solder them in position first of all. Next cut four heatsinks from shim copper or tinplate as illustrated in Fig. 3 (a rolled out tin can will do to make these).

Tin the tabs of the heatsinks and solder one to the centre three pins on either side of each IC.

Next mount the four diodes and the electrolytic capacitors, again checking orientation, as these devices are polarity conscious. Use shielded leads for the connections to the pickup cartridge and twisted pairs to the potentiometers.

Mounting position is not critical — a general rule of thumb is to keep input circuitry away from strong ac fields such as found close to power transformers and motors. Keep all leads reasonably short and away from moving parts likely to foul them. Additionally keep the power transformer well away from the pickup arm and its signal leads.

If you mount the volume and tone controls as we have, on a wood base board, solder an earth wire to the cases of the pots. This will stop the amplifier buzzing every time you adjust the controls.

For a description of circuit operation, refer to article on the LM380N elsewhere in this issue.

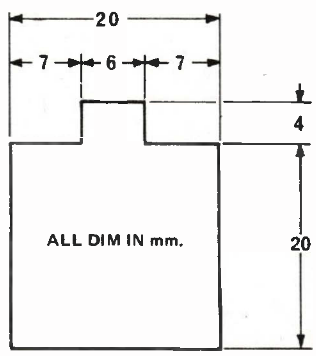


Fig. 3. Dimensions for the IC heatsinks. One is soldered to each side of the IC — to pins 3, 4, 5 and 10, 11, 12.

SPECIFICATIONS ETI 429

Input Sensitivity	200 mV
Input Impedance	150 k
Output power	2.5 W RMS / channel
Distortion	0.2%
Bandwidth	100 kHz (tone control flat)
Loudspeaker impedance	8 ohm or 15 ohm

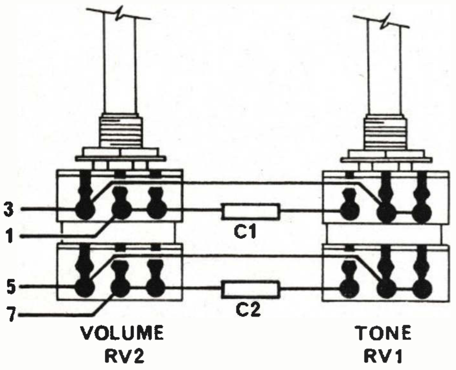
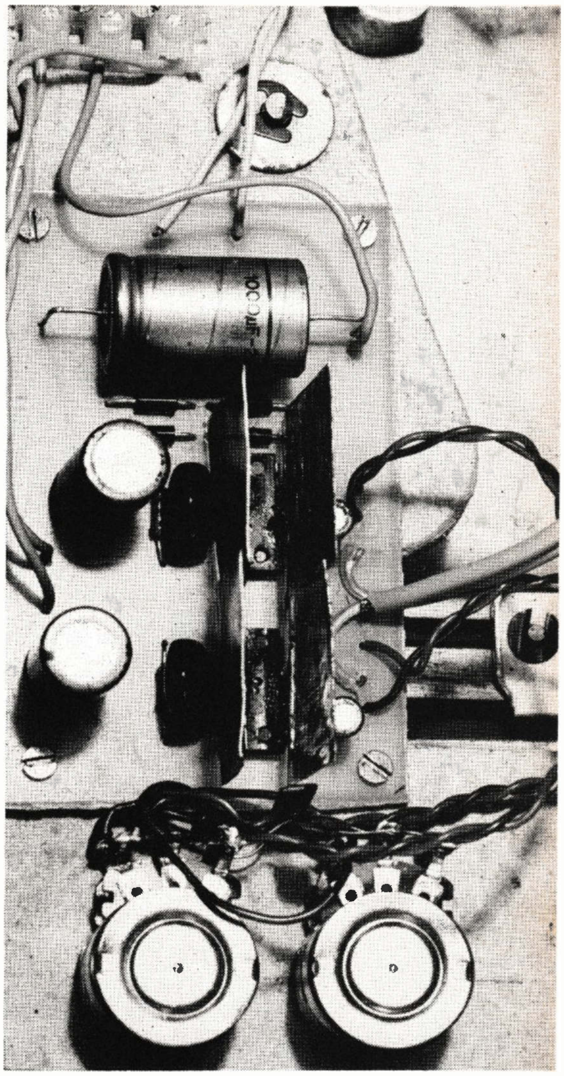


Fig. 4. Wiring to the volume and tone potentiometers.

PARTS LIST ETI 429

R1,R2	Resistor	2.7Ω ½W, 10%
C1,C2	Capacitor	0.0033μF, green cap
C3,C4	"	10μF, 25V electrolytic
C5,C6	"	0.1μF, green cap
C7,C8	"	470μF, 16V electrolytic
C9	"	1000μF, 25V electrolytic
D1,2,3,4	Diode	EM 401
RV1	Potentiometer	2.5 M LIN Dual
RV2	"	2.5 M LOG Dual
T1	Transformer	240V—12.6V, 0.15A PF2851, A&R 6474, DSE2851 or similar
SW1	Switch	DPST 2A 240V
PCB ETI 429		

Three core mains flex and plug, speakers (8-15 ohm), hookup wire, knobs, 3 way mains terminal strip.



The completed amplifier fitted below a conventional record player. Transformer (not shown) is mounted well clear of signal leads.

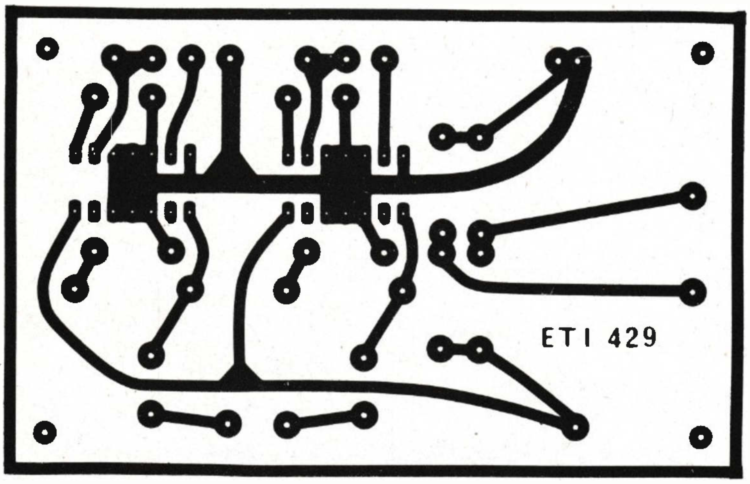


Fig. 5. Printed circuit board. Full size 97 x 61mm.

eti READER OFFER

UPRATED LM380N IC'S – TWO FOR $3·50

Limited to one thousand IC's only

Earlier this year we offered a limited quantity of audio IC's at a fraction of their normal price.

All sold out within the first three posts!

This month we have another equally attractive offer.

We have obtained a limited quantity of the SL60745 version of the LM380N IC.

These devices have been manufacturer-selected to operate on 22 volts (rather than the normal 20) and maximum power output (with adequate heatsink) is a full six watts!

They are completely interchangeable with the standard LM380N in all circuits and projects — and have identical specifications except that they are higher rated.

(Normal LM380's are readily available from kitset and component suppliers — in fact we notice that Dick Smith Electronics is offering them at a special low price in this issue).

To give as many as possible the chance to purchase these low-priced IC's we are restricting sales to a maximum of four IC's per reader. Also to assist our country readers a small quantity will be reserved for late applications.

Send your cheque or postal order together with a normal sized stamped (10 cents) addressed envelope to the address shown on the coupon. If you don't want to cut up your magazine just draw a similar version of the coupon and send that instead.

Please, please allow at least three weeks for delivery — everything they say about the Post Office is true!

To: **SPECIAL IC OFFER**
Electronics Today International
15-17 Boundary St, Rushcutter's Bay, NSW 2011.

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Please find enclosed my cheque/Postal Order for $3.50/$7.00 for two/four uprated LM380N ICs.

Numbers required ☐ ☐

Sleek, sheer soundpower. Cambridge Audio Integrated Amplifier. No fat, no frills. Just 5½ cms deep – but inside a massive toroidal mains transformer. Rated 35W it exceeds 45W effortlessly. All virtually distortion-free. In fact less than 0.05% at 1 Khz at all powers to full power – and crossover distortion almost non-existent. The sound? Incredible low frequency response at high levels. Hugely forgiving for boisterous speakers. Separate outlet uniquely sensitive for tape volume.

Computer-safe
Overload is impossible. Fail safe protection computes three ways – pre-amp analog on gain control; automatic output monitor; intricate double – fusings.

After this, other amps look clumsy.... and sound it.

International experts hail Cambridge Audio equipment as a triumph of intelligent design, and quality without compromise . . . "in the highest rank". For instance the matching Transmission Line Speakers are unique in their use of a long hair lambswool damped tapered labyrinth. The result is so rich and natural it has to be experienced to be believed.
This is truly ultimate sound – by specialists, for enthusiasts.
But the most remarkable thing is the cost: literally about half what your ear hears.

Cambridge Audio

For people who listen to music . . . naturally

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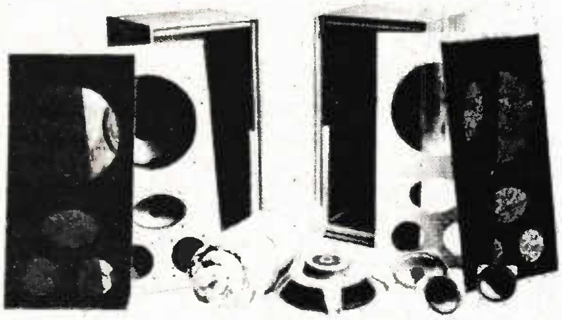
PRE-FAB HI-FI PRODUCTS
....the speaker kit specialists

If you want a job done properly-do it yourself.



Incredibly, more than half the money you spend on a "big name" Speaker System goes to pay for the name, the import duty, the sales tax etc. When you come right down to the nitty-gritty, the speakers themselves don't cost much at all. We have a simple solution to the problem; Do-It-Yourself. Our speaker systems are easy to build and cost very little.
We have done all the hard work for you — a little final assembly and finishing, (no special tools necessary with PRE-FAB KITS) is all that is required. PRE-FAB Cabinet kits are constructed from finest grade particle-board, imported and Australian veneers and feature exclusively, recessed terminal mountings, floor stands etc. to ensure a professional finish. Available in either teak, walnut, cedar or maple. PRE-FAB Kits offer a range of finest quality speaker grille cloths for maximum clarity.

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OMNIDIRECTIONAL Transmission-Pipe Style Enclosure. Suits any 8" woofer and wide-dispersion tweeter — complete with metal grille top and all accessories. $30.00 each., freight $4.00.

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- **SYSTEM 101** — 12W — Bookshelf enclosure — 4 cu. ft. as above supplied with Magnavox 6WR & 3" tweeter and all accessories PRICE $25.00 ea. Freight $3.00 each.
- **SYSTEM 202** — 20W — 1 cu. ft. enclosure as above supplied with 8" bass driver and 1" dome tweeter plus all accessories. PRICE $36.00 ea. Freight $4.00 each.
- **SYSTEM 303** — 30W 1.6 cu. ft. enclosure as above supplied with Plessey C12PX and Plessey dome tweeter plus all accessories $50 ea. Freight $5.00 each.
- **SYSTEM 305** — Magnavox 8-30 — 1.6 cu. ft. bass-reflex enclosure with a crisp sealed — back midrange and a dome tweeter, plus all accessories. PRICE $58.00 ea. Freight $5.00 each.
- **SYSTEM 501** — 30W — 2.8 cu. ft. system supplied with 12" integrated surround woofer, a crisp sealed back midrange and dome tweeter, plus all accessories PRICE $65.00 ea. Freight $6.00 each.
- **SYSTEM 525** — 60W R.M.S. — 5 YEAR WARRANTY. 2.8 cu. ft. enclosure supplied with 12" heavy-duty driver — Aluminium cast chassis 2" voice-coil, cloth surround (similar to J.B.L. & Altec Lansing) fully doped ribbed cone-hand made & tested — 5" cloth surround — doped cone midrange (sealed enclosure) — 1" synthetic dome high frequency unit. Response — 24 — 22,000 c.p.s. plus 3-way sophisticated matched X-over network kit. Rugged enough for the hungriest of amplifiers yet efficient enough for lower power units to reproduce an experience approaching the realism of the original live performance. PRICE $115.00 ea. Freight $6.00 each. EXCLUSIVE TO 'PRE-FAB'.
- **MAGNAVOX 8-30** — 30W — 1 cu. ft. system — supplied with Model 8-30 Woofer and 2 x 3TC Tweeters, or 1 x PHILIPS 1" Dome Tweeter, with all accessories etc. PRICE $45.00 each. Freight $4.00 each.
- **MAGNAVOX 8-30** — 30W — 1.6 cu. ft. system — speaker complement as above. PRICE $50.00. each. Freight $5.00 each.
- **OMNIDIRECTIONAL SYSTEMS** — enclosure kit above, with PLESSEY C-80 and X-30 — PRICE $48.00 each. Freight $5.00 ea. MAGNAVOX 8-30 and PHILIPS Dome Tweeter — PRICE $53.00. Freight $5.00 ea. includes all accessories.

Crossover Kits available for above systems — sophisticated design, 12dB/octave, 8 Ohms: 2 Way $6.00 each, 3-Way $9.00 each.
We will be pleased to forward further information on the above systems.

DIRECT FROM FACTORY

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(new factory) 9 Elizabeth St., Burwood
Address all mail P.O. Box 43, CROYDON N.S.W. 2132

COIN COLLECTOR

"It's almost impossible not to find something!"

TREASURE HUNTING is a rapidly growing hobby and a number of metal detectors are now commercially available.

What makes this hobby so popular is that it works! It's not only possible to find buried objects — it's almost impossible *not* to find something!

The unit described in this project is the simplest circuit that will provide reliable operation.

Buried metal is located by a change in an audio tone heard via headphones — range depends very much upon the type and size of object sought but generally varies from about five centimetres for small objects to half a metre or so for larger ones.

The circuit chosen is fairly conventional but has been refined in several ways to provide simple unambiguous operation. The biggest of these refinements has been enclosing the search coil within a shield. This ensures that the detector will respond only to the object sought and will ignore troublesome external effects caused by changes in capacitive coupling (such as wet soil etc.)

The circuit of the complete device is shown in Fig. 1. Transistor Q2 is the reference oscillator and its associated inductor L2 is a 465 or 470 kHz i.f. transformer loaded by capacitor C6; resultant oscillator requency is around 100 kHz.

Capacitor Cx is the capacitor normally fitted within the i.f. transformer. Manual control VC1 allows a small change in frequency to be made so that operation can be immediately adjusted, as necessary, at any time.

The i.f. transformer chosen for L2 is that normally used for mixer and i.f. coupling in transistor radios. Its screen must be earthed to the negative rail.

CONSTRUCTION

Our unit was constructed within a small plastic 'flowerpot' saucer. These are readily obtainable from most shops and hardware stores stocking gardening supplies.

The unit that we used was 6¼" (158.75mm) dia and 1¾" (44.45mm) deep. Inside diameter of the open top is 6" (152.4mm) and a disc of 1/16" paxolin is cut to fit. A suitable drawer handle is then bolted to the bowl which is used inverted.

Details of the long handle are shown in Fig. 2. This is a one metre length of plastic pipe — available from plumbing suppliers. The bottom of the handle is held in a bracket made from a short length of aluminium tubing, part of which is squeezed flat and bent over.

The unit is constructed within a plastic 'flower pot' saucer or bowl.

An extension lead is necessary for the headphones. This can be done by adding wire to the existing lead but it is neater to run it inside the tube. A hole should be drilled about 120 mm from the bottom of the handle (this is to prevent it being fouled by the bracket) and the extension feeds through this. A 2.5 mm jack plug should be fitted.

The 3.5 mm jack socket at the top is more difficult to fit as it should be about 100 mm from the top. The wire should be soldered to the socket outside the tube and a knitting needle jammed gently into the switching section. This can then be fed down the tube and the thread passed through the hole. It is not easy, but it *can* be done!

Note that the aluminium bracket affects the search coil and if the Coin Collector is converted to the hand held version (or vice versa) realignment is necessary.

The locator is built as a working unit on the paxolin disc. The cover or casing, with handle, is afterwards attached with two bolts. The on-off switch and headphone jack are on short flexible flying leads and they can be permanently mounted on the cover. To change the battery it is necessary to remove the control knob and two nuts, but the battery has a long working life in this circuit and should only have to be renewed occasionally.

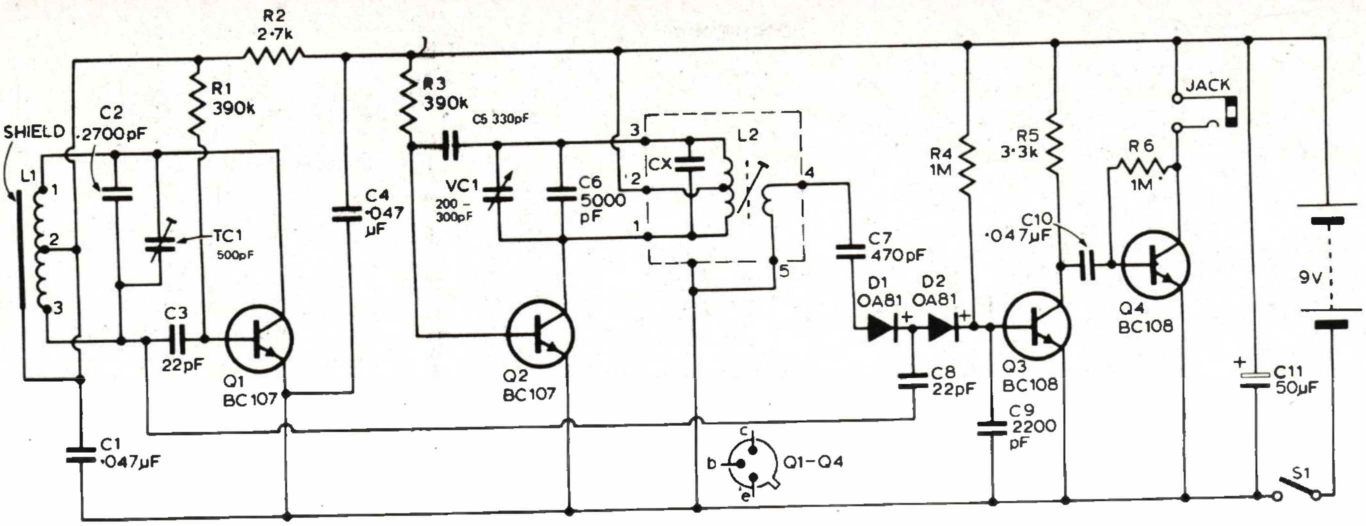


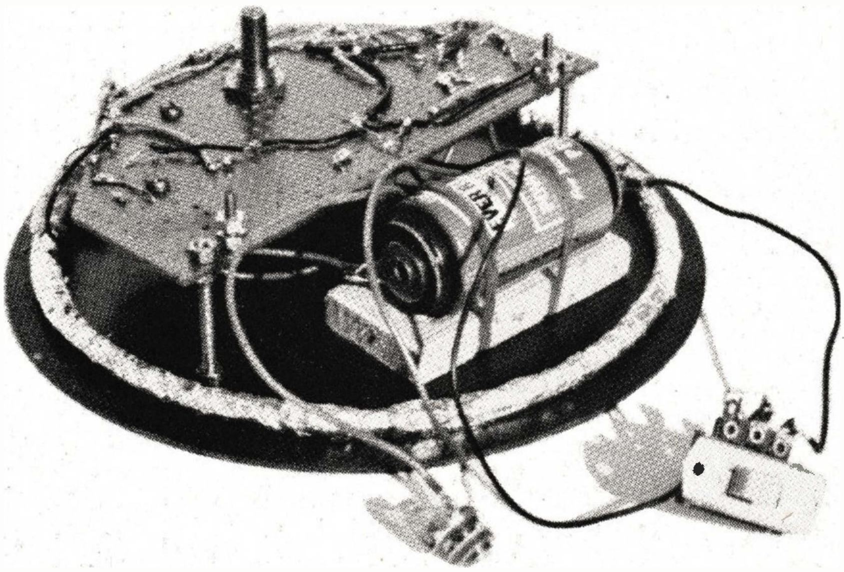
Fig. 1 The complete circuit of the ETI Coin Collector. L1 is the screened search coil and L2 the modified i.f. transformer acting as the reference oscillator.

PROJECT 531

CIRCUIT BOARD

This is cut as in Fig. 3, and the placement of components can then be as shown. The polarity of D1, D2 and C11 must be as marked.

First locate the circuit board correctly on the paxolin disc and drill holes "A" completely through both. Run countersunk bolts up through the paxolin, locking them with nuts. Put an extra nut on each bolt, so that the circuit board will be raised about 25



The main assembly without the case. The wires to the switch and earphone socket should be left reasonably long.

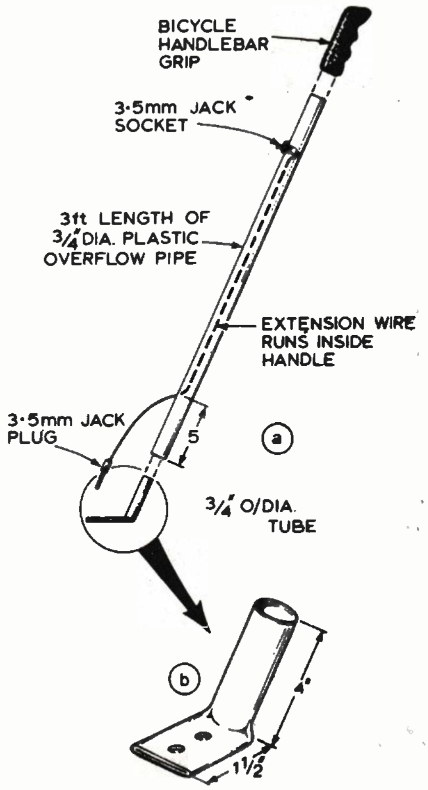
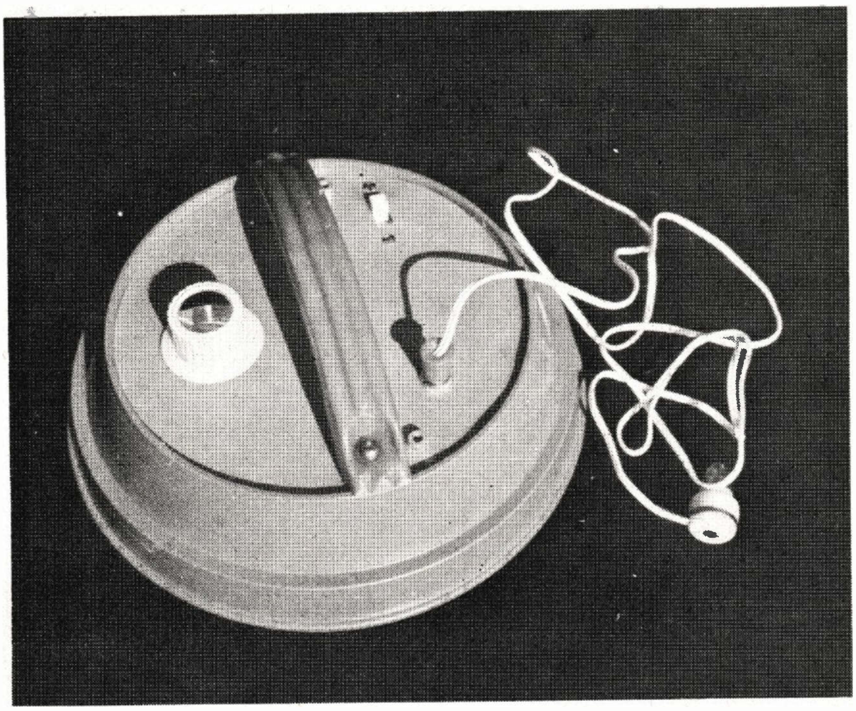


Fig. 2. Details of long handle and bracket



COIN COLLECTOR

Some parts of this project are still sold in 'inch' not metric sizes. Dimension's are shown here accordingly.

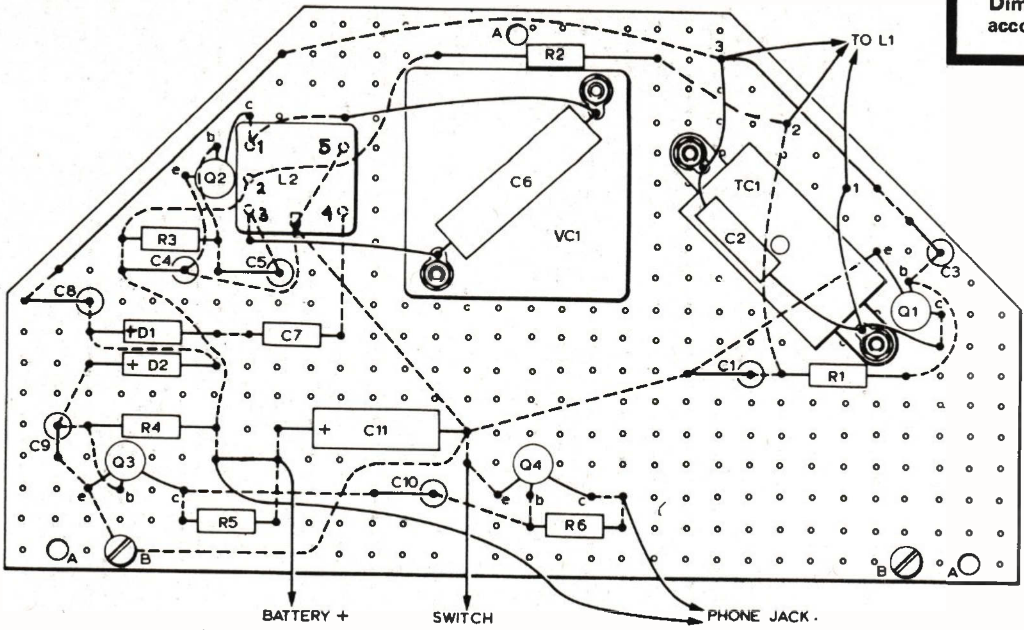


Fig. 3. Component layout – shown here mounted on matrix board (124.5 mm x 71 mm). Dotted lines show wiring on reverse side.

mm from the paxolin (to clear the components in Fig. 3). When wiring is completed the board is fixed in this position by three further nuts.

Drill two holes for the ½" bolts "B" which secure the cover. Each of these bolts has two nuts, plus a further nut each to hold the cover when it is on.

IC1 is located as shown, with a clearance hole in the cover to match. TC1 is mounted with bolts and spacers or extra nuts, with a hole so that its adjusting screw can be reached from the upper side of the board. A hole allows the core of L2 to be adjusted from this side also.

Wiring need not run *exactly* as shown in Fig. 3 provided connections are correct.

SEARCH COIL

This consists of 50 turns, centre-tapped of 26 swg enamelled wire, with a mean diameter of 133 mm. An object about 125 mm in diameter is most suitable as a temporary former for winding. A tapering object (such as a plant-pot) may be used by measuring it and marking the winding position.

Wind 25 turns in a compact pile, and secure with adhesive tape. Form a short loop for the centre-tap, and wind a further 25 turns in the same direction. The coil is then removed and bound in several places as shown.

Solder a lead to the centre-tap 2, and place insulated sleeving on ends 1 and 3.

Cut a ring of aluminium foil 180 mm in diameter and 25 mm wide and place the coil on this. Completely cut away a narrow piece from the foil, opposite the centre tap of the coil.

The foil is folded over the winding, from inside and outside, to enclose it. Regular folding of the inner edge outwards will be eased by snipping about 9 mm into the foil at 12 mm intervals from the inside. Leave a foil projection near the centre tap, secure a thin flexible lead to this with a short bolt and washers and solder this connection to the same lead as is used for the centre tap.

Bind the coil with thread or with adhesive tape. Tape the flying leads, and also the gap in the foil, taking care that the ends of the foil do not touch each other here.

The coil is smeared liberally with adhesive, and is placed onto the paxolin disc. After checking its

PARTS LIST

R1	Resistor	390 k	5%	¼W
R2	"	2.7 k	"	"
R3	"	390 k	"	"
R4	"	1 M	"	"
R5	"	3.3 k	"	"
R6	"	1 M	"	"
C1	Capacitor	0.047µF	Mylar etc	
C2	"	2700 pF	5%, Polystyrene or Silver Mica	
C3	"	22 pF	Polystyrene or ceramic	
C4	"	0.047µF	Mylar etc	
C5	"	330 pF	Plystyrene	
C6	"	5000 pF	5%, Polystyrene or Silver Mica	
C7	"	470 pF	Polystyrene	
C8	"	22 pF	Polystyrene or ceramic	
C9	"	2200 pF	Polystyrene	
C10	"	0.047µF	Mylar etc	
C11	"	50µF	10V min. Electrolytic	
TC1	"	500 pF	Compression Trimmer	
VC1	"	200-300 pF	solid dielectric variable capacitor	
Q1	BC107			
Q2	BC107			
Q3	BC108			
Q4	BC108			
D1	OA81 or OA91			
D2	OA81 or OA91			
L1	Search coil, 26 s.w.g. — see text.			
L2	I.F. transformer — see text.			

Plain Veroboard, 0.15in matrix about 124.5 mm x 71 mm; Veropins; Battery connectors; control knob; on-off slide switch; 3.5 mm jack socket; 152.5 mm disc of 1/16in paxolin; Plastic case, flower pot stand; Aluminium cooking foil; Drawer handle; Aluminium tubing, ¾in outside diameter; Plastic plumbing tube, ¾in diameter; Bicycle hand grip; Medium impedance headphones or earpiece.

HOW IT WORKS

Transistor Q2, L2 and C6 form a reference oscillator adjustable by VC1 to approx 100 kHz.

The output from this oscillator is heterodyned against the search coil oscillator via diodes D1 and D2.

Metal in the vicinity of the search coil causes a change in search coil oscillator frequency.

Transistors Q3 and Q4 boost the oscillator's difference frequency.

The search coil L1 is shielded by a Faraday cage to ensure that the coil responds to inductive changes but ignores capacitive effects from wet soil etc.

position, place a few small weights on it to hold it until the adhesive sets. The leads should come near the pins to which they will be connected.

BATTERY HOLDER

This is made of a small piece of wood. A channel is cut for the battery. Two sawcuts are made across the wood on its other side. Elastic bands are placed in the cuts round the wood, which is cemented in place. When the cement is dry the battery can then be secured by the bands.

ALIGNMENT

Temporarily fit a knob to VC1 and set this capacitor about half closed. Screw TC1 about half down. With the phones plugged in and the detector switched on, rotate the core of L2 until a loud audio tone is heard. Set the core for "zero beat".

In these conditions, turning the core either way will cause a tone, which rises in pitch the farther the core is turned. A similar effect arises with VC1: the control knob has a central or zero beat position and turning it either way from this will cause an audio tone.

LOCATOR USE

Unseen metal is located by a change in the audio tone. Initially rotate VC1 so that a steady audio tone is heard. The approach of metal into the vicinity of the search coil will then cause a change in pitch. Most metals vary the tone one way, but certain metals will cause the shift in frequency to be in the other direction. The way in which a particular metal causes a change in frequency can be adjusted by setting VC1 for the wanted effect.

Nearby, or large pieces of metal will cause a very pronounced shift in frequency. For maximum range, a very low frequency audio beat is most suitable, with VC1 adjusted so that this falls in frequency when the coil approaches metal. The limit of detection range is reached when it is no longer possible to observe any change in frequency at all.

HEADSET

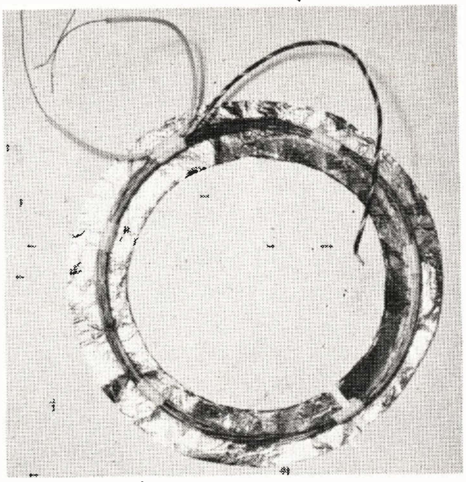
Best of all will be a light pair of phones with muffs. These help exclude external noise, and can be carried in a pocket. Headphones of similar type will usually be of about 500 to 2000 ohms.

A single earpiece is only suitable when there is little outside noise. The usual medium impedance type can be used.

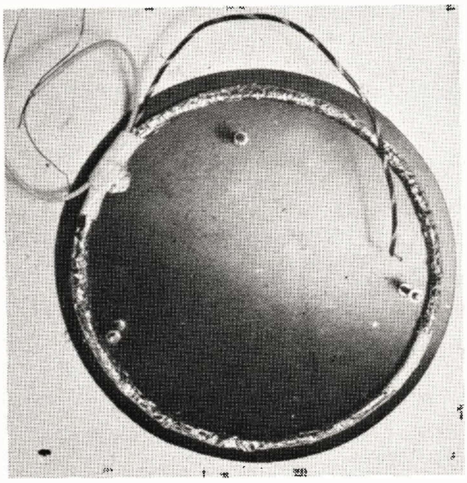
Great fun can be had with the Coin Collector but it will take you a little while to get used to it and achieve optimum performance.

Resist the temptation of scanning a large area of ground quickly, you will only be wasting your time. Concentrate on a small area — say 10 square metres. If the area has been frequented by people over the years, the chances are pretty good of finding something — even if it is of no value.

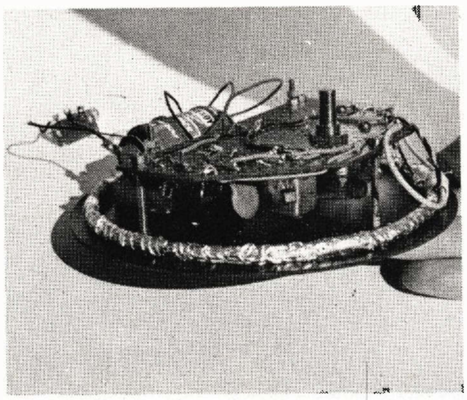
We cannot promise you anything of course and your chances of striking it rich are remote but just bear in mind that there are people who *make a good living* using a metal locator — think about it!



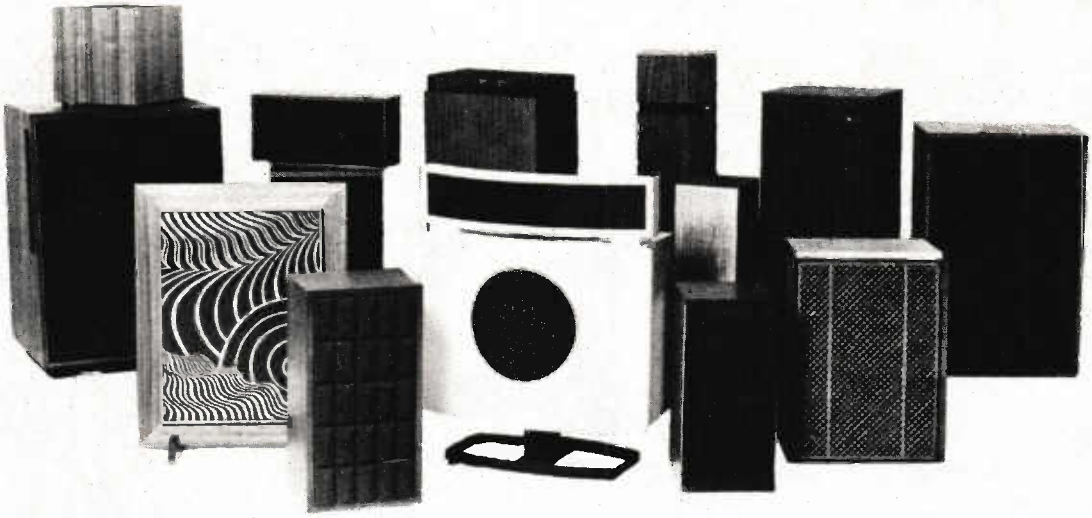
The coil should be laid on the aluminium foil as shown. Note the gap opposite the wire ends.



When screened the coil should be glued to the paxolin disc.



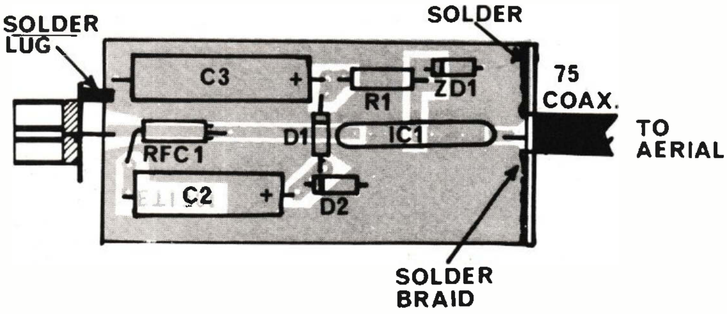
A general view of the prototype out of the case showing the circuit board in position. The extending nuts to the cover can also be seen.



TV MASTHEAD AMPLIFIER

ETI PROJECT 701

Improve your TV picture (mono or colour) with ETI's cheap and simple project.



SPECIFICATIONS: MASTHEAD AMPLIFIER ETI 701

Gain	18 dB
Bandwidth:	40 MHz – 860 MHz, ±1.4 dB
Noise Figure:	7 dB.
Output voltage:	80 mV for –60 dB intermodulation. Measured by DIN45004 method.

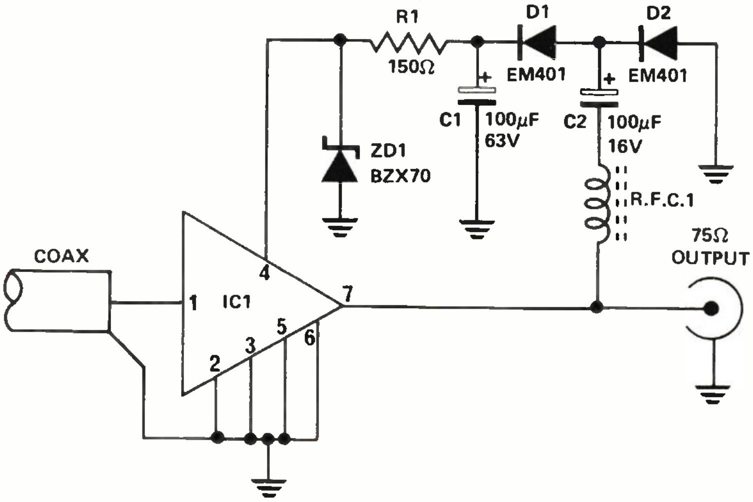


Fig. 1. Circuit diagram of masthead amplifier.

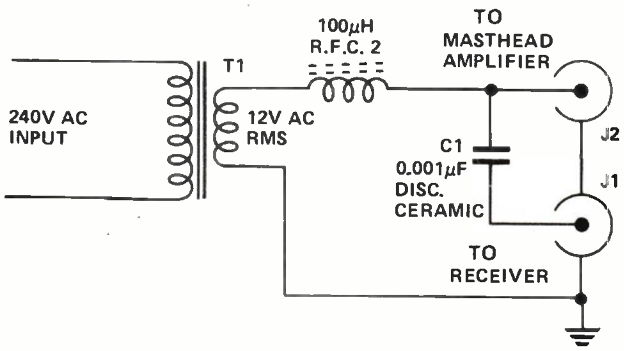


Fig. 1b. The power supply box circuit diagram. Note that outputs are taken to co-ax sockets on power supply box. Power is fed to mast-head amplifier via the signal co-ax.

OBTAINING a good TV picture in a poor reception area has always been a problem. And now that colour TV is here many people will have to re-assess their antenna requirements.

Not that colour TV really requires a better antenna but, after paying up to $1000 for a set, it is very disappointing to have a picture covered with 'hundreds and thousands' and plagued by ghost images.

SNOW

The effect, which appears as 'snow' on black and white sets is simply due to random electrical noise. The signal from the TV station, together with noise, is collected by the receiving antenna. The directivity and efficiency of this antenna therefore determines the signal-to-noise ratio available to the receiver.

If you are so unfortunate as to live in a poor-signal area you will need quite an elaborate antenna in order to achieve adequate performance. But, sometimes, even the best antenna you can afford is just not good enough. If the absolute signal level is not high enough to activate the receiver automatic gain control (AGC) — there will be snow on the picture.

GHOSTING

Ghosting may be caused by two factors, firstly by multipath reception due to reflection of signals by buildings and hills etc and secondly by signal pickup on the down lead. The first of these factors can only be eliminated by choosing and carefully locating, a suitable antenna. The second can be cured by using a feeder which is less prone to signal pickup.

The most commonly used feeder is 300 ohm twin ribbon. Whilst this cable does not unduly attenuate the signal, it is unshielded, and thus picks up signals and noise along its length. These signal voltages have a different phase relationship to those from the antenna and cause signal cancellation and ghosting.

The alternative to ribbon is 75 ohm coaxial cable. This eliminates the ghosting problem due to pickup but requires the use of baluns (matching transformers) and has a loss of between 4 and 6 dB per 30 metres (average). Thus the absolute amplitude of signal from the antenna will be degraded even with moderate feeder length.

However most colour TV sets are fitted with 75 ohm coaxial input sockets and it would be sensible to use coax — ghosts in colour can be quite objectionable.

Fig.2. Component overlay. Note piece of board soldered to right hand end of main board.

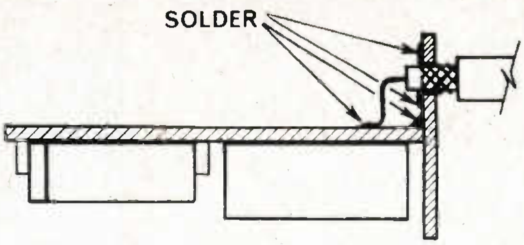
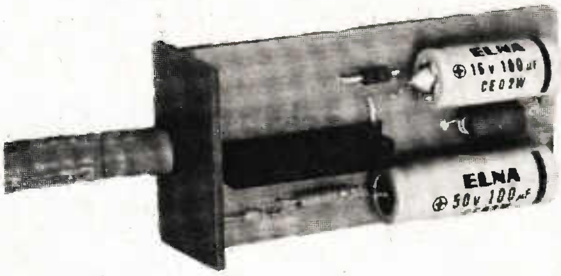


Fig. 3a. Side view of manner in which coax and end plate are fitted to main board. 3b. The completed assembly prior to assembly into the box.



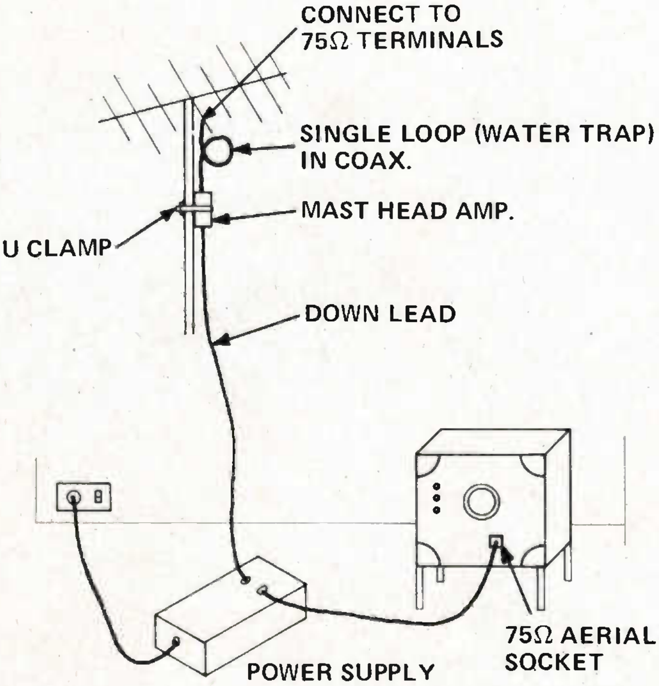
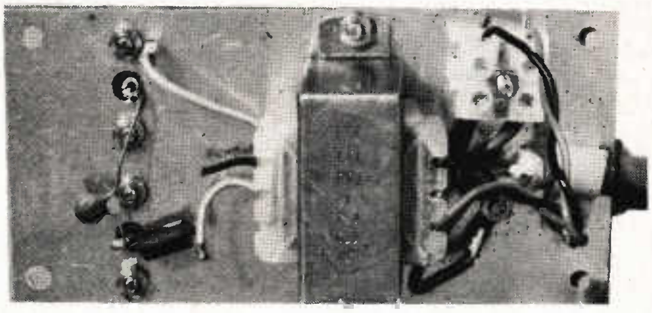


Fig. 4. How the amplifier is fitted to an existing system. Note that where the antenna was previously used with 300 ohm ribbon a balun must be used to match the antenna to the 75 ohm coaxial cable.



Internal view of the power supply box.

In low signal areas the consequent loss of signal level may be unacceptable. In such situations the use of a mast-head amplifier will compensate for cable loss and boost the signal to a suitable level for correct AGC action.

A mast-head amplifier is also essential where several sets must be fed from a common antenna. For such applications a splitter matching pad network must be used which results in 3-6 dB loss for each added set.

Note that adding an amplifier (which must be located at the masthead — not at the receiver terminals) will only *maintain the signal-to-noise ratio already present at the antenna terminals.* It cannot improve the quality of weak signals.

Constructing wide-band VHF amplifiers is quite tricky and generally not something to be tackled by the home constructor without experience in this field, however the availability (from Philips Elcoma), of a new thin-film, hybrid, integrated VHF-UHF wide-band amplifier has made this project both feasible and economic.

The sample we obtained from Elcoma bore the type number of OM190. These have since been re-numbered OM321. They are identical electrically, but encapsulated differently. So initially both types may be offered and either may be used. Stocks are presently limited, although Dick Smith Electronics has an initial supply. (Elcoma advise that the IC's should be readily available by early January).

The gain of the OM321 is about 18 dB, it has a flat response from 40 MHz to about 1 GHz, and its noise figure is the same as most modern solid state tuners — around 7 dB. Conventional wide-band amplifiers are prone to overload however this one is quite tolerant. Should you encounter overload problems, first try a simple attenuator ahead of the input. Otherwise a channel trap tuned to your local low channel should eliminate the interference. (These devices are commercially available from most antenna suppliers).

CONSTRUCTION

Mount the components on the printed circuit board in accordance with the component overlay. Pay particular attention to the orientation of capacitors and diodes. Place the PC board into the diecast box, copper side up, and solder the end piece to the board. Take a length of co-ax (about a metre), and strip back the vinyl cover 20 mm

TV MASTHEAD AMPLIFIER

HOW IT WORKS – ETI 701

Power for the amplifier is provided from a step-down transformer mounted in a small box which can be located in the vicinity of the set. The secondary supply from the transformer is fed to the masthead unit, via the coax, where it is rectified, and voltage doubled by diodes D1 and D2 and capacitors C1 and C2. The resultant supply is then stabilized at 24 volts dc by ZD1. Lower supply voltages could be used but at the expense of overload margin.

The radio frequency chokes in either unit are incorporated to separate the signal and supply voltages. Power is transmitted up the feeder as ac, rather than dc, to prevent corrosion due to electrolytic action. The signal is coupled out to the receiver, from the transformer box, by capacitor C1.

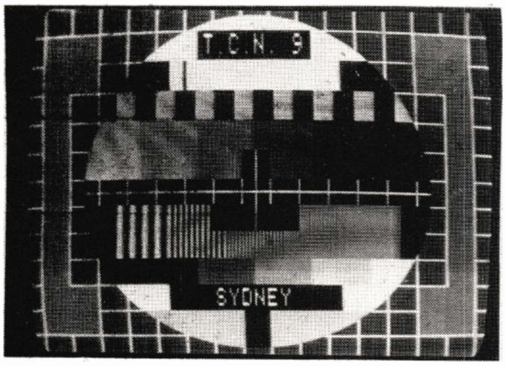


Fig. 5a. TCN9 test pattern received in a good signal area.

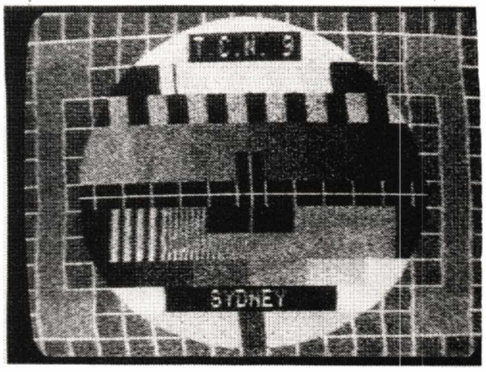


Fig. 5b. The same test pattern on a receiver with 16 dB less signal.

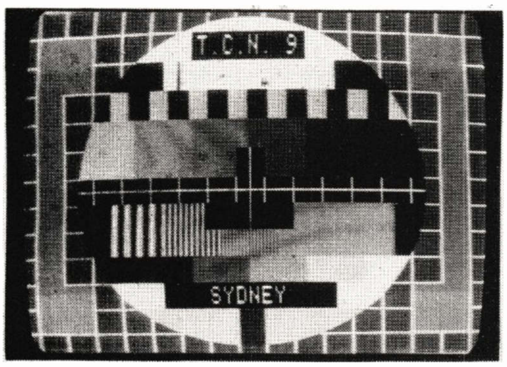
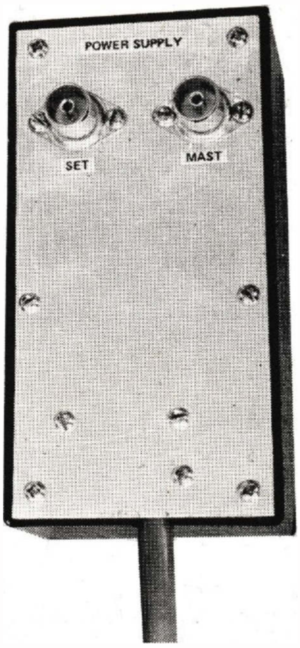


Fig. 5c. As in Fig. 5b but with the masthead amplifier fitted.

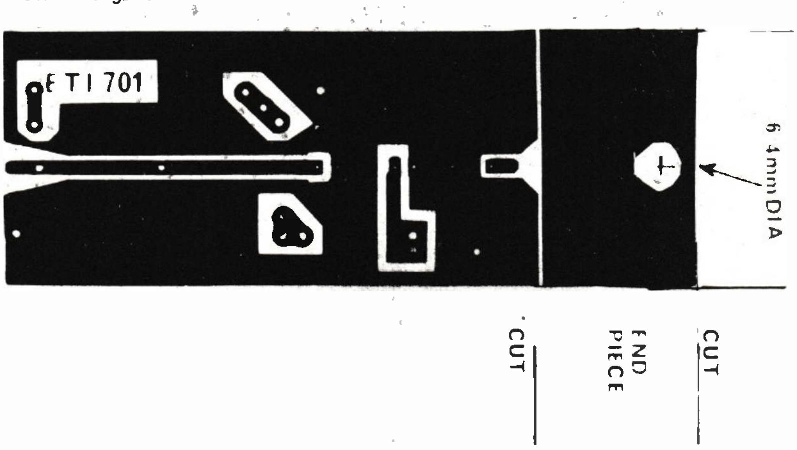
Fig. 5d. When using a wide band amplifier, too much signal on one channel may well interfere with other weaker ones. Here channel ABN2 is interfering with channel Ten. A simple attenuator ahead of the amplifier may be adequate. (If other channels are not too weak) alternately use a trap on the strong channel to selectively reduce its level.



from each end. Comb out the braid and cut away the exposed polythene core. Solder one end to the board as shown in the diagram and attach two solder lugs to the other. Check all terminations for dry joints. The final stage is to encapsulate the masthead amplifier in an epoxy resin, but first check that everything is working! Seal the free end of the co-ax with epoxy to ensure that no water can penetrate. It is also important to ensure that water cannot penetrate the main co-ax via the Belling Lee plug. The die cast box can then be simply attached to the mast with a U clamp.

As most new antennas and sets have provision for 75 ohm terminations we have not included baluns in the design. If your antenna and set has only 300 ohm terminations, you will need to interpose a balun at both the antenna and set connections. These are available from the usual suppliers of antennas.

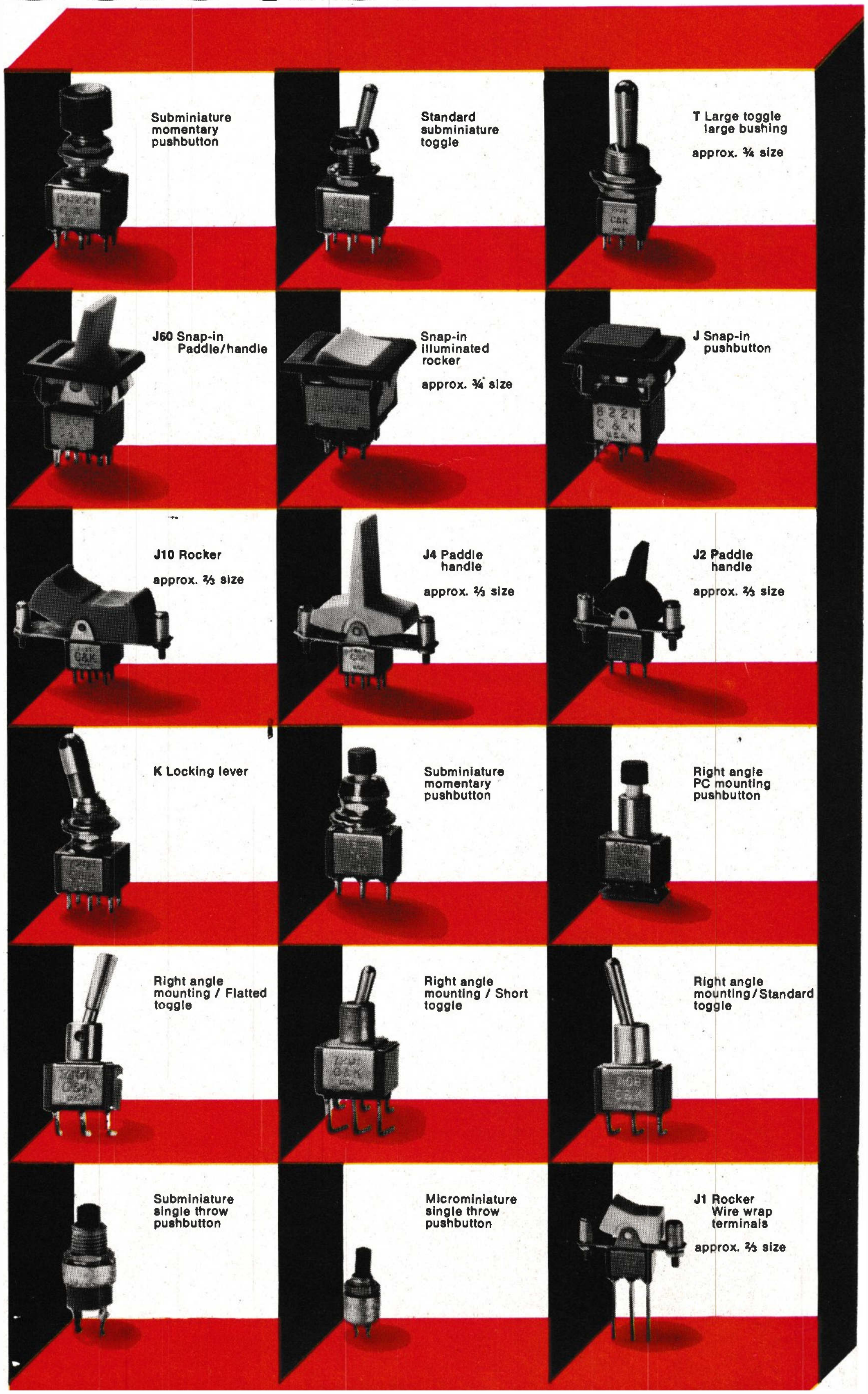
Fig. 6. Printed circuit board for the masthead amplifier. Note that the small piece at the right hand end is cut off and soldered to the main board as shown in Fig. 3.



PARTS LIST – ETI 701

R1 Resistor 150 Ω ½ W 5%
C1 Capacitor 0.001 µF 630V disc ceramic
C2 " 100 µF 63V electrolytic
C3 " 100 µF 16V electrolytic
IC1 Integrated Circuit OM321 or OM190 (Elcoma)
ZD1 Zener Diode EM401 or equivalent.
RFC1,2 RF choke. 2½ turns on Elcoma 4312-020-36640 6 hole ferrite bead.
T1 Transformer 240V/12V DSE 2581 or similar
J1,2,3 Socket L604/S Belling Lee or similar
P1,2,3 Plug L734/P Belling Lee or similar
PC board ETI 701, Die cast box Eddystone 7968/P or similar, Zippy box UB1 (Dick Smith) or similar
3 core flex and plug, cable clamp, 3 way terminal block, solder lugs, 75 ohm coax
Baluns 300 ohm to 75 ohm — Elcoma 3102-108-33091 or similar.

C&K Switch Selector



The switch is to C & K because switches from C & K Components, Inc. (USA) are superior in every design aspect through engineering know-how and experience. Quality, craftsmanship and care make each of these switches a precision component.

The types illustrated are simply a basic cross section of the range available. The range embraces the widest possible variety of switch combinations to meet every requirement . . . Toggles, Rockers, Illuminated Rockers, Paddle Handle, Pushbutton.

Miniature, subminiature and microminiature sizes in many circuit/position configurations are available in one, two, three and four pole models. All switches feature rugged construction and simple mounting . . . long-term, trouble free operation is ensured.

Toggle switch contacts are rated 2 amps @ 240 VAC and 5 amps @ 28 VDC resistive load.

A catalogue containing full specifications, options, mounting information, panel layouts, etc., is available on request.

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tear out and keep for easy future reference

ETI PRODUCT TEST

Recommended retail price $499.

CROWN D-150 POWER AMPLIFIER

MEASURED PERFORMANCE
CROWN D-150 DUAL-CHANNEL POWER AMPLIFIER SERIAL NO. D6992

Power Output

Measured	75 watts (rms) in 8 Ω + 8 Ω both channels driven between 20 Hz and 20 kHz.
Measured	95.5 watts (rms) in 8 Ω + 8 Ω both channels driven at 1 kHz.
Rated	75 watts (rms) in 8 Ω + 8 Ω both channels driven.

Frequency Response

at rated	output	20 – 20 000 Hz. ±0.5 dB
at 10 watts	output	20 – 20 000 Hz. ±0.5 dB
at 1 watt	output	20 – 20 000 Hz. ±0.5 dB

Channel Separation at Rated Output
100 Hz = –110 dB
1 kHz = –115 dB

Hum and Noise with Respect to Rated Power

Gain Control at Maximum Gain	–87 dB unweighted –102 dB (A) weighted
Gain Control at Minimum Gain	–104 dB unweighted –123 dB (A) weighted

Input Sensitivities for Rated Output
1.4 volts rms at 1 kHz for 95.5 watts rms.
1.3 volts rms at 1 kHz for 75 watts rms.

Total Harmonic Distortion at Rated Output (both Channels driven)
less than 0.005%

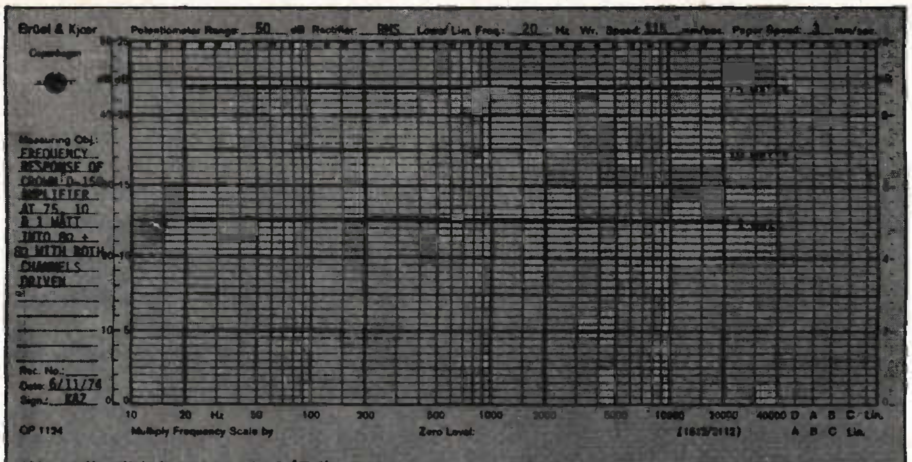
Intermodulation Distortion
less than 0.01%

'Good enough to be used as a laboratory standard'
— Louis Challis.

ONLY TEN or so years ago, the biggest power amplifier you could buy (over the counter) was a 'mere' 30-40 watts. A 10 watt amplifier was regarded as very powerful and the average home unit rarely exceeded three to five watts. Now times have changed and no audiophile would dream of buying a three watt amplifier, would think twice about a 10-12 watt amplifier, and would probably be convinced by his friends that he needed at least 30 watts-plus (continuous rating).

There are several reasons for this move to ever-higher power outputs. The most important of these is the recent introduction of low efficiency speakers.

It is not that low efficiency speakers are necessarily better than high efficiency speakers, but rather that a low efficiency speaker, which also offers low distortion, is generally less expensive to manufacture. So the nett trade-off comes as speakers requiring more and even more powerful amplifiers. This situation is undoubtedly a boom to amplifier manufacturers, the majority of whom now produce amplifiers ranging from



We really didn't use a ruler! (Ed).

10 watts per channel to as high as 500 watts per channel to cater for the demanding tastes of a burgeoning market.

During the past three years we have examined the claims of these manufacturers. These include – the need for higher powers to cope with the transients of the signal content (often particularly hard to justify); claims that very low harmonic distortion, i.e. less than 0.1% is a must (which we reject); that low intermodulation distortion is a prerequisite for proper listening, (which we fully agree with); and that it is cheaper to produce a more powerful amplifier in terms of dollars per watt than a less powerful amplifier (which is true for some manufacturers but not for others!). The situation we find ourselves in is that the best of the high quality amplifiers have performances so good that they are one to two orders better than the peripheral equipment which drive them or which they in turn drive.

The Crown D-150 Amplifier is a remarkably good example of the best of these super performance amplifiers. Like most top quality amplifiers it comes complete with a factory calibration sheet presenting the maximum (in this case single channel) measured performance figures feeding both into both eight and four ohm loads.

The D-150 is a relatively small amplifier compared with some of its bigger competitors. It consists mainly of a large unusually-finned aluminium heat sink forming the main chassis of the unit. This takes the form of a channel at the front on which are mounted the eight power transistors, behind a pressed metal cover. There are two large fins at the rear, located towards one side, behind which is mounted a single epoxy glass printed circuit containing the electronics of the driver stages feeding the power transistors.

Generally, this is a professionally made piece of equipment – certainly all components are of premium quality.

We do however feel that the printed circuit board quality could be improved in one respect – on the unit inspected the copper laminate does not appear to have been given the full anti-corrosion treatment that one now normally expects with professional equipment. In fact surface corrosion was already evident on one or two areas.

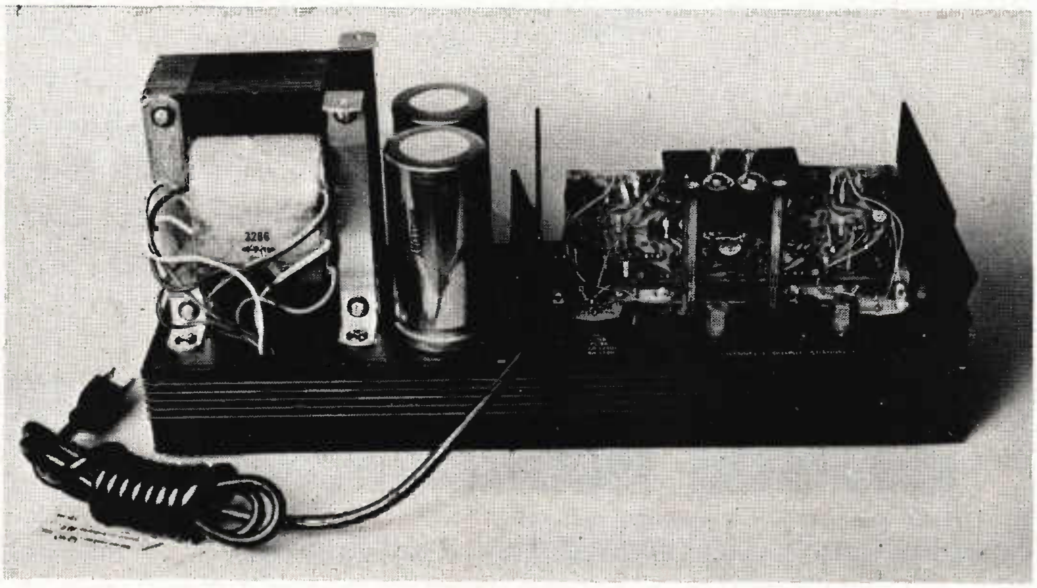
The cover over the electronics contains a cut-out which provides direct access to a pair of tip ring and sleeve sockets for line input, together with a pair of recessed screwdriver slotted potentiometers to provide adjustable input sensitivity level.

Immediately below the pressed metal cover are two pairs of universal terminals (with a standard ¾" spacing) for speaker output, an ac line fuse, and a three core lead finishing in a standard US three pin plug.

The left hand side of the rear of the amplifier consists of a metal enclosure, 187mm x 125mm x 145mm, covered by a solidly constructed die-cast lid. This contains a large power transformer and two large electrolytic capacitors for the power supply. Each of these is a 9400 μF capacitor with a 50 volt working rating. The power transformer is wired for either 120 or 240 volt operation and will work between 50 and 400 Hz.

The electronic circuitry is fairly straight forward. It uses an integrated circuit in each of the channels as the first high gain preamplifier stage; there is a very high level of feedback around the circuit. The other very important feature, which renders this amplifier almost fail-safe, is an overload protection circuit which protects the amplifier from excessive drive. To make doubly sure, Crown supply a pair of line connectors incorporating fuses to protect both the speakers and the amplifier from inadvertant abuse.

The performance of the Crown



CROWN D-150 POWER AMPLIFIER

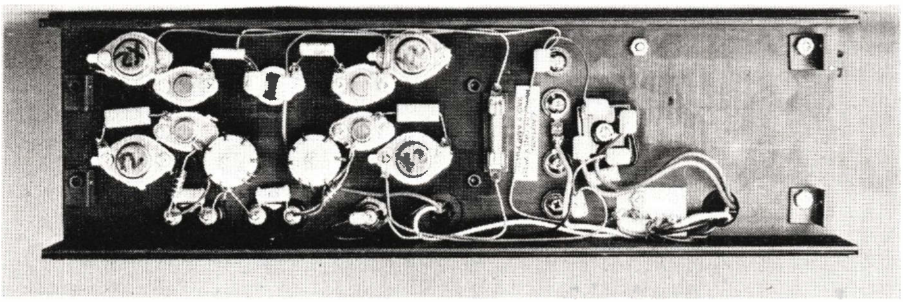
D-150 amplifier is extremely good. This amplifier can provide a genuine 105 watts into eight ohms single channel at 1 kHz, 170 watts into four ohms single channel at 1 kHz, and 75 watts for three minutes with both channels driven in the range 20 Hz to 20 kHz.

The distortion figures are exceptionally low, being less than 0.005% at full power output and at all powers as low as 1 watt. The intermodulation distortion figures are even better, being less than 0.005% according to our measurements and being less than 0.003% from Crown's measurements. Crown's figure may well be correct because we have difficulty measuring intermodulation distortion of less than 0.005% — the limit of our system (in terms of internal noise) is 0.002%.

The overall performance of this amplifier is exemplary. As we stated at the beginning it is far better than called for in the relatively mundane application of high fidelity listening.

The Crown D1-50 is undoubtedly good enough to be a laboratory standard, to be used in a servo feedback system, or as a yardstick for evaluating other amplifiers.

It is possible to buy many an amplifier inferior to this one but we doubt very much that you will be able to buy one that is better.



The Crown IC150 pre-amplifier is specifically intended to drive the D-150 power amplifier.

This unit was reviewed in our August 1972 issue — price then was $554. Surprisingly, in view of our current rate of inflation, the recommended retail price is now lower — $499.

UNDER $60 SCIENTIFIC CALCULATOR

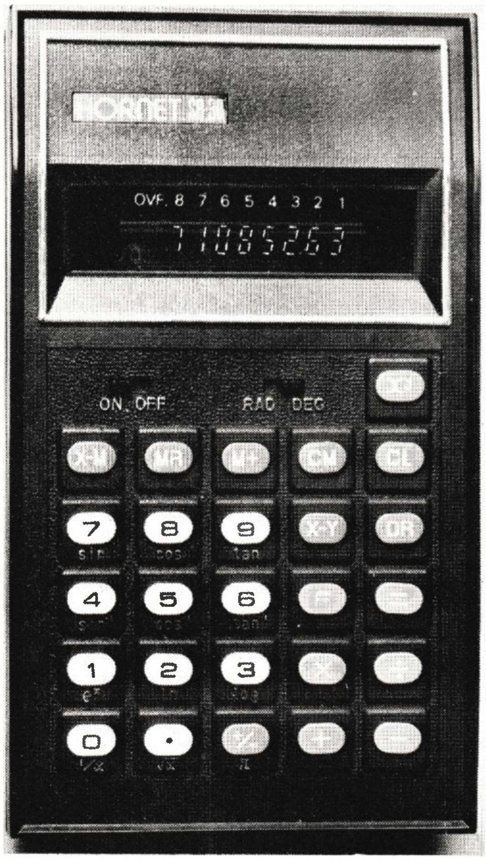
POCKET-SIZE scientific calculators have recently plummeted in price in much the same way as their simpler four-function counterparts.

It is now possible, by careful shopping around, to buy several units — having trigonometric and logarithmic functions — for around $100.

But this month, ETI readers are offered a very unusual opportunity — that is the chance to buy these units for just under $60. That is their price fully assembled — not in kit form.

Full details of the offer are published on page 64 of this issue.

So that readers may have a reasonable chance of assessing the units' capabilities here is our review of the unit offered — spelling out all the bad points as well as the good ones.



THE SR 30 CALCULATOR

— ETI Technical Editor, Brian Chapman reports.

A USEFUL scientific calculator should incorporate trig. and reverse trig. functions; logs to base e and base 10, e^x, x^y, $\sqrt{x}$, π constant; and a memory.

To facilitate complex calculations it should also include an operational stack and scientific notation.

There are calculators which incorporate *all* these characteristics, such as the HP35 (about $180), and some even more sophisticated programmable types such as the HP65 (about $700). However, there are others which, whilst lacking scientific notation, do have the rest of the facilities. The Hornet SR30 is this type of unit.

The SR30 is an algebraic-mode, eight-digit, scientific calculator that incorporates the normal four functions (+, –, x and ÷) plus the following key functions.

MEMORY OPERATION

M+ sums the displayed number with the previous contents of the memory.

MR duplicates the contents of the memory in the display register. This number can then be operated upon in any desired way.

X-M exchanges the displayed number and that stored in memory without affecting the existing chain of operations. Thus, in effect, the memory is cleared and displayed number is stored.

CM clears memory without affecting any other operation.

COMMAND FUNCTIONS

+/– Changes sign of displayed number (except after function key (F) is pressed.)

F changes mode of dual-label keys to alternate scientific function.

DR deletes last digit entered and terminates number entry mode (see text for further explanation.)

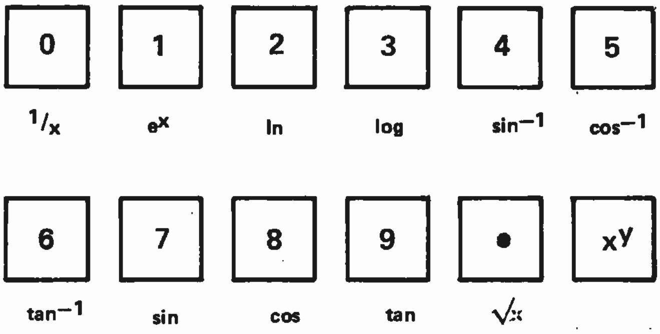
X-Y exchanges the contents of the x and y registers.

rad/deg allows calculations of functions in degrees or radians.

CL The clear key performs different functions depending on the condition of the calculator logic at the time of depressing the key.

Error Conditions. the key resets the error flag, the displayed number is retained and may be used in a new calculation. The constant operator and operand are also retained.
Number Entry. Clears the input register but implied chain and constant operations are not affected.
Second Depression the second of two depressions sets add mode and clears all registers except memory.
Scientific Calculations halts the calculation, sets add mode and clears all registers except memory.

SCIENTIFIC FUNCTIONS



If any one of the above keys is pressed, after pressing the F key (except x^y which is direct), the second function of the key will be performed using the number in the display register as the argument.

With the exception of 1/x and √x, these functions may not be chained, with other scientific functions or arithmetic operations, as both x and y registers are used in their calculation.

Thus to solve (sin 27°) (cos 40°) we must solve one function and store it in memory whilst the other is calculated. This, however, is not a limitation of capability, merely an inconvenience.

The x^y function is performed in two steps using the algorithm $x^y = e^{y \cdot \ln x}$. When the first number is entered, and the x^y key is pressed, the natural logarithm of the first number is calculated. The remainder of the calculation is performed when the second number is entered and the equals key is pressed.

The limitation on this function is that the answer must not exceed the eight digit capacity otherwise zero will be displayed together with an error flag. Additionally the first part of the calculation takes approximately half a second, therefore if a second number is punched during this period an incorrect result will be obtained. It is possible to beat it – but you have to be fast.

The calculator does not have scientific rotation (8 numbers represented as a mantissa multiplied by a power of 10 eg. 1.362×10^{12}) and at first sight one would consider this a major disadvantage. But in this machine, this has been overcome to some extent by a unique overload system.

If, for example, two 8-digit numbers are multiplied together, the display will overflow. In common with many of the better-quality four function machines, the SR30 now displays the eight most significant digits with the decimal point 8 places to the left of its true position, overflow being indicated by a symbol on the left of the display. Again in common with other calculators the machine locks out any further operations. However, on the SR30, if you wish to proceed, you must note that further results must be multiplied by 10^8, and press the clear button.

When the clear button is pressed the overload sign is switched off, the calculated number is retained in the display and calculation may then be continued. This allows positive numbers of any magnitude to be calculated, but does not handle an underflow condition. That is numbers smaller than 10^{-8} are all indicated as zero. Again this may be overcome by putting your numbers in scientific form and noting down the appropriate power of ten. This is a little inconvenient – but perhaps not so inconvenient that a more powerful calculator at two to three times the price of the SR30 is warranted.

The algebraic mode of SR30 operation using a two stack system where the x and y numbers are both held in registers. Thus one enters problems in the manner in which they would be written, eg, 123.456 x 124.456 =. This system allows automatic constant operation, eg, if one wanted to multiply 123.456 by a series of numbers one would merely perform the first calculation, as above, and then enter new numbers and "equals" command.

e.g.	123.456 x 123.456	=	15241.383
	20	=	2469.12
	15	=	1851.84

At any point a new x, ÷, + or – etc command will revert the calculator to normal calculation mode using the last result.

ACCURACY

The trigonometric and logarithmic functions are calculated to six decimal places and, by comparison with seven figure tables we determined that these functions were accurate to at least the fifth decimal place – it is only the last digit which is ever in error. Such accuracy should be more than adequate for most purposes.

For example, using the x^y function to calculate 2^2 one obtains 3.999996, a graphic example of the degree of error obtained due to the six-place limit on scientific functions.

SUMMING UP

The calculator is powered by four penlight cells which provide about three hours continuous operation, a jack is provided for a dc input and it would be quite a simple matter to fit the calculator with rechargeable cells and a charger.

The eight digit display has well formed easy to read characters and consists of 7-segment LED digits. The keyboard uses conductive rubber type contacts and is well laid out with 25 colour coded keys.

Internally the calculator is very simple. The simple LSI calculator IC, together with the nine display driver transistors and the display devices are all mounted on a single PC board. There just doesn't seem to be much in it at all. However this one chip design-simplicity augers well for reliability.

The calculator is supplied complete with a soft vinyl carrying case and an instruction book which fits in a small pocket in the case.

In common with most pocket calculators – scientific or otherwise – the handbook does not really cover all the possible uses of the unit. However these have been described fairly comprehensively in this review, and this, together with the handbook plus a period of experimentation will soon allow the user to become conversant with the calculator's capabilities.

In all we found the calculator a delight to use. Everyone we showed it to wants to buy one! At the special offer price we doubt if better value for money exists at the time of writing.

The supreme sound achievement.

700 Line

700T AM/FM STEREO TUNER
700C STEREO CONTROL AMPLIFIER
700M STEREO POWER AMPLIFIER

A new Kenwood trio of high fidelity components which, in embodying everything for the very highest quality audio reproduction, sets new standards of audio excellence, and gives a new meaning to the phrase 'the state of the art.'

Both the 700-C control amplifier and the 700-M power amplifier have ultra-stable balanced twin (positive and negative) power supply lines. Capacity is big enough to avoid 'pull-down' of voltage on even the largest peaks of output power. Several stages of differential amplification ensure stable low-distortion operation. Incredibly low distortion is a feature of the 700-T tuner, too. The crystal-oscillator synthesizer circuitry of the 700-T puts EVERY station AUTOMATICALLY at dead centre—even stations 100 kHz apart. Nothing less than the best is incorporated in Kenwood's new top of the line 700 series.

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700T

AM/FM STEREO TUNER

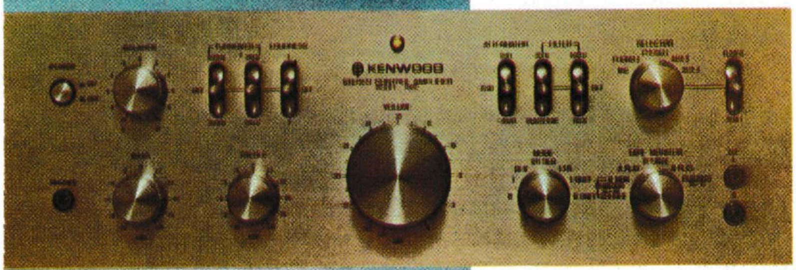
The 700-T tuner is the ultimate in audio tuners—a result of the search for 'Absolute Zero' in tuning error, phase distortion, hardware faults and user dissatisfaction. Superb technology has achieved this in the 700-T.

• Frequency Synthesizer System gives stability of more than tenfold over the very best LC units. Perfect pinpoint tuning is achieved.

BRIEF SPECIFICATIONS
FM STEREO: 50 dB Quieting Sensitivity, 45 μV • Stereo Separation, 40 dB at 100 Hz, 45 dB at 1 kHz, 35 dB at 10 kHz • Sub-Carrier Rejection, 65 dB Ultimate T.H.D. at 800 μV input, 0.25% at 1 kHz.
AM TUNER SECTION: Usable Sensitivity (1HF), 13 μV • S/N Ratio, 50 dB at 1 mV input • Image Rejection, 70 dB.

700C

STEREO CONTROL AMPLIFIER



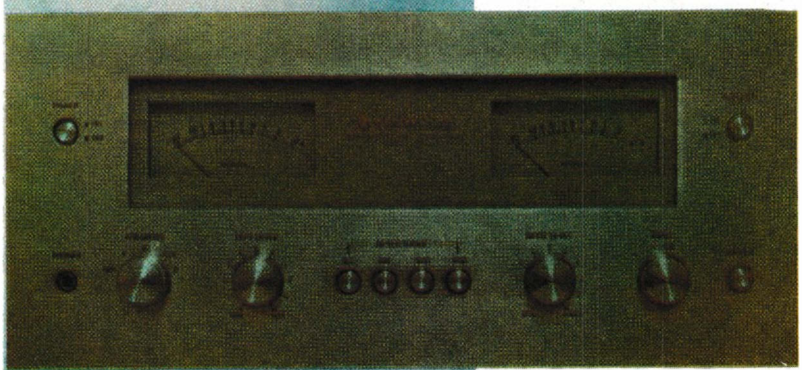
This unit offers a full and flexible range of controls for handling all possible input sources with the ability to optimize the sound quality of each. It incorporates a unique combination of innovative solutions which set new standards for control amplifier performance.

• All Stage Differential Amplifier with balanced twin power lines aims at zero distortion • Low Noise Transistors, Resistors and Capacitors aim at zero noise • Tone Controls aim at zero tone coloration • Parallel Control System for double tape monitory so that FM broadcasts and records, etc., can still be enjoyed while dubbing is going on from tape to tape.

BRIEF SPECIFICATIONS
• Total Harmonic Distortion, 0.04% at rated output voltage into 50 k ohms • Intermodulation Distortion (60 Hz : 7 kHz = 4:1), 0.04% as above.
PRE-AMPLIFIER SECTION: S/N RATIO—Phono 1, 2, 70 dB (into 5 mV) • Tuner, 85 dB (into 150 mV) • Aux. 1, 2, 3, 85 dB (into 150 mV) • Tape Play A, B, 85 dB (into 150 mV) • Mic., 70 dB • Attenuator, 0 dB, −15 dB, −30 dB.

700M

STEREO POWER AMPLIFIER



Kenwood's aim in designing the 700-M was to offer tremendous reserves of power without any penalties in terms of increased distortion at normal listening volumes, while distortion at high power outputs has been remarkably reduced so has the noise and distortion at low levels. No feature of circuitry was left unexamined, and the result is a design which is truly unique—and uniquely effective.

• Differential Amplifier with balanced twin power lines aims at zero sound quality degradation. Output power adequate to recreate the level of a large scale orchestral fortissimo. Full Range of Functions—output level meters, three sets of speaker terminals, monitor headphone jack, dimmer control for meter scale brightness, four separate AC power outlets.

BRIEF SPECIFICATIONS
RMS POWER OUTPUT: Both Channels Driven, 170 + 170 watts into 8 ohms at 20 Hz-20,000 Hz, 175 + 175 watts into 8 ohms at 1,000 Hz • Dynamic Power Output, 400 watts into 8 ohms, 620 watts into 4 ohms • Total Harmonic Distortion, 0.1% at rated power into 8 ohms, 0.05% at ½ rated power into 8 ohms at 1,000 Hz.

JM/K-56-74

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KC6M	8W RMS	50Hz-11kHz
KC6MX	8W RMS	50Hz-20kHz
C60	10W RMS	35Hz-7500Hz
C60X	10W RMS	30Hz-17kHz
C80	20W RMS	35Hz-8kHz
C80X	20W RMS	35Hz-20kHz
C100	20W RMS	40Hz-11kHz
C100X	20W RMS	40Hz-20kHz
C12P guitar	30W RMS	55Hz-10kHz
C12P woofer	30W RMS	35Hz-10kHz
C12PX wide range	30W RMS	35Hz-13kHz
C12PX guitar	30W RMS	55Hz-13kHz
12U50	50W RMS	25Hz-11kHz
12UX50	50W RMS	40Hz-13.5kHz
MIDRANGE		
C6MR	20W RMS	450Hz-6600Hz
KC5MR	15W RMS	700Hz-14kHz
TWEETERS		
X20 horn	—	3kHz-30kHz
X30 dome	—	3kHz-30kHz
KC 3G X cone	—	1.5kHz-19kHz
5FX cone	—	4kHz-20kHz

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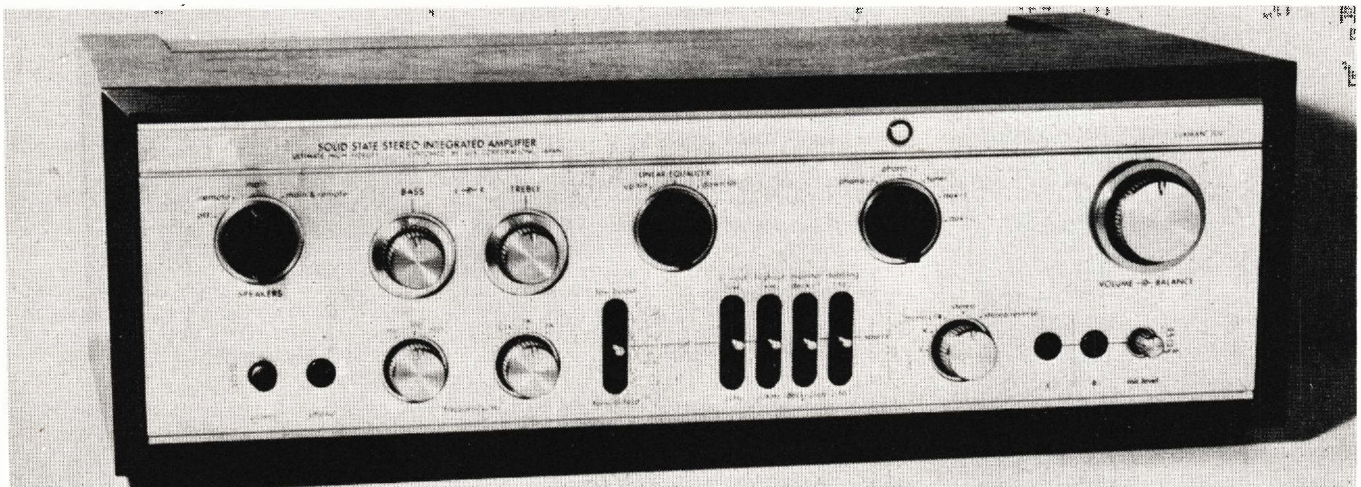

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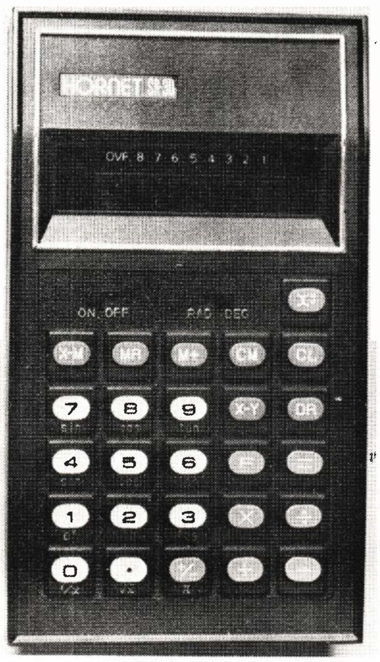
Readers may order more than one unit if desired but a separate original coupon must be returned for each unit ordered.



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DISPLAY: 8-digit red LED display.

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DECIMAL POINT: Floating decimal calculation.

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eti INDEX

Innumerable readers have asked us to publish a complete index of all articles published in Electronics Today since the first issue.

Here it is then, together with Errata to date. The indices for 1971 and 1972 are on pages 65 and 66; those for 1973 and 1974 are on pages 71 and 72. The reason for the apparently strange page sequence will be obvious to those people who wish to remove the index from the magazine. With reasonable luck (!) it should be possible to remove the entire index together with the Errata page without affecting any editorial material.

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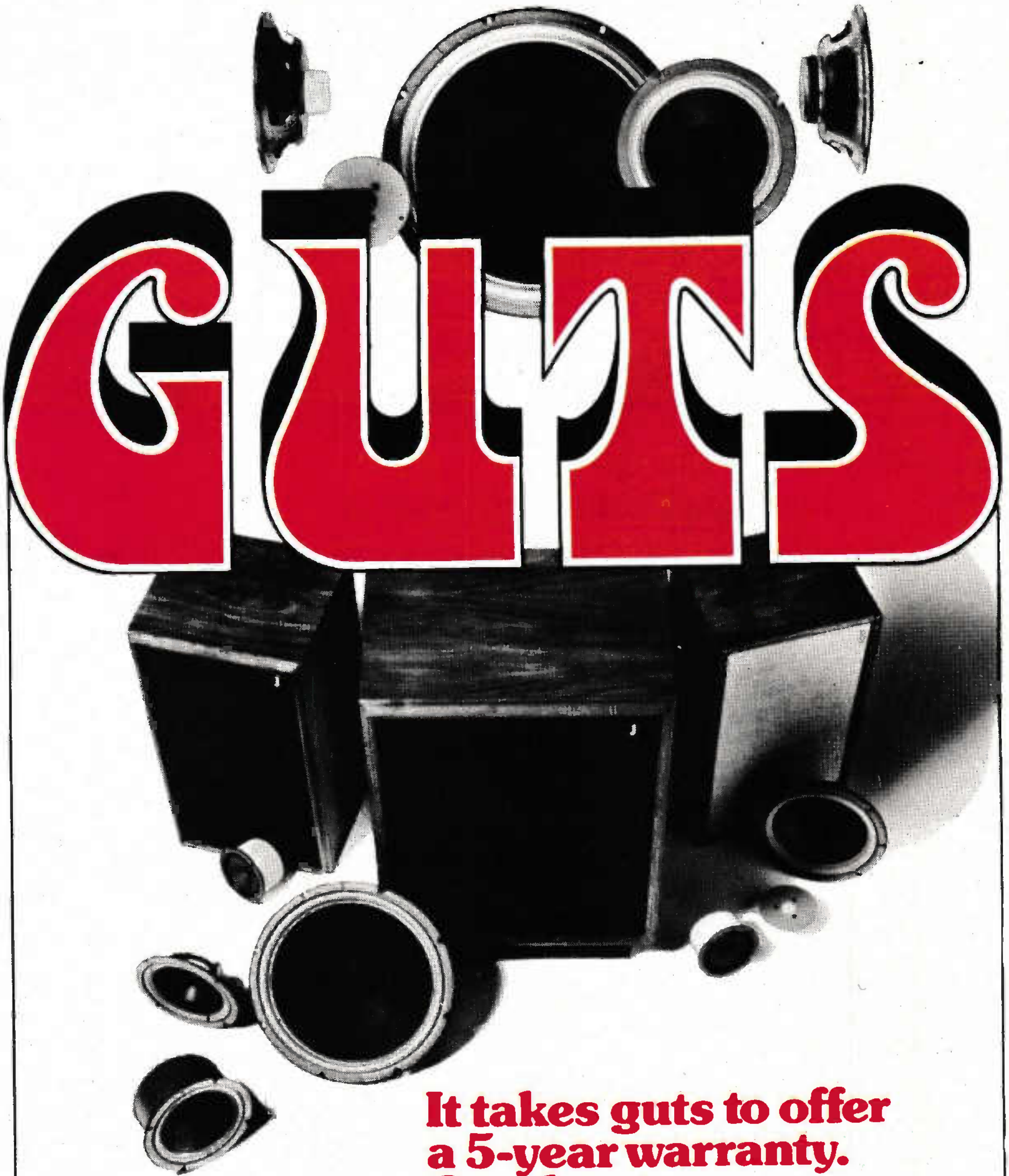

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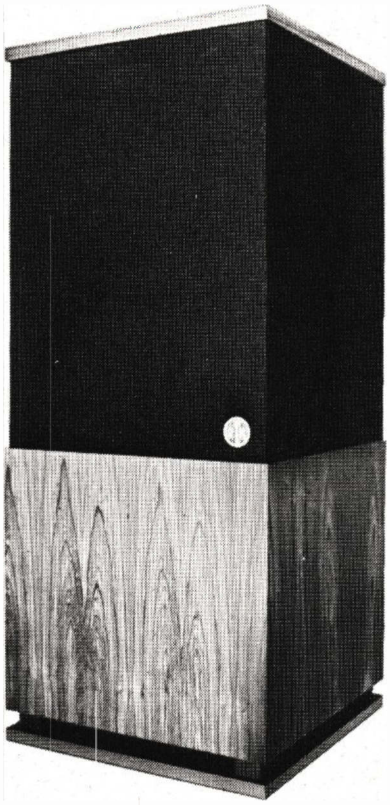

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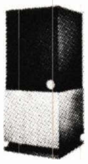
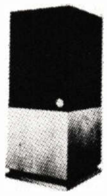


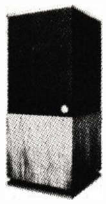
MODEL 88/D

Freq. Resp:– 40-18500 Hz. Size:– 11" x 26¼" x 11" Deep. Rec. Amp. Power:– 20-60 WRMS



MODEL 180/D

Freq. Resp:– 28-18500 Hz. Size:– 14" x 33¼" x 14" Deep. Rec. Amp. Power:– 25-60 WRMS



MODEL 280/DR

Freq. Resp:– 22-25000 Hz. Size:– 16½" x 39" x 16½" Deep. Rec. Amp. Power:– 25-100 WRMS

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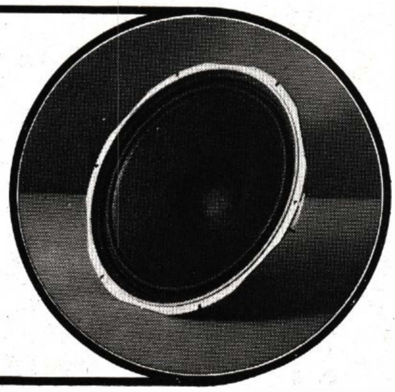

SPECIFICATIONS

Power Handling:–	150 watts RMS
Free Air Resonance:–	12 Hz
Impedance:–	8 ohms
Freq. Response:–	15-800 Hz, properly loaded
B/L Product:–	7.5 pounds/amp.

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ERRATA ROUNDUP

Jan.'73-Dec.'74

Master Mixer, Mar 73, Page 60.
Windings details for coil L1 as given in Table 1 are incorrect. The number of turns should be 1000 not 100.

Digital Stopwatch. Oct 73
There is a typographical error in the parts list on page 102 of this project.
Capacitors C6, C7, C8 and C10 should be 4.7 μF not 4.7 pF and 1 pF as shown. The correct values are shown in the circuit diagram.
Integrated circuits IC3, 4, 5, 6 and 7 should be 7490's not 7493. The correct numbers are shown on the circuit drawing.

Laser, Dec. 73
The circuit drawing on page 43 shows C8 with incorrect polarity. This capacitor should be reversed.

ETI Synthesizer
Modifications have been made to some modules in the synthesizer, and these have been published as follows; Page 68 April 74, Page 69 June 74 and Page 69 July 74.

420 Amplifier. Jan 74
Page 66, Fig. 3. Under 'notes', bottom left of circuit diagram, Q1 should be TT 800 not TT 801.
Fig. 4, The printed circuit board is incorrectly designated. The correct nomenclature is ETI 420c not ETI 420a.
Premaplifier parts list, page 68. In list of resistors line commencing R5, R6, delete R26. Add R28.
In list of capacitors commencing C1, C2, add C31 and C32.
Page 70. Paragraph 12b — should read cable is 6" i.e. 15cm. Paragraph 12c — should read cable is 8" i.e. 20cm.

Discrete SQ Decoder, Mar 74, page 73
C22 and C30 on overlay are shown with wrong polarity.

Monophonic Organ. May 74
Due to a platemaking error, the component overlay for the monophonic organ was omitted from the printed circuit board pattern shown as Fig. 3 (page 60). The correct drawing is shown on this page.

422 Stereo Amplifier. May 74
Page 73, SPECIFICATION. Frequency response should be 20 Hz-20 kHz ± 0.5 dB not 5 dB as published.
Page 74, circuit diagram. Voltage at junction of R55 and R57 should be 1.7 volts not 2.9 volts as published.
Page 78
Lines six and seven in the third column of the parts list should read as follows.
ZD1 Zener diode BZY88C5V6, ZD2 Zener diode BZY88C5V6, ZD3 Zener diode BXZ70C18 (16V or 20V will do).
Fairchild type AY9149 and AY8141 transistors, as used in this amplifier, are no longer available. Types MJ2955 and 2N3055 may be used as replacements but these have a lower fT and high frequency oscillation may occur on some amplifiers when these transistors are used.
To overcome this problem the following modifications should be carried out on the main amplifier board.
1. Connect 0.1 μF capacitors in parallel with R33, R34, R39 and R40.
2. Change C7 and C8 to 330 pF.

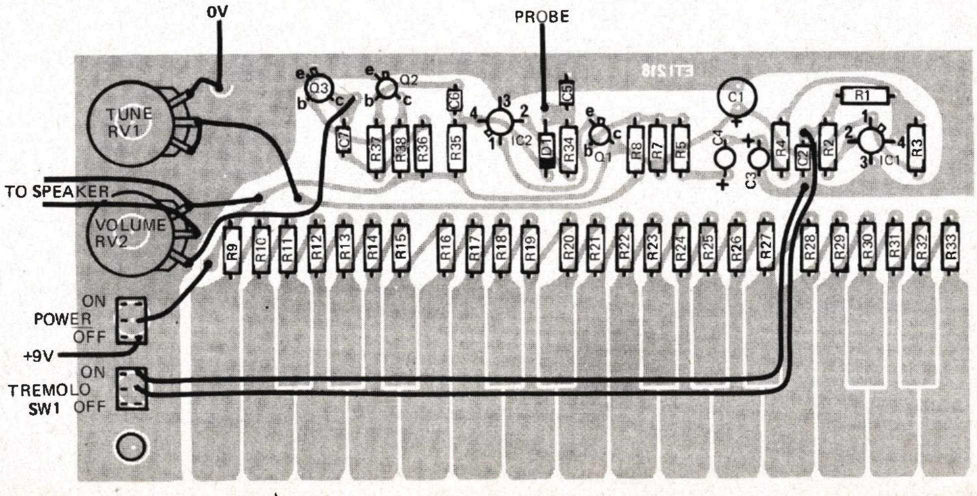
Tacho Timing Light, Sept 74, page 54.
SCR1 should be C106D1 or 2N6240 not 2N2640.

Graphic Equalizer, Oct 74, page 74
Capacitor C16 should be 0.001 μF not 0.01 μF. R20 should be 18k ohms as shown on circuit diagram.

Pot Core Design, Oct 74
Page 112; Table 2 should be headed 'P26/16 Potcores' not P18/11 Potcores. In table 2A insert line in sequence
28820 — 4C6 — 22 — 120 — ± 1% — 30780 — Green.
In table 2B after catalogue number 29240 change 29280 to 29250.
Page 113; Table 3 should be headed P18/11 Potcores.
Table 3a, grade of ferroxcube for the first six cores should be 3B7 not 387.
Catalogue number 24240 has an effective permeability of 47 not 100.5.
Catalogue number 24450 has a tolerance on inductance of ± 1% not ± 3%.
The third column should be headed 'Number of turns for 1 mH ∝

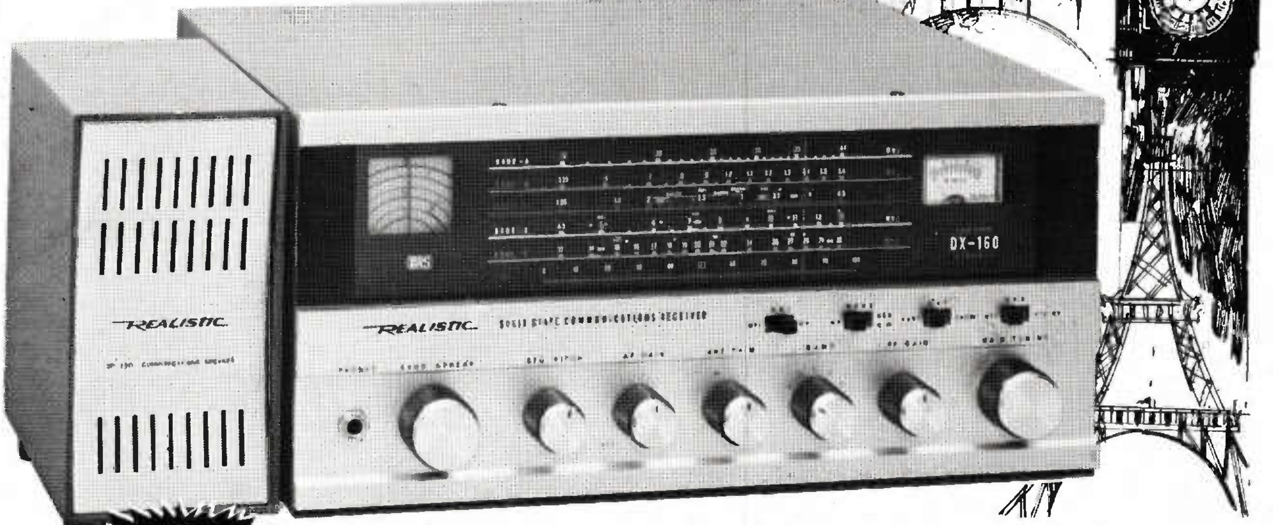
Simple Intercoms. October 1974 page 70.
Fig. 1. Output of LM380 should be labelled pin 8 not pin 3.

Meter Beater — Nov 74 Page 60
Fig. 1 circuit diagram. Switches at centre should read from top to bottom. SW1b, SW2b, SW3b. Switches at right should read from top to bottom, SW1a, SW2a, SW3a.



'Monophonic organ overlay — May '74'.

TUNE IN THE WORLD



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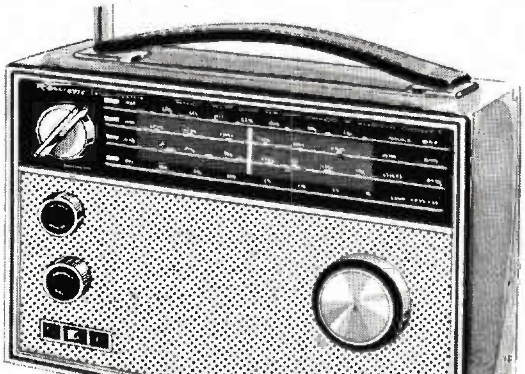

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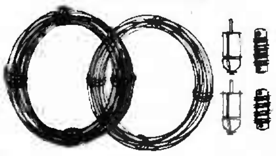

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Most of this is explained at the right here, but another point worth mentioning is that we're so deeply into this side of the business that we can easily supply baffle boards to suit existing enclosures on a custom one-off basis.
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And with the brass you save — well, you might even consider carpeting your garage floor!
A Merry Christmas to you all — and especially to Alfred E. Neuman of Gore Hill, who writes such nice letters. But in crayon?

Kit

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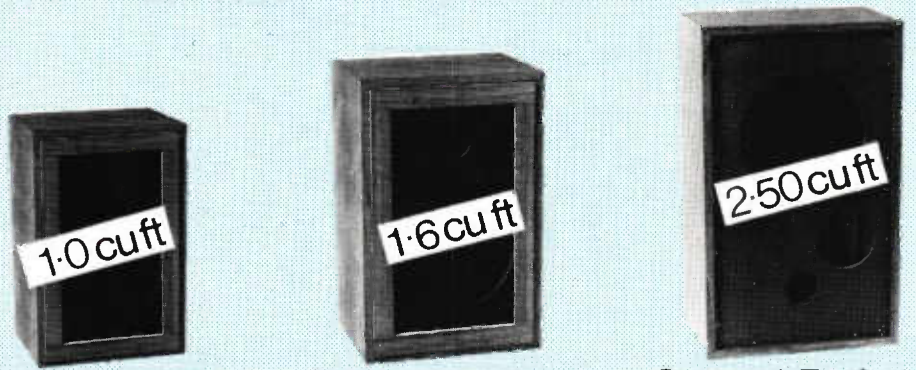

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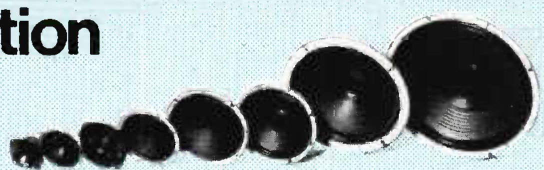
speaker selection to suit above systems



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3A: 12" Plessey C12P woofer (P&P $1.50) **$19.80** OR C12PX (P&P $1.50) **$21.** 6" Plessey C6MR mid range (P&P 75c) **$8.** 1" X30 dome tweeter (P&P 50c) at **$7.50.**

3B: 12" Phillips woofer (P&P $1.50) **$28.** 5" Phillips mid-range (P&P 75c) **$13.50.** 1" Phillips dome tweeter (P&P 50c) for **$8.75.**

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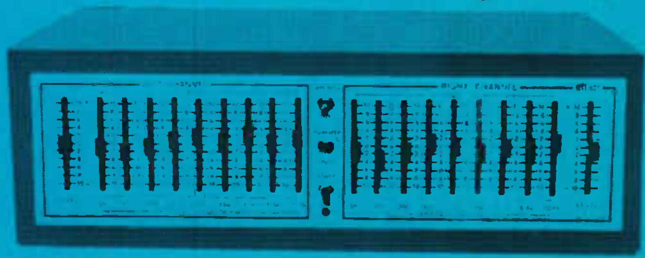

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UNDERSTANDING COLOUR TV

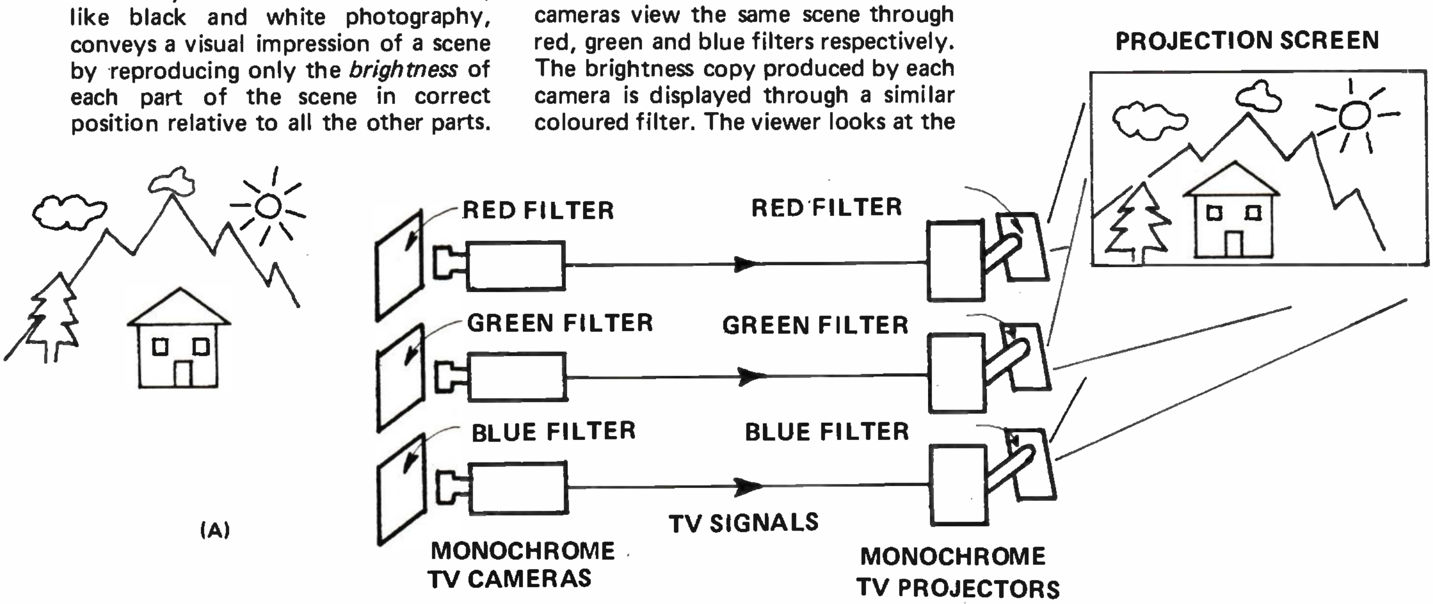
The aim of this series is to explain the basically simple principles which, when combined, make the near-miracle of colour television possible. The intention is to avoid intensive explanations of any step in the process (as a specialist may require) since this would cause a general reader to feel adrift. Instead we shall describe the fundamentals which are essential matter for anybody seeking a broad understanding of colour television.

IN PART 1, last month, it was shown that the human eye can be persuaded to see almost any colour merely by presenting it with a mixture of three lights of the primary colours red, green and blue in suitable proportions. The only shortcoming of the illusion is that the full vividness (saturation) of most of the pure spectral colours cannot be simulated, but it is acceptable for television.

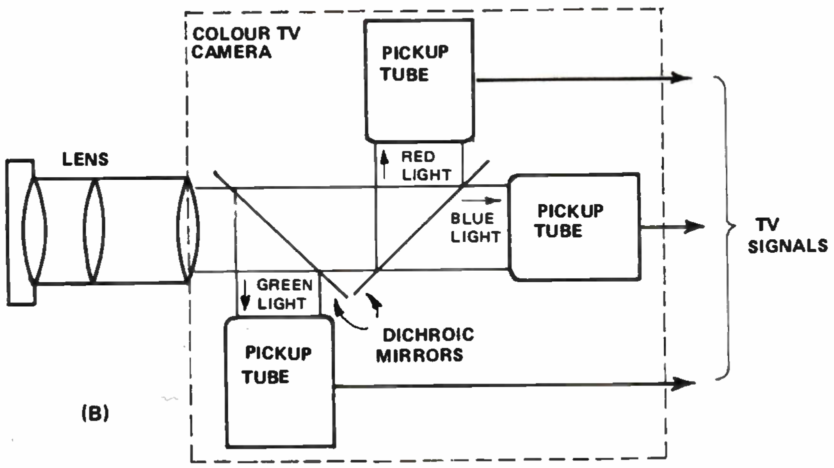
Ordinary monochrome television, like black and white photography, conveys a visual impression of a scene by reproducing only the *brightness* of each part of the scene in correct position relative to all the other parts. For many purposes this 'brightness copy' is adequate since we can recognise most objects by their shape alone, and guess at their colours from experience. Colour TV on the other hand requires three brightness variables — one for each primary colour.

Fairly obviously, a workable colour television link can be made by using three monochrome television links as follows: Three monochrome television cameras view the same scene through red, green and blue filters respectively. The brightness copy produced by each camera is displayed through a similar coloured filter. The viewer looks at the red, green and blue brightness copies superimposed and therefore sees the original colour scene. This simple scheme is sometimes used for closed-circuit projection television, in the form shown in Fig.9.

Unfortunately the scheme is impracticable for domestic colour television. The main objection is to the use of three transmitting channels. This would involve expensive triplication of transmitting and receiving equipment, ineffective use of transmitter power, and excessive occupation of valuable frequency space (a single television signal fills a bandwidth that could otherwise be occupied by at least 400 different radio programmes!). Another objection is that standard monochrome receivers, of which large



(A)



(B)

Fig. 9. A workable colour tv link can be made by using three monochrome links to copy the brightness of a scene independently in each of the three primary colours. Fig. 9a (top) shows a simple closed-circuit projection tv system. To reduce registration problems a single lens can be used to view the scene, and dichroic mirrors used instead of filters to split the light into its primary colour components, to give the usual arrangement of a colour tv camera shown in Fig. 9b (below).

numbers will probably always be in use, would give poor pictures since any single colour channel has an unnatural colour bias, e.g.: a bright red object is 'black' to the blue channel since it reflects no blue light.

The solution of these two problems of restricted bandwidth and compatibility with monochrome receivers was the major achievement which made domestic colour transmission possible.

MONOCHROME COMPATABILITY

This demands that a colour television signal should resemble a monochrome signal so closely that a viewer of a monochrome receiver sees a monochrome picture which ideally is not degraded in any way, so that he cannot even tell whether the transmission is colour or monochrome!

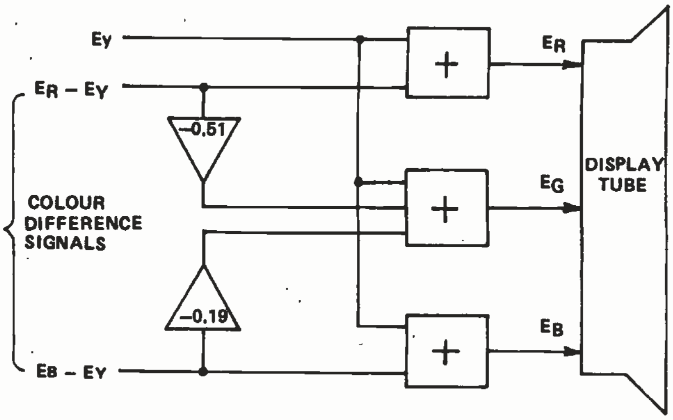
The relative brightness of different coloured objects in the monochrome picture must be correct. The eye sensitivity curve in Fig.2 last month shows that the eye is somewhat more sensitive to green than red or blue, and therefore the colour green should appear brighter in the monochrome picture than the others. If a scene is being viewed by a colour camera (such as in Fig.9b), the three tubes of which have been adjusted for equal sensitivities, the output signals can be added together in the following conventional proportions to give a brightness or *luminance* signal 'E_Y' whose colour response resembles Fig.2 and will therefore give a good monochrome picture:—

$.3\,E_R + .59\,E_G + .11\,E_B = E_Y$ where E_R, E_G, E_B are the voltage outputs of the three colour tubes for any part of the scene, E_Y = level luminance of that part of the scene.

Fortunately it is easy to add (or subtract) voltages in any proportions by means of resistor networks and summing amplifiers.

COLOUR DIFFERENCE SIGNALS

Transmitting luminance solves the compatibility problem but, at first sight, appears to occupy all the frequency space available for one television channel. For colour we must



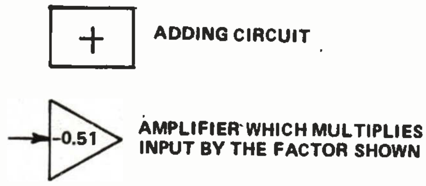


Fig. 10. Process by which a receiver reconstructs the primary colour signals required by the display tube from the luminance signal Ey plus the two colour difference signals.

transmit three channels of information from which the colour receiver can reconstruct E_R, E_G, and E_B. Since compatibility requires E_Y to be transmitted, it would be convenient to transmit two further variables:

$E_R - E_Y$

and $E_B - E_Y$.

These are known as colour difference signals and are of interest only to colour receivers. In the receiver, E_R and E_B can be reconstructed simply by adding particular pairs of signals together thus:

$(E_R - E_Y) + E_Y = E_R$

and $(E_B - E_Y) + E_Y - E_B$

It is not necessary to transmit more than the three signals E, $(E_R - E_Y)$ and $(E_B - E_Y)$ for the receiver to be able to reconstruct the third primary colour signal E_G as well, since it can be obtained from:

$-\ .51\,(E_R - E_Y) - .19\,(E_B - E_Y) + E_Y = E_G$

To prove this just write the equation again, replacing E_Y each time it appears by its full form $(.3\,E_R + .59\,E_G + .11\,E_B)$. Try it!

The colour difference signals have peculiar properties which are worth summing up.

1. In conjunction with the luminance signal they provide sufficient information for a colour receiver to reconstruct E_R, E_B and E_G. The process is summarised in Fig.10.

2. A monochrome receiver does not use the colour difference signals, only the luminance signal which contains all the brightness information of the scene.

3. The colour difference signals convey no brightness information. Together they specify points on the triangle of reproducible colours, and their axes were shown in Fig. 8 last month. Thus they convey information on the *hue* and *saturation* of any colour.

4. Unlike E_Y their values can go positive or negative.

5. For white, black or any shade of grey, both colour difference signals are zero. Thus the converse compatibility requirement of a colour receiver being able to receive a monochrome transmission is neatly solved since no colour difference signals are transmitted and their values are effectively zero.

BANDWIDTH

Somehow the two colour difference signals must be transmitted together with the luminance signal in spite of the fact that the luminance signal can

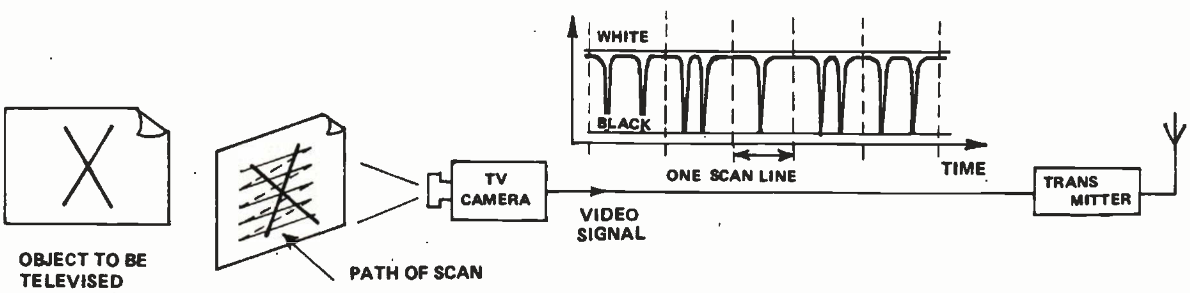


Fig. 11. Principle of tv scanning. The flyback at the end of a scan line to the start of the next is assumed to be instantaneous.

UNDERSTANDING COLOUR TV

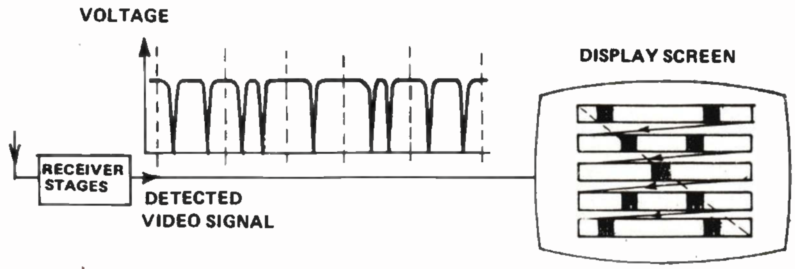


Fig. 12. Television display. The screen is scanned in synchronism with the camera by a spot of brightness controlled by the video signal. If the scan is sufficiently fast, an illusion of the televised scene is created.

be expected to take up all the available frequency space for a television signal, and in such a way that neglible interference between the three signals occurs! The requirement seems impossible until the nature of television bandwidth is understood.

Referring to monochrome television, at any instant the television camera produces a voltage which represents the brightness of a single small part of the scene. To convey brightness information about the whole scene, the pickup tube in the camera 'scans' the scene in horizontal sweeps (lines) each a little below the previous one, similar to the movement of your vision in reading this paragraph. The output voltage therefore varies as the scan passes across light and dark objects, this forming the *video* signal. This is shown in Fig.11 where the output waveform can be related to the simple picture shown. When the whole scene has been scanned, the scan begins again from the top.

It is arranged that the receiver produces a spot of light on its screen which scans the screen surface in synchronism with the camera scan. At any time the brightness of the spot is made proportional to the voltage from the camera. If the scan is so fast that each part of the screen is rescanned before the visual impression of the previous scan has faded, the eye has the impression of a complete picture as shown in Fig.12.

Clearly the video signal must at times change very rapidly between its 'black' value and its 'white' value. It is vital to know the fastest it might change. The following determine this.

1. The faster the scan the faster the video signal may have to change. In most countries a whole picture, called a frame in comparison with cinematography, has 625 lines to give adequate vertical resolution. Successive pictures must be presented to the eye about 50 times a second or flicker is intolerable. This could imply a need to scan all 625 lines every $\frac{1}{50}$ second but a technique called interlaced scanning is used to halve the scan, every *alternate* line in $\frac{1}{50}$ second, then scan the remaining lines in the next $\frac{1}{50}$ second. Each of these scans of 312½ lines is called a field. From a distance the eye sees the field flicker rate (50 per second), not the frame flicker rate (25 per second). Since 312½ lines are scanned in $\frac{1}{50}$ second, each line is scanned in 64 millionths of a second (64 μS).

2. The finer the detail of the scene, the faster the video signal must change. It is reasonable to expect the picture resolution horizontally to be about as good as it is vertically. Combining factors such as the loss of some vertical resolution because about 40 lines are necessarily outside the picture area, and the rectangular shape of the screen, the absolute maximum horizontal resolution desirable is the ability to display about 320 pairs of alternate bright and dark patches across a line. While this is unlikely to occur in a picture, such fine detail can occur in parts of scenes and the video signal would then have to change at a frequency of about $\frac{320}{64\mu S}$ = 5 MHz. In practice an absolute limit is set at 5.5 MHz – see Fig. 13a). This applies both to monochrome video signals and to the luminance signal for colour television.

Thus in theory the luminance signal might at different times have any frequency from zero to 5.5 MHz, depending on the scene detail being scanned. Apparently there is no frequency space available for our colour difference signals since 5.5 MHz is all the bandwidth allowed for a television channel, and any attempt to reduce the luminance signal bandwidth would cause blurred (reduced horizontal resolution) pictures.

However examining the actual *occupation* of the 5.5 MHz bandwidth

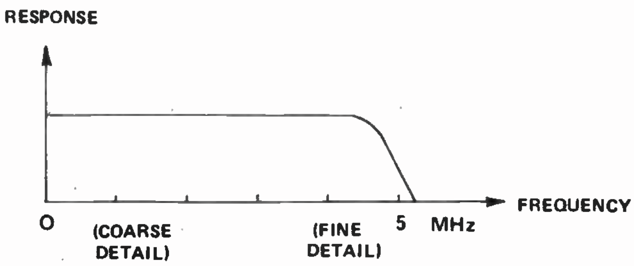
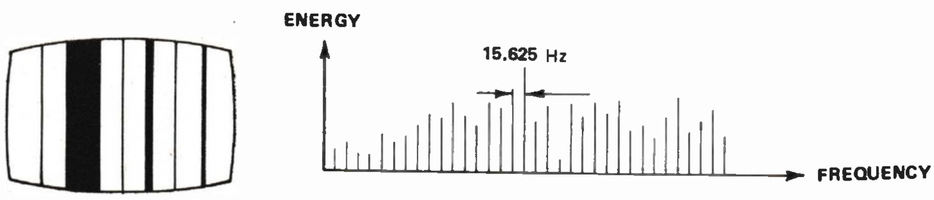
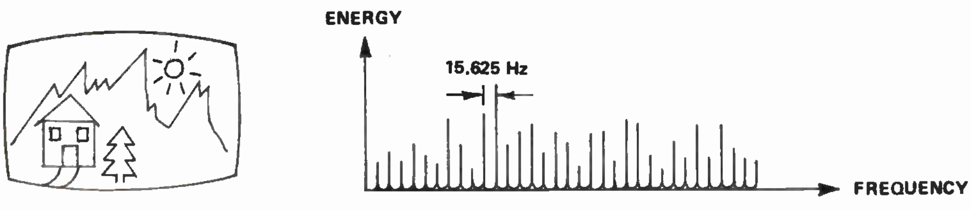


Fig. 13.
a) To ensure a luminance signal does not occupy excessive bandwidth it is passed through a filter of the response shown, which permits adequate picture resolution.



b) A scene containing only horizontal detail would cause a luminance signal containing only harmonic frequencies of 15.625 Hz.



c) The luminance signal for typical real scenes still tends to contain energy concentrated at multiples of 15.625 Hz.

by the luminance signal shows that some frequencies are far more likely to occur than others! For all likely scenes to be televised, the waveform produced by a typical scanning line is fairly similar to the line before and the line after. If we imagine a scene where every line waveform is *exactly* the same (a picture of a row of vertical bars perhaps), a mathematical description of the video signal would be:

(complex waveform of one line) X (line scanning frequency).

Although the complex line waveform might consist of many frequencies, the video signal would consist only of whole multiples (harmonics) of the line scanning frequency, which is $\frac{1}{64\mu s}$ = 15 625 Hz. (Fig. 13b). The frequencies between these harmonics would not occur at all! Although a real scene is not like this, all real scenes tend to give video waveforms containing little or no energy midway between line frequency harmonics.

COLOUR DIFFERENCE BANDWIDTH

Clearly the luminance signal does not fill the available bandwidth as completely as it appeared, which might offer a possibility of finding room for the colour difference signals. Can the extra bandwidth requirement first be minimised?

Another property of the eye ensures it can. The eye is insensitive to fine *colour detail* i.e. differences in colour between adjacent small areas. It is far more sensitive to brightness detail, which the luminance signal provides. The bandwidths of the two colour difference signals can be considerably restricted to 1 MHz, resulting in reduced horizontal colour resolution, without seriously affecting the colour picture. The eye tends to extract fine detail from the luminance information, and be satisfied by correct colours only for comparatively large objects in the scene.

Like the luminance signal, the colour difference signals contain energy mainly at harmonics of line scan frequency.

COLOUR DIFFERENCE SUBCARRIER

The trick which makes it possible to add the colour difference signals to the luminance signal without interference is to *multiply* (modulate) them by a special high frequency known as the *sub*carrier, to distinguish it from the transmitter carrier frequency. Amplitude modulation of a carrier produces *sidebands* or frequencies spaced away from the carrier by the modulating frequency. Since the colour difference signals contain mainly line frequency harmonics, the sidebands produced will be at line-frequency steps either side of the subcarrier frequency, up to ± 1 MHz away from it. We are free to choose the subcarrier frequency. If it is placed between two high harmonics of line frequency, all the colour difference sidebands will occur in the 'dead gaps' of the luminance frequency spectrum. The modulated subcarrier can therefore be added to the luminance signal with minimum interference as shown in Fig.14. The process is called 'frequency interleaving' for obvious reasons.

Since the modulated subcarrier is an ac signal it has no nett dc value and therefore does not affect the output level from the simple diode envelope detector in a monochrome receiver, which therefore responds only to the luminance signal. The subcarrier oscillation does tend to produce fine dots on the monochrome picture but using suppressed carrier modulation, plus very careful choice of subcarrier frequency, make this effect entirely negligible.

Part 3 next month will explain how it is possible to modulate *both* colour difference signals on the single subcarrier and the remarkable implications of the method chosen, summed up in the magic word PAL! ●

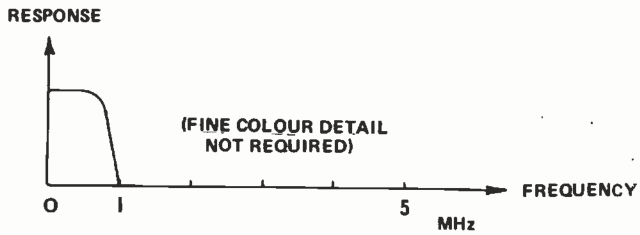
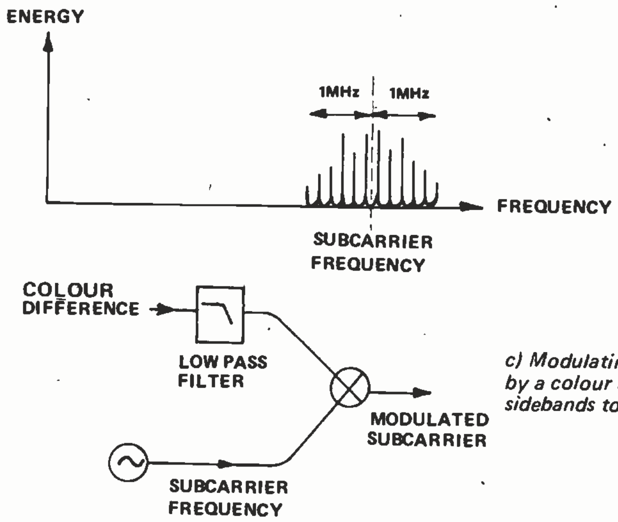


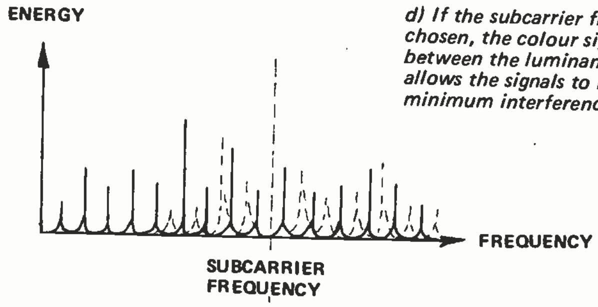
Fig. 14

a) The colour picture does not suffer much if both colour difference signals are passed through low pass filters with this response.

b) Energy in the colour difference signals tends to be concentrated at harmonics of line frequency.



c) Modulating a high frequency (subcarrier) by a colour difference signal produces sidebands to ± 1MHz.



d) If the subcarrier frequency is carefully chosen, the colour signal sidebands lie between the luminance energy peaks. This allows the signals to be added together with minimum interference.

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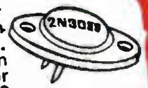

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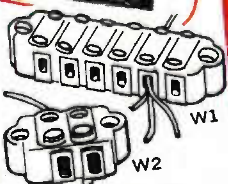

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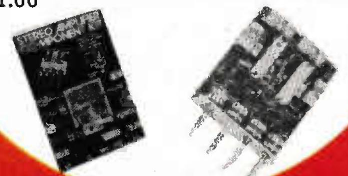

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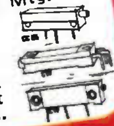

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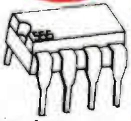

NE555 TIMER As recommended in the ELECTRONICS TODAY project features in the November issue. Owing to an enormous purchase of these very versatile linear I.C.'s we can now offer them at the very low price of $1.25 each or 10 for $11.00. FEATURES: Timing from Microseconds through Hours; Operates in both Astable and Monostable modes; Adjustable Duty cycle; High current Output can source or sink 200 mA; Output can drive T.T.L.; Temperature stability of 0.005% per °C Normally ON & OFF output. Also special offer of Signetics NE556 Timer (Replace 2 NE555 Timers). Same features as above but in a 14pin D.I.L. package $2.15 each or 10 for $20.00

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CORAL
SPEAKER SYSTEMS

8" SPEAKER SYSTEM KIT 8SA-1

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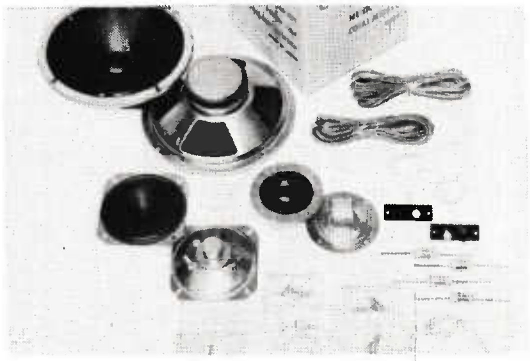
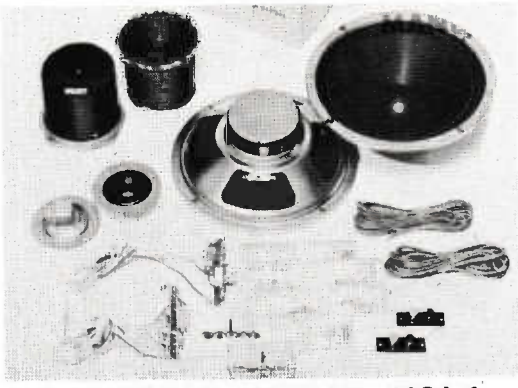


The features as assembled in a designed cabinet are as follows:

Features (8SA-1)	
Type of cabinet	Closed type
Type of speaker	3-way 3-speaker
Input impedance	8 Ohms
Crossover frequency	4,000 : 9,000 Hz
Frequency response	70 ~ 20,000 Hz
Sensitivity	93 dB
Capacity	35 W

$30 PAIR



10" SPEAKER SYSTEM KIT 10SA-1

50W, 3-way, 3-speaker system in kit form includes all speakers, crossovers, terminals, wire, screws, coral emblem for front of box.

The features as assembled in a designed cabinet are as follows:

Features (10SA-1)	
Type of cabinet	Closed type
Type of speaker	3-way 3-speaker
Input impedance	8 Ohms
Crossover frequency	2,000 : 6,000 Hz
Frequency response	40 ~ 20,000 Hz
Sensitivity	93 dB
Capacity	50 W

Price **$50** pair

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Features (12SA-1)	
Type of cabinet	Closed type
Type of speaker	3-way 4-speaker
Input impedance	8 Ohms
Crossover frequency	1,000 : 10,000 Hz
Frequency response	30 ~ 20,000 Hz
Sensitivity	95 dB
Capacity	60 W

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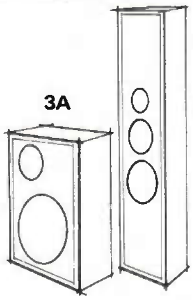

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MOTORIZED 12volt CAR AERIALS. Manufactured by HARMAN. Beautifully packed, and complete with all necessary connecting cable, raise and lowering switch and retaining clamp. A FANTASTIC XMAS OFFER at only **$14.95** each. P & P $1.00.

LOCK-DOWN CAR ANTENNA. Completely vandal proof. 3' 4" extended. Nil feet when locked down. 2 keys supplied, and includes 4' cable with connector. Side key lock: **$3.40** each; Top key lock: **$3.25** each, P&P 75c.

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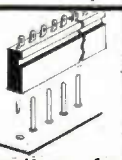

Slimline Connectors are a most handy innovation for making up Male and Female wiring connections for Printed circuit and VERO Board. The removeable pins are soldered direct into the application Board, and the mating wiring direct on to the Female Strip connector, which also has a fixed polarising pin to avoid accidental reversing of Connector. 20 Connectors from 4 to 12 way in .1" & .15" & .2" pitch. **$2.50** per 20. P & P 30c.

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Finned type. Size 2" x 6". Ready drilled to accept either 1 power transistor in TO3 case (2N3055 or similar) or 2 Power Transistors in T066 case (2N3054 or similar). Originally made for car radio's. 60c each or 2 for **$1.00** Post 30c

THE GREAT NAME FOR ELECTRONIC COMPONENTS IN AUSTRALIA

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ELECTRONIC IGNITION SYSTEM

Reliable CD1, tachometer and engine speed limiter — all in one unit!

by Barry Wilkinson.

THE CONVENTIONAL electro-mechanical engine ignition system has been with us virtually unchanged since its development by Charles Kettering over fifty years ago.

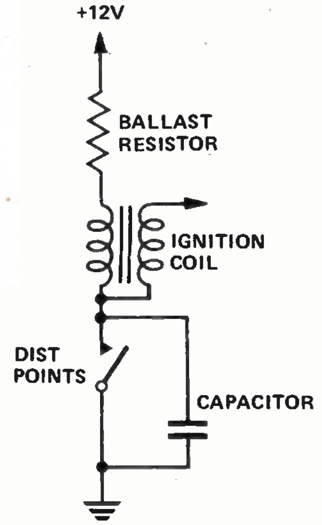
It is simple in concept and fairly reliable in operation, but even if maintained in impeccable working order it's performance is only *just* adequate in vehicles of average performance used in moderate climates.

The Kettering system has characteristics that are very far from ideal. The voltage supplied to the spark plugs, for instance, is low during starting and also at high engine speeds — just when high output is most needed. Contact breaker point and distributor cam wear is quite rapid and cause efficiency to fall off alarmingly.

Even when new, it is rare indeed to find a Kettering system that is working correctly, (that is the reason why many people obtain better results than should otherwise be expected when they fit a CDI or other electronic system to their car).

Now the system's deficiencies have become more serious — our world has too little oil and too much pollution. Good fuel economy and low engine emission has become of greater importance than original engineering cost.

At first sight it seems a relatively simple job to convert a Kettering system to electronic operation. But there is far more to it than that, as many have found to their cost. And whilst there has been a plethora of electronic systems on the market for the past ten years, few indeed can even remotely match the conventional system's reliability.



Normal (Kettering) ignition system.

As recently as August of this year, one of Britain's leading motoring magazines tested ten electronic systems made by leading European manufacturers. Incredibly, five of those systems failed within an hour and a half of installation! The reasons for the failure of these systems is discussed later in this article.

Nevertheless though, it *is* possible to design and construct sound reliable electronic ignition systems and these do have many advantages over Kettering systems.

At this point we might as well debunk a few myths — and probably lose the odd advertiser or two as well!

Unless your original ignition system is grossly maladjusted, there is no way in the world that an electronic system will improve power or fuel consumption by the 20% plus that many of their manufacturers claim.

What you can *realistically* expect is about three to five per cent better consumption and about the same increase in top end power — especially with small high revving engines. There is rarely any measurable difference with big lazy V8s, except that starting may be easier on cold mornings.

Distributor point life is greatly extended, spark plugs will last longer and the system will remain in tune for much longer periods.

EARLY ELECTRONIC SYSTEMS

The first transistor systems came into use about ten years ago. These were rudimentary systems in which a transistor was used to switch the main current — so that a control current only passed through the contact breaker points.

These systems were effective in that they prevented point burning but were just as adversely affected by high-speed point bounce as the systems they replaced. Apart from that, only low-voltage rating (100 V) transistors were generally available so special high ratio ignition coils were required. These special coils drew heavy current — as much as 12 amps was not uncommon.

The systems just described were not really electronic ignition systems — rather they were transistor-assisted.

CDI

Capacitor Discharge Ignition (CDI) was introduced some three years later.

In this system a capacitor (normally between 1.0μF and 1.5μF) is charged to 400 V or so, and, when triggered, is discharged into the spark coil thus inducing the required high voltage by transformer action.

CDI systems can be made to work very well indeed, they have excellent characteristics, such as low current drain and almost constant voltage output.

But whilst they *can* be very effective, many CDI systems are very unreliable due mainly to designers not appreciating that many of the components are being run way beyond their design limits.

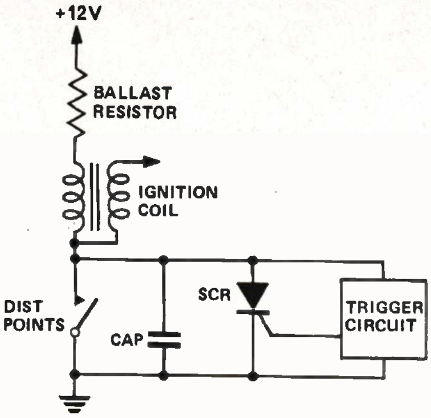
DWELL EXTENDERS

A simple device called a dwell-extender made a brief appearance a few years ago. This operated by using an SCR to 'close' the points about half a millisecond after they opened thus allowing greater current build up in the coil. In effect, dwell extenders extended the 'effective rev range' of an ignition system by about 20%.

At present the transistor assisted system is making a comeback and is just as common as CDI systems. There is also a trend towards breakerless (no contact points) systems — thus eliminating point bounce and ideally ensuring that each cylinder is fired precisely at the correct time — something that rarely happens with Kettering systems due to manufacturing errors in the distributor cam.

THE ETI SYSTEM

Many readers have asked us to design and publish a reliable up-to-date CDI system, so over the past year we have investigated very many different types to see which would provide the optimum in performance and cost combined with total reliability.



Typical dwell-extender circuit

Since electronic components can fail suddenly and unexpectedly (usually at the most inconvenient times) we opted out of a contact-breakerless system or any system which could not be changed rapidly back to standard.

This latter constraint ruled out transistor assisted systems since these normally require a low inductance ignition coil which cannot be used with standard points.

Eventually we came back to the CDI technique, but then set about eliminating those aspects of earlier designs that compromised reliability.

Our starting point was to study existing CDI systems — to see just why they fail.

The circuit diagram of a conventional CDI system is shown in Fig. 1.

In this circuit the most likely component to fail is the discharge capacitor since peak currents of 10 to 20 amps flow during each cycle. Few capacitors will withstand this sort of treatment for long. To make matters worse, the charging voltage may under certain conditions reach 500 volts or more. Since 300-350 volts is really all that is required, this higher voltage causes the capacitor to operate at twice the energy density needed — thus stressing the capacitor unnecessarily.

The SCR is also subjected to high current peaks and unless of adequate rating (as few are) it too may soon fail.

The inverter used to provide the high input voltage required by the CDI system is normally a self-oscillating saturating core circuit of the type shown. This type of circuit too has inherent failings. High currents are drawn at the moment of switching, thus causing high peak power dissipation in the transistors themselves, and as the output from the inverter is a square wave the rectifier diodes are subjected to very rapid changes in polarity.

Diodes such as the EM 410 or the IN4007 (which are commonly used) need 10 microseconds in which to turn off, so that in the inverter circuit shown, opposite pairs of diodes may be on simultaneously, thus creating a momentary short circuit across the output every half cycle.

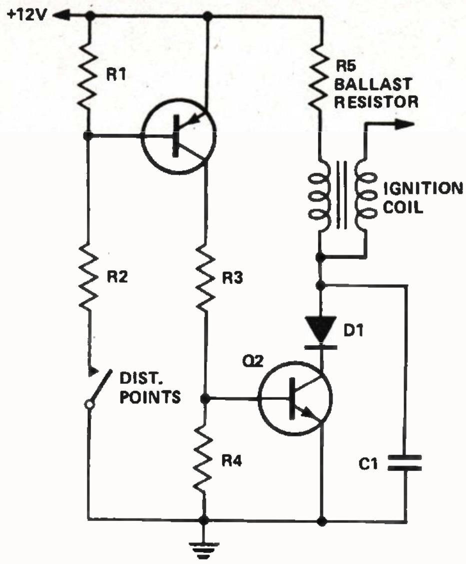
Another failing common to many commercial units is that if the inverter is sufficiently powerful to deliver full power up to 5000 rpm to a V8 engine (i.e. operating frequency of plus 2 kHz) the power dissipated in the diodes may eventually destroy them.

A final most annoying characteristic of otherwise satisfactory CDI systems is the hard-to-quieten whistle from the inverter transformer.

The Electronics Today unit is more complex than most CDI's currently available — but all the above problems have been eliminated — and it has two further features that make it (we believe) unique.

Besides being a very good CDI unit, the circuit includes a tachometer output and an adjustable rev-limiting circuit.

The tacho has been included because most electronic tachos cannot be used in conjunction with a CDI system (to use the tacho function all that is



Transistor assisted ignition

needed is a suitably calibrated 0—1 mA fsd meter).

The rev limiter circuit is intended for engine overspeed protection only. It is of particular value with sporting cars in which safe engine rpm may be inadvertantly exceeded — and also in high power motor boats which frequently suffer engine damage due to the propellor jumping out of the water, thus unloading the motor sufficiently for engine speed to exceed a critical level.

Engine speed limiters are already fitted to a few vehicles (some Lotus cars for example) but these usually consist of a mechanically controlled electrical ignition cut-out. They work quite reliably but are prone to a 200 rpm or so hysterisis. If they cut out at, say 6500 rpm, then ignition will not be switched on again until the engine speed has fallen to 6300 rpm. In the meantime unburnt fuel has collected in the silencer where it will be ignited (with a bang) when ignition re-occurs.

The ETI electronic unit has virtually no hysterisis and operates smoothly and effectively.

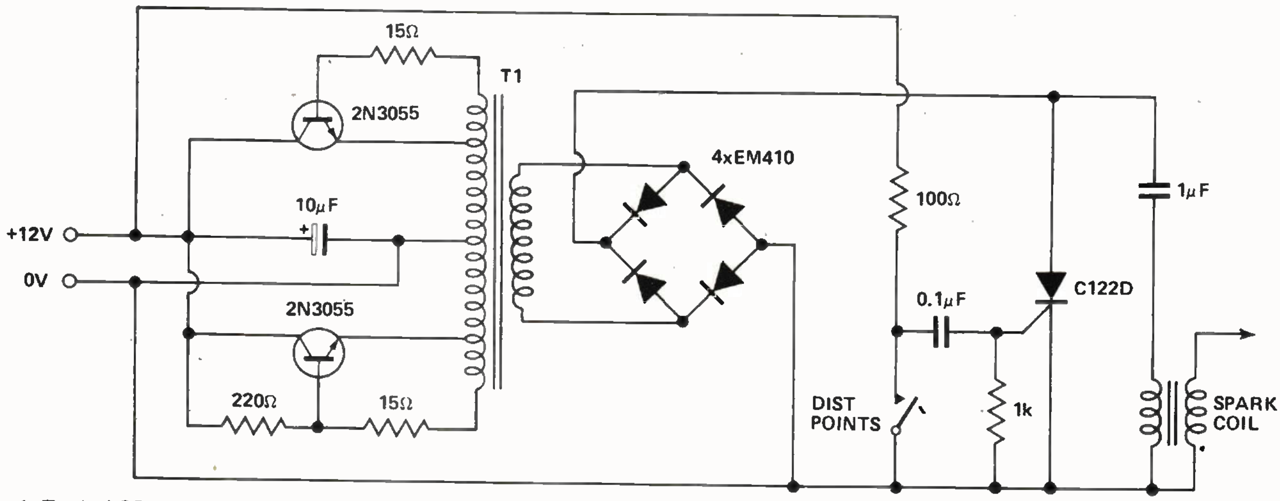


Fig. 1, Typical CD1 system.

ELECTRONIC IGNITION SYSTEM

A full description of how the ETI unit operates will be published in the second (and final) part of this article next month. Briefly however the tacho/rev limiting circuit uses a dual timer (NE556). The first half of this IC operates as a monostable which is triggered when the ignition contact points open. This provides the tacho drive.

When the first delay period ends, the second monostable is triggered and this sets the limiter. If the next pulse from the points occurs before the completion of the second delay, the SCR is inhibited thus switching off ignition until the speed has fallen below the preset limit.

As the limiter has no real hysterisis, the motor will usually fire every second or third cylinder.

Any back firing that may occur takes place in the exhaust pipe near the cylinder head — not in the silencer.

We would like to emphasise once again that the limiting circuit is intended for motor protection only. It should not be used as a road speed limiter or governor.

EARLY IGNITION SYSTEMS

The very earliest gas and oil engines used a flame or hot tube ignition system. The systems were basic yet reliable and effective. When ignition was required, a port in a reciprocating slide valve provided a passage between the burning flame and the mixture in the combustion chamber. Once the mixture was ignited, the port was mechanically closed.

The first electrical ignition system was devised by Sir Dugeld Clerk in the mid-1800's. The principle was similar to that of flame ignition except that an electrically heated platinum wire replaced the flame or hot tube. (This system is described in Sir Dugeld Clerk's classic work 'The Gas, Petrol and Oil Engine, Vol II.)

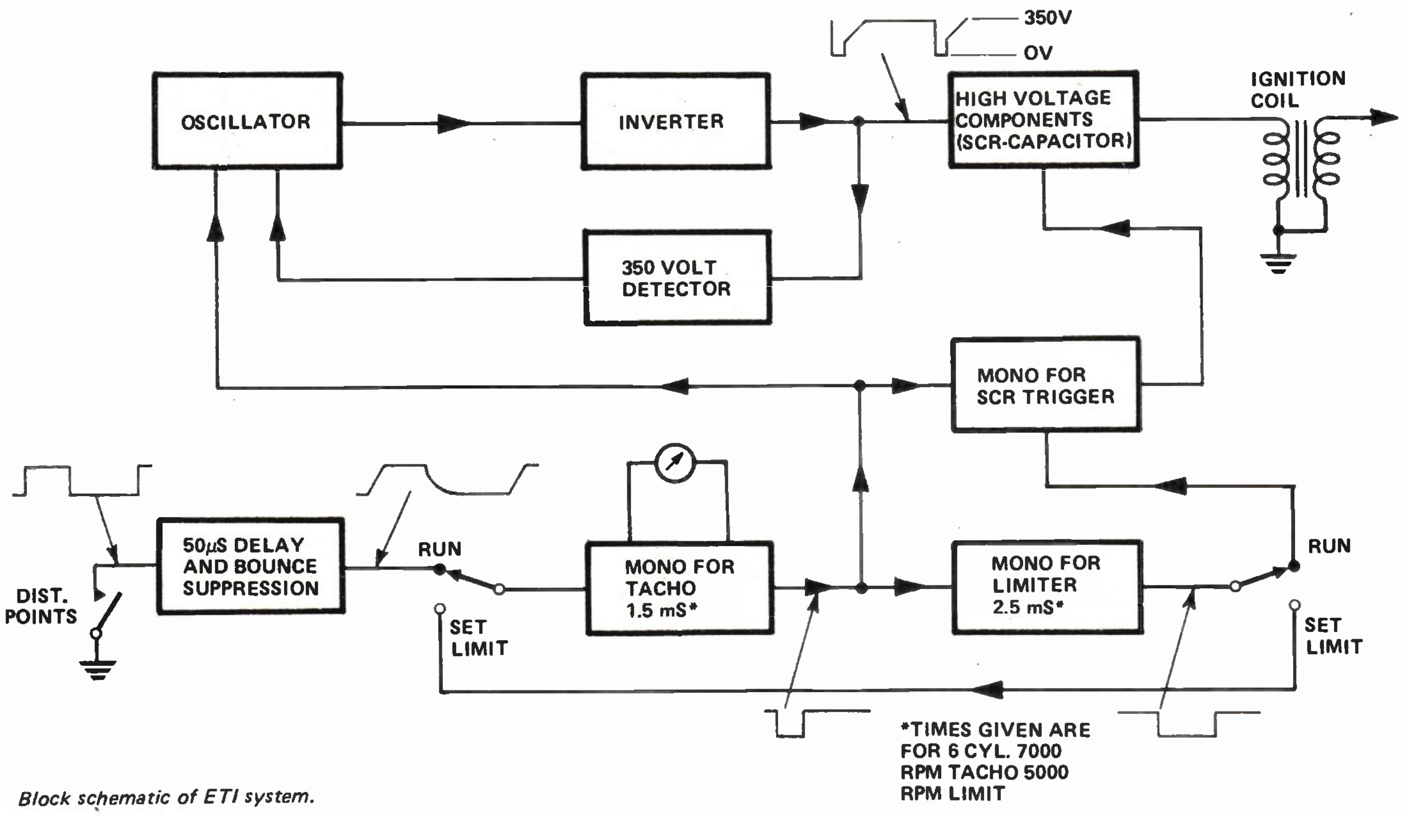
Break-spark ignition was used for a short time in the early days of motoring. In this system, a low voltage generator produces current in an inductive circuit. A spark is established within the combustion chamber at the required moment simply by mechanically separating two normally closed contacts. (This system is still used in a number of slow-speed stationary engines.)

The first high tension spark gap ignition was developed in France by Lenoir in 1860. Ten years before, a French mechanician, Ruhmkorff, had started to produce induction coils on a commercial scale. Lenoir based his system on the Ruhmkorff coil. His circuit was virtually identical to present day practice except that he used a trembler make and break on the primary side of the induction coil, instead of the mechanically operated synchronous switch used today.

The so-called 'trembler' ignition system was fitted to early Model 'T' Fords, and a few other (mainly American) vehicles, prior to 1920 or so. In this system, sixteen or so magnets were located around the engine flywheel. When the flywheel revolved, the magnets caused an alternating flux change in sixteen coils fixed to the engine main flywheel housing.

All sixteen coils were connected in series and provided an ac input to four separate trembler coils which in turn provided a high tension output, via a rotating distributor, to the spark plugs.

The system was not overly reliable and later models used an orthodox Kettering system.



Block schematic of ETI system.

HOW THE ETI UNIT WORKS

The block schematic drawing shows all functions of the ETI system.

The oscillator is based on a TTL device and runs at approximately 36 kHz. The output is frequency divided down to 9 kHz and can then be gated on or off by either of two control lines.

The output of the oscillator is used to drive an inverter which is simply a set of power transistors driving a centre-tapped transformer (no feedback windings are used).

The output of the transformer is rectified by high-speed diodes to provide about 500 volts with 14 volt input. This output is monitored by a detector. If the voltage rises above 350 volts the oscillator output is gated off which in turn shuts off the inverter. The oscillator restarts when the voltage drops below 325 volts. This circuit ensures that the output voltage (i.e. across the capacitor) is maintained at a constant level for input voltage changes from eight to 16 volts.

High voltage components consist of a 1μF or 1.5μF capacitor and a 16 amp SCR. Due to the closely controlled drive voltage from the inverter, stress on these high voltage components is greatly reduced.

When the distributor points open, a 50μsec delay is initiated. This approximates the delay inherent in the normal mechanical system, thus the original distributor timing is maintained.

At the end of this 50μsec period, a monostable (half a NE556) is triggered. Its output is used for several purposes. The complete pulse is used to drive the tachometer (1 mA fsd) and the leading edge of the pulse triggers the SCR via a short monostable and signals the oscillator to switch off and remain off for a period long enough for the SCR to discharge the capacitor and turn off again. This prevents the inverter looking into a short circuit.

The trailing edge of this monostable output pulse triggers a second monostable comprising the second half of the NE556. This latter monostable is used for the rev limiting function. If its output has not returned to 'normal' before the contact breaker points re-open, the firing pulse to the SCR will be inhibited.

The rev limiting function is adjusted by simply connecting the output of the second monostable to the input of the first. The tacho meter will now indicate the maximum rpm before limiting occurs. Then, by adjusting the second delay, the desired rpm limit can be set.

To be continued . . .

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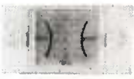

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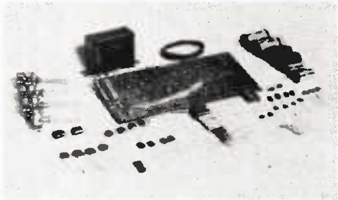

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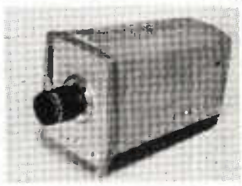

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WATTS 'RMS'

Latest FTC amplifier power ruling disrupts industry!

MODERATION, said Oscar Wilde, is a fatal thing. Nothing succeeds like excess.

Never was an epigram more applicable than in those claims made for amplifier power outputs by American manufacturers during the past five years.

Absurd claim was heaped upon absurd claim. One classic example was a claimed 100 watt power rating for a unit audio system made by a manufacturer, who in his own specification sheets showed that the unit tested under EIA practices could generate no more than six watts per channel at 5% distortion over a very restricted frequency range. Tested at 1% distortion over the usually accepted 20 Hz – 20 kHz bandwidth that unit could at the most have been rated at *two watts per channel!*

Finally the US Government had enough. There is after all a fairly clear difference between advertising hyperbole and commercial fraud.

FTC TRADE REGULATION RULE ON AMPLIFIER POWER-OUTPUT SPECIFICATIONS

Power Output Claims for Amplifiers Utilized in Home Entertainment Products

§ Section 1. Scope.

(a) Except as provided in paragraph (b) of this section, this Rule shall apply whenever any power output (in watts or otherwise), power band or power frequency response, or distortion capability or characteristic is represented, either expressly or by implication, in connection with the advertising, sale, or offering for sale, in commerce as "commerce" is defined in the Federal Trade Commission Act, of sound power amplification equipment manufactured or sold for home entertainment purposes, such as, for example, radios, record and tape players, radio-phonograph and/or tape combinations, component audio amplifiers and the like.

(b) Representations shall be exempt from this Rule if all representations of performance characteristics referred to in paragraph (a) of this section clearly and conspicuously disclose a manufacturer's rated power output and that rated output does not exceed two (2) watts (per channel or total).

(c) It is an unfair method of competition and an unfair or deceptive act or practice within the meaning of Section 5(a)(1) of the Federal Trade Commission Act [15 U.S.C. § 45(a)(1)] to violate any applicable provision of this Rule.

§ Section 2. Required disclosures.

Whenever any direct or indirect representation is made of the power output, power band or power frequency response, or distortion characteristics of sound power amplification equipment, the following disclosures shall be made clearly, conspicuously, and more prominently than any other representations or disclosures permitted under this Rule:

(a) the manufacturer's rated minimum sine wave continuous average power output, in watts, per channel (if the equipment is designed to amplify two or more channels simultaneously)

(I) for each load impedance required to be disclosed in paragraph (b) of this section, when measured with resistive load or loads equal to such (nominal) load impedance or impedances, and

(II) measured with all associated channels fully driven to rated per channel power;

(b) the load impedance or impedances, in ohms, for which the manufacturer designs the equipment to be used by the consumer;

(c) the manufacturer's rated power band or power frequency response, in hertz (Hz), for each rated power output required to be disclosed in paragraph (a)(1) of this section; and

(d) the manufacturer's rated percentage of maximum total harmonic distortion at any power level from 250 mW to the rated power output, for each such rated power output and its corresponding rated power band or power frequency response.

§ Section 3. Standard test conditions.

For purposes of performing the tests necessary to make the disclosures required under Section 2 of this Rule:

(a) the power-line voltage shall be 120 volts AC (230 volts when the equipment is made for foreign sale or use, unless a different nameplate rating is permanently affixed to the product by the manufacturer, in which event the latter figure would control), RMS, using a sinusoidal wave containing less than 2 per cent total harmonic content. In the case of equipment designed for battery operation only, tests shall be made with the battery-power supply for which the particular equipment is designed and such test voltage must be disclosed under the required disclosures of Section 2 of this Rule. If capable of both AC and DC battery operation, testing shall be with AC line operation;

(b) the AC power-line frequency for domestic equipment shall be 60 Hz and 50 Hz for equipment made for foreign sale or use;

(c) the amplifier shall be preconditioned by simultaneously operating all channels at one-third of rated power output for one hour using a sinusoidal wave at a frequency of 1,000 Hz;

(d) the preconditioning and testing shall be in still air and an ambient temperature of at least 77° F (25° C);

(e) rated power shall be obtainable at all frequencies within the rated power band without exceeding the rated maximum percentage of total harmonic distortion after input signals at said frequencies have been continuously applied at full rated power for not less than five (5) minutes at the amplifier's auxiliary input, or if not provided, at the phono input;

(f) at all times during warm-up and testing, tone, loudness-contour and other controls shall be preset for the flattest response.

§ Section 4. Optional disclosures.

Other operating characteristics and technical specifications not required in Section 2 of this Rule may be disclosed, *provided*:

(a) that any other power output is rated by the manufacturer, is expressed in minimum watts per channel, and such power output representation(s) complies with the provisions of Section 2; except that if a peak or other instantaneous power rating, such as music power or peak power, is represented under this Section, the maximum percentage of total harmonic distortion [see Section 2(d)] may be disclosed only at such rated output: *and provided further,*

(b) that all disclosures or representations made under this Section are less conspicuously and prominently made than the disclosures required in Section 2 of this Rule; and

(c) the rating and testing methods or standards used in determining such representations are disclosed, and well known and generally recognized by the industry, at the time the representations or disclosures are made, are neither intended nor likely to deceive or confuse the consumers, and are not otherwise likely to frustrate the purpose of this Rule.

(*NOTE 1*: For the purpose of paragraph (b) of this section, optional disclosures will not be considered *less prominent* if they are either bold faced or are more than two-thirds the height of the disclosures required by Section 2.)

(*NOTE 2*: Use of the asterisk in effecting any of the disclosures required by Section 2 and permitted by Section 4 of this Rule shall not be deemed *conspicuous* disclosure.)

§ Section 5. Prohibited disclosures.

No performance characteristics to which this Rule applies shall be represented or disclosed if they are not obtainable as represented or disclosed when the equipment is operated by the consumer in the usual and normal manner without the use of extraneous aids.

§ Section 6. Liability for violation.

If the manufacturer or, in the case of foreign-made products, the importer or domestic sales representative of a foreign manufacturer of any product covered by this Rule furnishes the information required or permitted under this Rule, then any other seller of the product shall not be deemed to be in violation of Section 5 of this Rule due to his reliance upon or transmittal of the written representations of the manufacturer or importer if such seller has been furnished by the manufacturer, importer, or sales representative a written certification attesting to the accuracy of the representations to which this Rule applies, *and, provided further,* that such seller is without actual knowledge of the violation contained in said written certification.

Promulgated: May 3, 1974
Effective: November 4, 1974
By the Commission.

Charles A. Tobin
Secretary

So following the dictum laid down by Sir William Jones nearly 200 years ago — that 'power should always be distrusted, in whatever hands it is placed', — the FTC took the matter out of the hands of the industry and devised a standard method of measuring and presenting amplifier power output.

The proposed standard (or Rule as it is known in the USA) was finally promulgated in May 1974 and became law on November 4th 1974.

In American law, once a Rule of this nature comes into force it is virtually impossible to alter or amend it in any way. And that, to put it mildly, is unfortunate, for the new rule contains a clause that very seriously prejudices manufacturers of high power amplifiers.

That clause is the outwardly innocent looking Clause c of Section 3 which reads 'the amplifier shall be preconditioned by simultaneously operating all channels at one-third of rated power output for one hour using a sinusoidal wave at a frequency of 1000 Hz'.

This seems a reasonable enough requirement until one realizes that a transistor output stage is at its most inefficient (and thus generates the most heat) at 30% — 40% of full power. And there is hardly a high power (domestic) amplifier in the world that has a snowball's chance in hell of running at the required 33 1/3% full power for more than a few minutes — let alone a full hour!

Incredibly, not a single person spotted the problem before the Rule became law. Now it's too late.

The EIA (Electronic Industries Association) realised that they had a problem after the Rule was published and considered obtaining an injunction to prevent the Rule coming into effect. However legal opinion was that their chance of obtaining such an injunction was absolutely nil.

The absurdity of the situation is that the Rule — (if enforced, as it certainly seems it will) only hits manufacturers of high power amplifiers — who generally speaking were not guilty of making excessive power output claims anyway.

This is because music generally has a ratio of some 10:1 to 20:1 between peak power and average power, and average listening levels require amplifier power output of well under five watts.

Thus most high power amplifiers run at less than 5% of their output most of the time and only (in fact *can* only) generate their full 100 watt plus capability on transients.

This is a completely realistic design approach, bearing in mind the nature of programme material. Low powered amplifiers must be designed to generate half to full power output virtually continuously — because that's how they are going to be used. So for these units the 33 1/3% pre-conditioning requirement is no problem.

High power amplifiers *can* be made to conform to the requirements of the FTC Rule — in fact one or two actually do. But the great majority have no hope at all of meeting the requirements without major upgrading of heat sinks and power supplies. Such units would be larger, heavier and at least 50% more expensive — for no possible beneficial return to the non-professional user.

Currently, US manufacturers are accepting that it is unlikely that the Rule can be changed — it could however be 'bent' slightly.

One suggestion, put forward by the US journal Stereo Review is that the 1000 Hz sinudoidal input waveform be cycled — such as one millisecond on, two milliseconds off repeating for one hour. In this way the amplifier would be driven to its *full* power output for one third of the time — conditions that most high power amplifiers could just about meet. As average power would be 33 1/3% of full power the requirements of the Rule could still be met.

They might just get away with it! ●

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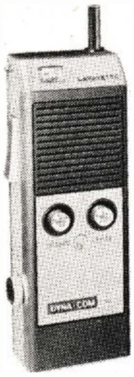

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MODEL 8414 MICRO EXECUTIVE – $30. DISPLAY: 8 digit. FUNCTION: Addition, subtraction, Multiplication Division, Continuous Calculation Multiplication by Constant. Division by Constant, Reciprocals Square, ADD-ON/Discount, Percentage Calculation, etc. DECIMAL POINT: Full floating 6/4/2 — 4 position 3rd, 5th & 7th digit rounded off respectively, underflow system 10^8. SIGN: Overflow, Battery Low, Negative. POWER SYSTEM: AC 240V 50 Hz. DC 6V 1.5 Volt Cell x 4 (Optional AC adaptor).

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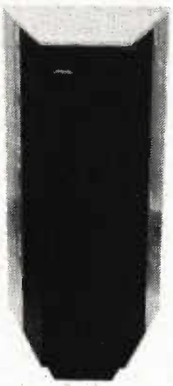

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Nominal Power Input: 60 Watts
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Frequency Range: 30-22,000 Hz
Size: 30-3/8 x 14 x 12½
77 x 35.5 x 31.5 cms
Finishes: Teak, Walnut or White

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1 x 12" bass speaker, 1 x 4" midrange, 1 dome tweeter.
Nominal Power Input: 40 Watts
Impedance: 4-8 Ohms
Sensitivity: 9 Watts
Frequency Range: 35-22,000Hz
Size: 30 x 14¼ x 10-5/8"
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Model One-Ten Am/Fm Tuner Amplifier

Power Output: 50 Watts per Channel into 4 Ohms
Variable Tuning Ranges: VHF FM: 87.5-108 MHz
Length: 584mm
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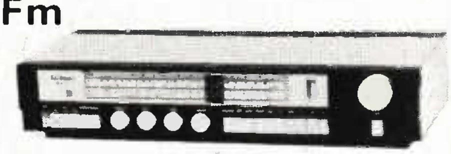

Amplifiers

Model Forty Forty Amplifier

Power Output: 35 Watts RMS per channel into 4 ohms
Total harmonic distortion: Less than 0.1% at 30 Watts per channel
Frequency Response: 30 – 20,000 Hz ± 1.5 dB
Finishes: Teak, Walnut or White
Size: 22 x 11¾ x 3¾ ins.

Magnum S.L.

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1 x 12" bass speaker, 1 x 4" midrange, 1 dome tweeter.
Nominal Power Input: 40 Watts
Impedance: 4-8 Ohms
Sensitivity: 2 Watts
Frequency Range: 30-22,000 Hz
Size: 24 x 15 x 11-3/8
62 x 38.1 x 29 cms
Finishes: Teak or Walnut

Havant S.L.

- 3 way system

1 x 8" bass speaker, 1 x 3-3/8" midrange, 1 dome tweeter,
Nominal Power Input: 20 Watts
Impedance: 4 Ohms
Sensitivity: 4.4 Watts
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Size: 18¾ x 10½ x 10½
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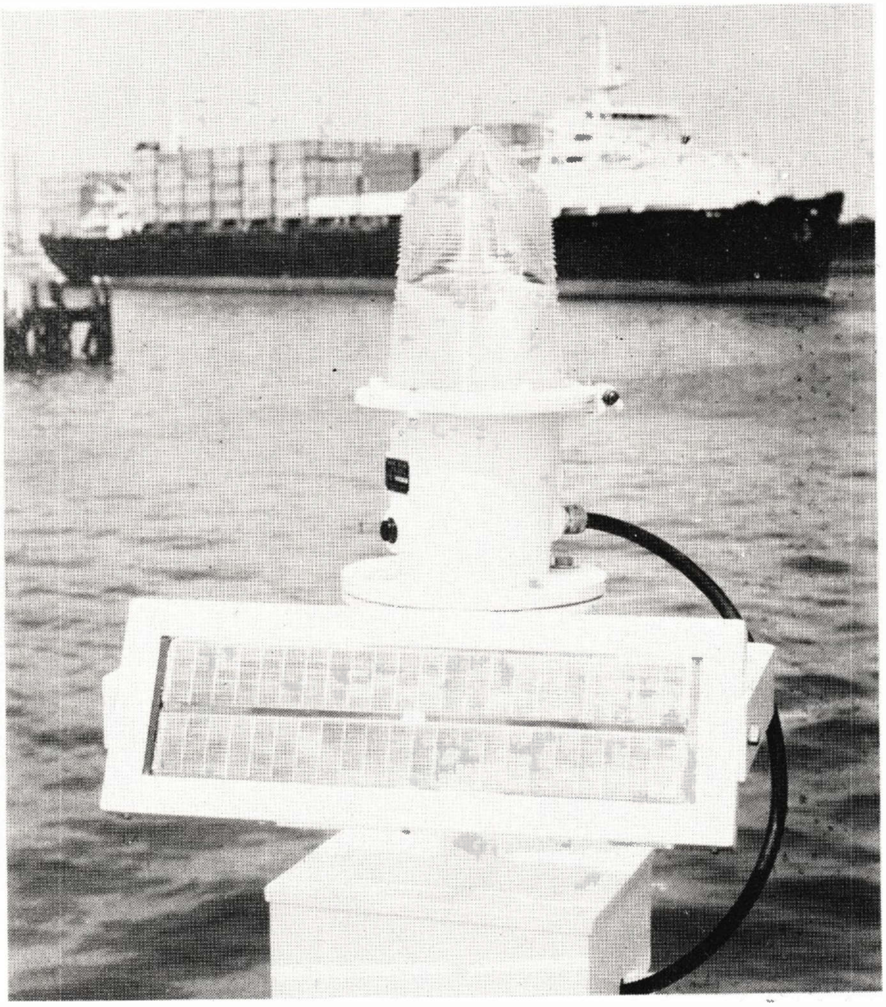
ELECTRONICS —it's easy! Part 13

The sources of power.



Solar-cell powered buoy.

OUR COURSE, so far, has concentrated on developing basic electronic system blocks from combinations of passive and active components. You will have seen that, with each type of circuit, there is a requirement for some sort of power supply, although, there are some very rare circuits that may be powered by signal energy alone.

The provision of power for electronic circuits, is hence of primary importance. In the circuit illustrations, used so far, power supplies have been of a very simple kind, but, in some circumstances, they may be quite complex and expensive. Hence, before developing our circuitry still further we must gain a better understanding of the types of supply and the methods of implementing them.

The most commonly used source of electrical energy is that provided by the power mains and this, as we know, is alternating current (ac). However electronic circuits, in the majority of cases, need direct current (dc) supplies. Hence a discussion of power supplies for electronic systems must cover firstly the production. and secondly the stabilization of dc voltages.

PROVISION OF DC

The source of dc power for electronic circuits, at any particular voltage, must be convenient, economic and easily started and stopped as required.

A wide range of basic power supplies is available to choose from — see Fig. 1 They range from tiny batteries to huge engine-driven generators. Each application has to be considered individually and the appropriate means chosen to suit the requirements of the circuit and the way it is to be used. Can the supply provide enough power. Does it provide the desired conditions of portability? — (in the field the weight of the supply may be critical). Is the method used economic? (batteries may be simple to use but their replacement can be costly). Is a non-portable supply already available for use? (such as the electricity mains). Sometimes a power supply already operating on some existing equipment may have adequate spare capacity.

There are many known methods of producing dc power. Batteries use electro-chemical action; rotating generators move conductors in a magnetic field to generate electricity; the mains supply (derived by rotating generators) is rectified to produce dc, fuel cells combine chemicals (still an exotic way to produce energy); thermo-electric systems generate electricity from thermo-couples or solar cells.

However the two most common sources of dc are firstly from batteries and secondly transformer/rectifier systems driven from the mains ac supply.

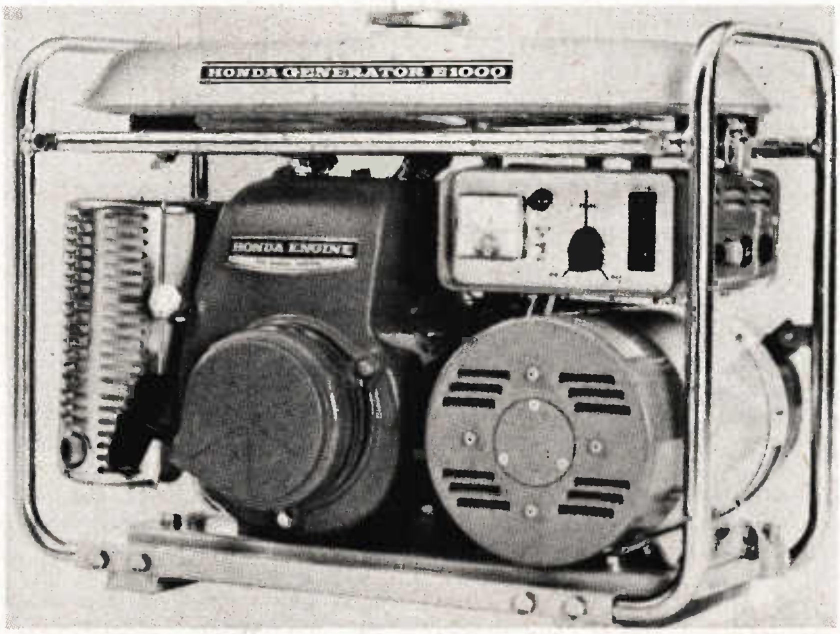
BATTERIES

In 1792 Italian anatomist Luigi Galvani, whilst working on dead frogs, discovered that the frog's legs twitched when touched with two dissimilar metals. The same phenomena occurred when the frog's legs were attached to an electrostatic generator. He (wrongly) attributed this to an effect which he called "animal electricity".

However, another Italian professor, Alessandro Volta, investigated the effect in 1800 and, showed that it did not depend on the animal tissue, but upon electrical generation due to two dissimilar metals being separated by a conductive solution. He thus showed two important things — that animal muscle was activated electrically, and that electricity could be generated chemically. (Previously only static electricity was known.)

Volta produced the first practical battery, called at that time a voltaic pile, by placing moistened paper sheets

Fig. 1. *Power sources for electronic systems may vary from dry batteries, engine driven generators, thermo-electric (as the solar-cell powered buoy p. 100) — to specialised laboratory power units deriving their energy from the mains.*

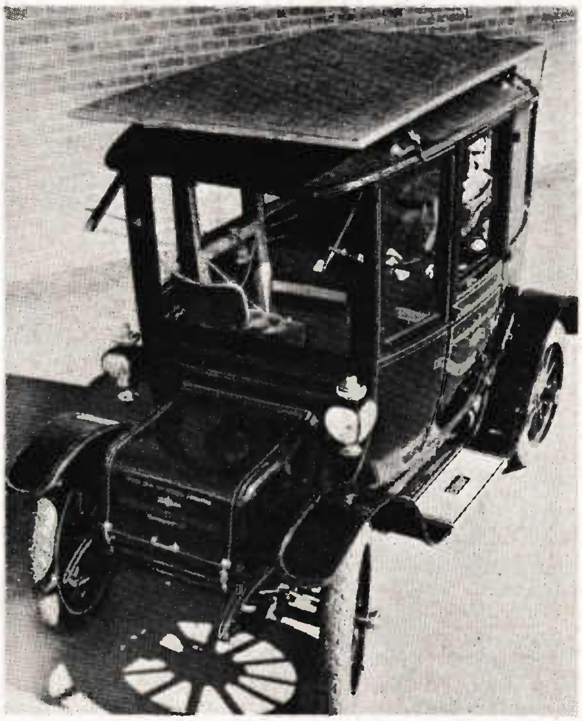


between alternate sheets of copper and zinc as shown in Fig. 2a. He also made cells in which the separating fluid (now called the electrolyte) was a liquid. His wet-cells used rods of zinc and copper, placed apart, in a diluted solution of sulphuric acid (Fig. 2b). Volta thought that the solution merely separated the electrodes without playing any vital role. We now know differently.

The fluid (it can also be a paste or solid) acts as an electrolyte. That is, the dissolved compound dissociates into positive and negative ions, however, the electrolyte has overall electrical balance.

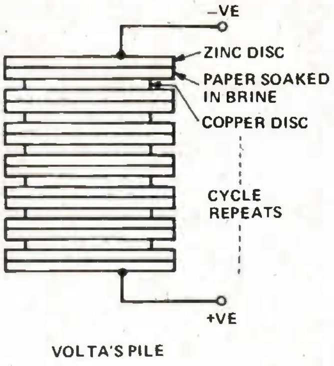
When the copper and zinc electrodes are inserted an electric field is set up in the boundary layer between each electrode and the electrolyte. With the copper/zinc cell the copper is at a lower potential than the acid and the zinc is at an even lower potential.

The cell thus has an electromotive force between the electrodes which



This 1912 Baker Electric is now driven by solar energy! An array of 10 640 silicon solar cells mounted on the vehicle's roof charge intermediate storage batteries. Final drive is via the Baker's original dc electric motor

ELECTRONICS –it's easy!



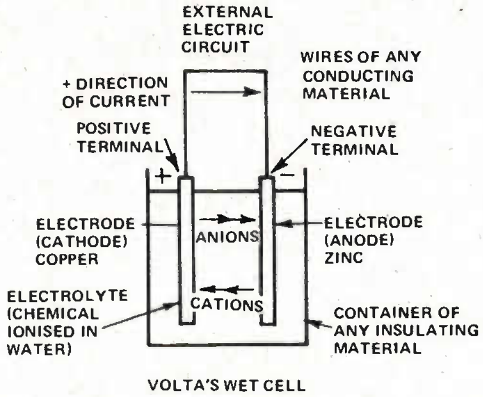


Fig.2. Cross sectional diagrams of the first electrochemical cells – VOLTA'S pile and wet cell.

depends on the difference in potential between the copper and the zinc.

When the electrodes are connected to allow electrons to flow, the dissociated ions move towards the electrode of opposite polarity. For example, in Volta's wet cell, the zinc electrode combines with the negative sulphate ions leaving the zinc electrode with an excess of electrons. These electrons flow through the external circuit to the copper electrode where they combine with the hydrogen ions to produce free hydrogen.

Many combinations of electrodes and electrolytes may be used to form cells in a similar manner. Some arrangements are more useful than others by virtue of higher energy capability, and hence many of the original systems developed have now been discarded as inefficient.

DEPOLARIZATION OF CELLS

The formation of gas on an electrode (hydrogen in the voltaic cell) becomes an effective insulator and may cause the cell to cease working efficiently or even completely. If the gas (or other product, eg solid in some cells) can be chemically removed, as it is formed, the cell will continue to produce power until the negative plate material has been used up – it redeposits on the other plate. Such an additive, which maintains full cell efficiency, is known as a depolarizer.

PRACTICAL BATTERIES

The electrochemical process just described can be optimized to either *produce* electricity or to *store* it for reuse. Cells providing power from an initial chemical charge are called primary cells. Those that are made intentionally to store power are called secondary cells (also called accumulators in earlier literature). Some combinations and designs will act as both, but usually a primary cell is a throwaway item. A secondary cell usually requires charging (the process of storing electrical energy) after manufacture, and may be recharged as often as is necessary.

PRIMARY CELLS

The most commonly used primary cell is the well-known dry-cell (or more correctly, the Leclanche cell, after the original developer who introduced it in 1877). It is made, as shown in Fig. 3, from a zinc can containing a central carbon rod surrounded by, firstly, a depolariser (manganese dioxide) and then the electrolyte which is in paste form (ammonium chloride, zinc chloride, water and a filler material). The basic cell is made in many sizes and is also packaged as groups of cells connected in series and/or parallel to provide either greater capacity at the 1.5 V delivered per cell – or increased voltage. For example 90 V batteries (constructed from sixty 1.5 volt cells) were extensively used in the days of valve-circuit portable radios.

There are many alternatives to the basic Leclanche cell. All have characteristics which make them suitable for low power, portable applications. The characteristics of the different primary cells are given in Table 1.

The mercury cell, developed in the 40's, is far more rugged than the Leclanche cell and retains its voltage better over long periods of light use or storage – several years is typical. These use zinc and mercuric oxide (or graphite) electrodes with alkaline hydroxide electrolyte. A typical arrangement is shown in Fig. 4. They can be made extremely small in size and are ideal for powering very small equipment, such as hearing aids, or for equipment used intermittently such as photographic light meters.

Another cell available today is the alkaline-manganese battery. Its interior design consists of pellets of anode and cathode materials; zinc and carbon are used. The manganese dioxide depolariser is arranged to be more efficient than in the common dry-cell and the electrolyte is potassium hydroxide. This battery has an excellent shelf-life and is capable of sustaining a high discharge rate.

Several other primary cells will be encountered in electronic instrumentation – The Daniell cell 1836 (copper, sinc and sulphuric acid), the Clark cell 1872, and the Weston cell 1892 (mercury, cadmium amalgam and cadmium sulphate solution, as

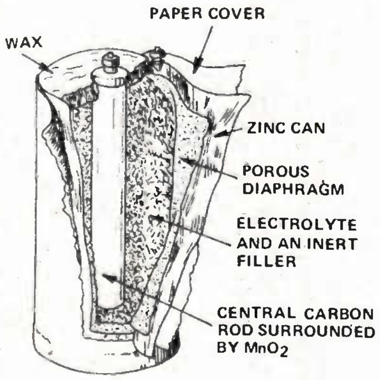


Fig.3. The common dry cell was originally developed by Leclanche in 1877. It produces power for a limited period and is then discarded.

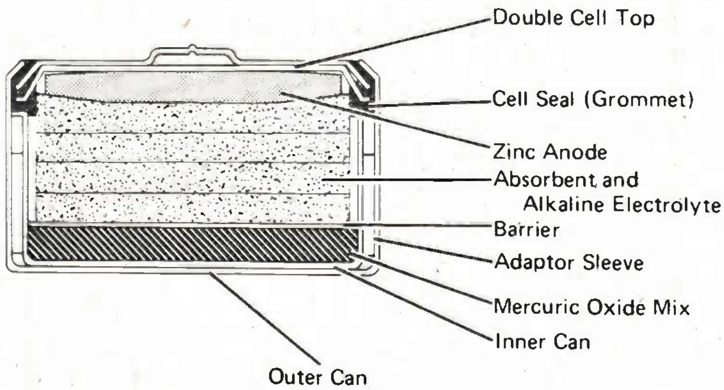


Fig.4. Cross sections of a typical mercury cell.

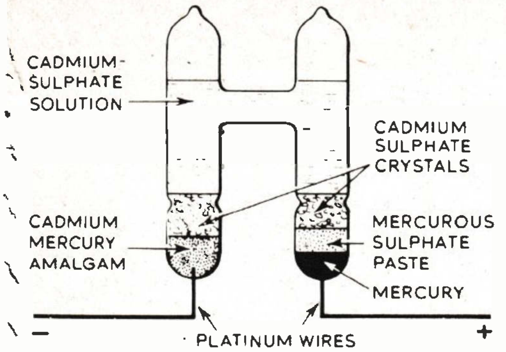


Fig.5. The Weston standard cell delivers 1.0186 volts provided the load is minimal. It has found extensive use as a standard of the voltage unit.

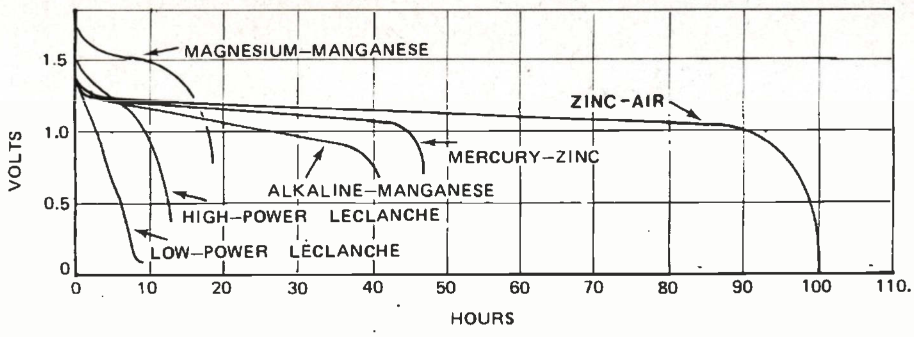


Fig.6. Comparative chart showing voltage characteristics of similar size units of various types of dry cell battery.

shown in Fig. 5) are the three cells which were used internationally at various times to define the standard of voltage. The latest voltage standard has recently been changed to use the so-called Josephson solid-state effect, but the Weston cell is adequate for many voltage calibration tasks (1.086 volts). Standard cells are used only to provide accurately-known and time-stable voltage, but only at low current. They are not intended for power use.

A more recent development are zinc-air cells. These use a zinc powder anode in contact with potassium hydroxide electrolyte. The cathode is a porous arrangement that breathes to atmosphere making use of oxygen, via an intermediate process and a catalyst, to produce hydroxyl ions which enable current flow to occur.

The silver-zinc primary cell has high energy density and discharge rate but because of high cost, is restricted to exotic applications such as spacecraft electronics.

Each type of cell has its own particular merits. Figure 6 shows the voltage-time curves for an ideal loading condition along with comparative figures for the commonly used cells. Leclanche cells operate best in intermittent service, where high currents are needed, or continuously for low drains. Mercury cells especially suit low current demands for very prolonged periods. Zinc-air batteries work best for high current loads maintaining voltage uniformly over considerable periods. Silver-zinc provides the highest available energy density.

The relative cost of each should be considered in selection along with the requirement. It may well be more economical, in the not too long a run, to use the more expensive alternatives.

SECONDARY CELLS

We have seen that the electrical energy provided by a primary cell is derived from a chemical process. From school chemistry we know that, when zinc is dissolved in sulphuric acid, a large amount of energy is released as heat. In the voltaic cell this energy is released as electricity rather than as heat. If the reaction is *not* reversible the cell is a primary cell and is thrown away when exhausted.

There are however others in which the reaction *is* reversible and these are known as secondary cells. For the system to be reversible the electrolyte and electrodes must be capable of being converted back to their original state after discharge. This reversal is *not* spontaneous. The cell must have the electrical energy pumped back into it. That is – it must be charged.

The commonest arrangement (in use since the last century) is the lead-acid battery, such as is used to start cars and to power the auxiliary circuits. The second most commonly used is the nickel-iron cell.

The lead-acid battery consists basically of a plate of lead (negative electrode) and a plate of lead dioxide (positive electrode) immersed in dilute sulphuric acid – as shown in Fig. 7. As the cell discharges, the lead electrode and sulphate ions in the electrolyte combine to produce lead sulphate plus electrons, and the lead-dioxide combines with sulphate ions, hydrogen ions and electrons to produce lead sulphate plus water. The insoluble lead sulphate adheres to the plates, finally shielding them from further electrochemical reaction – the cell is then discharged. The recharging process reverses the reactions, rebuilding the electrode material as the lead sulphate is removed from solutions to produce sulphuric acid and electrode. The nominal voltage produced is 2.0 V. As water is liberated the cell is easiest vented to air, but it can be made as a sealed cell.

The nickel-iron cell, invented by the Edison Company at the turn of this century, uses oxides of iron and nickel as the electrodes together with potassium hydroxide electrolyte. The electrochemical action is similar to the

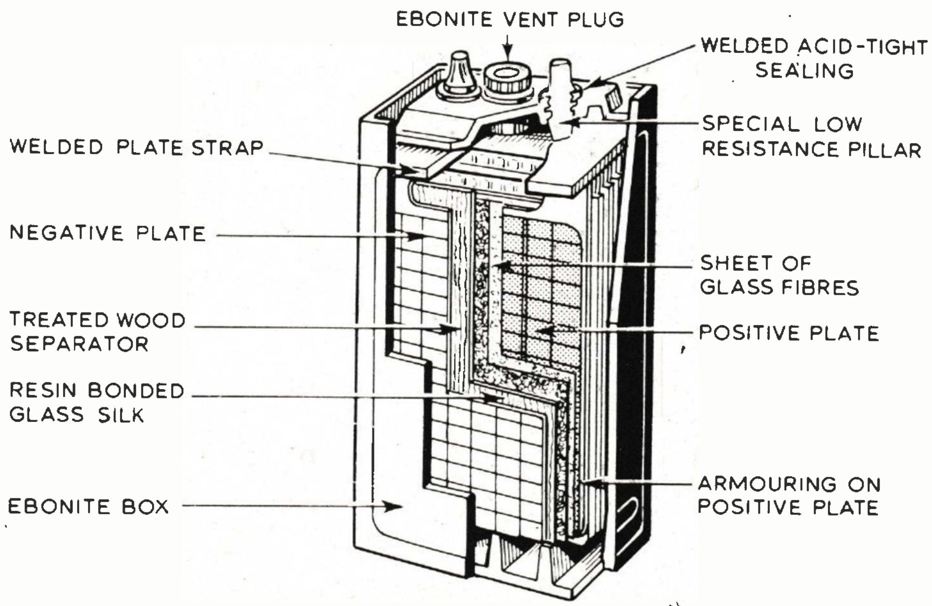


Fig.7. Interior of lead-acid storage cell. Electricity is stored by virtue of chemical reactions induced by charging the cell with electricity.

lead-acid battery — electrodes and electrolyte combine releasing electrons and the process is reversible. These cells can be sealed without difficulty, they are more rugged, give a longer life than lead-acid cells, but cost more.

In the search for more storage capacity for unit volume and weight, research has yielded some exotic battery designs. Silver and zinc are used in a design originated by Andre in the 1930s. Clearly the cost is higher but the considerable gains in weight reduction may make them attractive where weight is a major cost factor — missiles, satellites and man-packed equipment.

As it is now clear that a new kind of storage battery will be in extensive use within this decade we include a brief description of the high-temperature batteries now approaching market production. These cells, also use electrodes and electrolytes, but run at temperatures up to 400°C, and can provide at least four times the storage capacity at the same cost and weight as lead-acid cells. The need for high-temperature operation does, however, exclude them from low power applications. The two main contenders are the sodium/sulphur battery that uses liquid sodium and sulphur electrodes with solid alumina electrolyte (the most developed to date) and the lithium/sulphur battery that uses liquid lithium and sulphur electrodes with molten salt electrolyte (the most theoretically efficient cell). This latter type, will probably be more costly to produce. Both of these types, plus several other high temperature arrangements, have been used in prototype situations — powering electric cars is the dominant requirement, but large scale mains-power, system-float storage will be the main usage in the future.

The range of storage cell available for powering electronic circuits is therefore broad, and the type must be chosen to suit the application. For circuits having only medium demands, electronic flash units, calculator supplies — small rechargeable nickel-cadmium cells are best. These are made in the same shape as mercury or Leclanche cells allowing them to replace primary cells and be recharged when needed. ●

Table 1—Primary Batteries

	Leclanché (Dry Cells) Cylindrical	Alkaline-Mercuric Oxide: Mercuric Oxide	Alkaline-Mercuric Oxide: Mercuric Oxide Manganese Dioxide	Alkaline Manganese Dioxide	Magnesium-Manganese Dioxide	Zinc-Air	Solid State	Silver-Zinc
Cap. Avail. (Ah)	0.350 - 21	0.075 - 14.0	0.036 - 3.6	0.580 - 10.0	2.0 - 9.0	3 - 25	0.010 - 1.5	1.5 - 220
Open Circuit Voltage (V)	1.55 - 1.70	1.35	1.40	1.50	2.0	1.45	0.66	1.86
Nom. Operating Voltage (V)	1.25	1.25	1.25	1.25	1.55	1.1	0.55	1.45
Recom. Dischg. Temp. (°F)	65 - 85	65 - 130	65 - 130	65 - 115	65 - 130	50 - 100	40 - 120	50 - 90
Recom. Storage Temp. (°F)	−40 - 75	−10 - 80	−10 - 80	−40 - 80	−40 - 120	−80 - 100	−65 - 120	32 - 90
Self-Dischg. Rate/Mo. at R. T. (%)	1.0 - 1.5	0.8 - 0.9	0.8 - 0.9	0.8 - 0.9	0.5 - 2.0	0.2 - 1.0	0.02 - 0.25	N/A
Watt Hr./Lb	15.5 - 34	37 - 48	34 - 52	33 - 38	55 - 60	80 - 150	5 - 10	40 - 80
Watt Hr./Cu. In.	0.9 - 2.7	4.7 - 6.0	4.5 - 7.5	3.8 - 3.9	3.30 - 3.70	10 - 15	0.6 - 1.2	2.37 - 6.51
$/Watt Hr. (approx)	0.04 - 0.17	0.16 - 5.4	0.20 - 4.4	0.04 - 0.41	0.08 - 0.20	0.02 - 0.04	0.30 - 30.0	0.60 - 8.0
Characteristic Features	Inexpensive, available in a large variety of sizes & battery volt.	Excellent shelf life, High energy density	Excellent shelf life, High energy density	Excellent shelf life, High-rate discharge cap.	High Operating vdltage, High storage cap.	High energy density	Excellent shelf life, Low temp. operating cap.	High energy density, High-rate cap but very expensive.

Table 2—Practical Secondary Systems

	SEALED NICKEL-CADMUIM			SILVER-ZINC			LEAD-ACID SYSTEMS					
									STATIONARY			
	Cylindrical	Button	Rectangular	Low Rate SZR(L)	High Rate SZR	Fast Activating SZFA	Auto	Motive Power	Antimony	Calcium	Planté	Sealed Gelyte
Cap. Avail. (Ah)	0.100 - 7.0	0.02 - 0.50	11 - 23	1 - 140	1 - 150	1 - 180	33 - 340	180 - 2175	10 - 8000	50 - 2550	8 - 996	6 - 9
Open Circuit Voltage (V)	1.30	1.30	1.30	1.86	1.86	1.86	2.10	2.12	2.06	2.06	2.06	2.10
Nom. Operating Voltage (V)	1.25	1.25	1.25	1.45	1.45	1.45	1.98	1.94	1.94	1.94	1.94	1.97
Nom. End-of-Chg. Voltage (V)	1.48	1.48	1.48	2.05	2.05	2.05	2.53	2.55	2.17 @ Float	2.17 @ Float	2.17 @ Float	2.55
Recom. Dischg. Temp. (°F)	65 - 85	65 - 85	65 - 85	50 - 90	50 - 90	50 - 90	70 - 90	70 - 110	70 - 90	70 - 90	70 - 90	70 - 90
Recom. Storage Temp., Wet Chg'd (°F)	−40 - 80	−40 - 80	−40 - 80	32 - 90	32 - 90	32 - 90	−40 - 115	30 - 77	−40 - 80	−40 - 80	−40 - 80	0 - 50
Recom. Storage Temp., Dry Chg'd (°F)	N/A	N/A	N/A	32 - 90	32 - 90	32 - 90	−40 - 115	32 - 100	−40 - 115	−40 - 115	−40 - 115	N/A
Self-Dischg. Rate/Mo. at R. T., Wet Chg'd (%)	10 - 15	5 - 8	5 - 8	2 - 5	2 - 5	5 - 10	5 - 11	7 - 10	7 - 12.5	1.0	3.0	7 - 12
Watt Hr./Lb.	8.3 - 19.0	10 - 12	7.4 - 9.2	32 - 60	38 - 66	36 - 73	12.7 - 21.8	8.6 - 11.0	4.8 - 9.7	5.7 - 9.7	3.9 - 6.5	14.5
Watt Hr./Cu. In.	0.85 - 2.20	0.64 - 0.90	0.62 - 0.73	1.66 - 4.20	1.95 - 4.61	2.20 - 5.22	0.79 - 1.6	1.08 - 1.37	0.27 - 0.84	0.43 - 0.84	0.22 - 0.58	1.16 - 1.50
Cycle Life (nom. cycles expectation)	250 - 10,000	250 - 10,000	250 - 10,000	25 - 50	10 - 20	2 - 5	150 - 250	1000 - 2000	N/A	N/A	N/A	100 - 1000
Calendar Life (nom. yr expectation)	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	∼15	15 - 24	∼24	N/A
$/Watt Hr. (approx)	0.90 - 10.00	3.50 - 52.00	1.10 - 1.43	0.75 - 11.00	0.80 - 11.00	0.65 - 11.00	0.012 - 0.024	0.05 - 0.09	0.09 - 0.42	0.08 - 0.28	0.11 - 0.54	0.22 - 0.30
$/Watt Hr./Cycle (approx)	0.004 - 0.04	0.014 - 0.21	0.004 - 0.006	0.030 - 0.44	0.080 - 1.10	0.37 - 5.50	0.00008 - 0.00016	0.00005 - 0.00009	N/A	N/A	N/A	0.0022 - 0.0030
Characteristic Features	Operative in any position, no maint.	Operative in any position, no maint.	Operative in any position, no maint.	High rate capability, High energy density	High rate capability High energy density	High rate capability, High energy density	Inexpensive Excellent high-rate capability	Excellent cycle life, Rugged const.	Rugged Const. Wide range of available cap.	Lowest float current, Excellent life	Long life, High Reliab.	No Maint. Inexpensive

V.H.F. All-Band Communicator RADIO SENSATION

★*Complete VHF coverage*

★*Separate front-end tuners*

★*16 transistors, 15 diodes, 2 rectifiers, 1 varistor*

Open up whole new vistas in short wave listening

★ AM
This is the standard broadcast band.

★ TV-1
50-88 MHz
covers low band TV channels 6 metre amateur band. Fire Brigades, Ambulances, Taxis, Tow trucks, Public Utilities, Police, Private Business, Radio Paging, Couriers, Private detectives, etc.

★ FM
88-108 MHz
covers TV channels plus the new Frequency Modulated radio service

★ Air
108-136 MHz
covers AM aircraft bands, automatic weather and landing information, aircraft approach and departure instructions, air-craft to aircraft communications, VOR etc. In fact listen to all the aircraft from International Jumbos to trainers. Hear all the instructions from the control tower.

★ PB
135-174 MHz
starts with the interesting 2 metre amateur band covering both mobiles and repeaters etc. Then the International marine band, harbour control, tugs, ocean liners coming into port, distress frequencies etc. Hi band VHF covers ambulance, fire brigade, police, business, paging, 2 way car radio, radio doctor, taxis, TV service, road patrols, councils and many many more.

★ TV2
covers all the hi band TV channels.

For the first time, Dick Smith is proud to introduce a VHF receiver that covers all bands. Yes even the much sought after low band from 60 to 85 MHz. This exciting new monitor receiver covers Broadcast band plus 50 to 220 MHz in 4 bands.

Warning Do not confuse with similar looking receivers with only limited coverage.

We are introducing the Communicator 33, including built-in 240 V ac adaptor and earpiece delivered anywhere in Australia with FREE insurance for only $59.00. You only have to plug it in or use batteries supplied, then open up these fascinating bands!

CHECK THESE UNBELIEVABLE FEATURES:

- *Separate tuner front ends eliminate all the complex problems of switching r.f. circuits and design compromises.*
- *Exclusive Red-Led signal strength indicator. Light emitting diode glows on tuning pointer as signal is tuned in. Also acts as signal indicator when volume is turned down. Brightness indicates strength almost as critically as meter movement and is much more reliable.*
- *Full AFC can be switched on or off. This automatic frequency control overcomes drift on VHF signals.*
- *240V ac or battery operation. Just flick the switch for mains or battery operation.*
- *Handsome 'Military Look' Finish in black with white lettering etc. and grey functional controls. Positive grip and action on tuning control. Vinyl carrying case complete with shoulder strap.*
- *Multisection telescopic aerial adjusts for horizontally or vertically polarized signals.*
- *Tone control adjusts Bass and Treble response to reduce noise.*
- *Earphone socket built in*
- *Large band change switch*

This receiver is ideal for the location of bugging devices which mainly operate in the VHF bands. Simply tune receiver for feedback signal.

SPECIAL PRICE $59

★ Special Offer
Because this receiver is capable of receiving so many signals we will provide a FREE listing of where to find Australian VHF channels with each one. Hurry, demand will be heavy. The radio described below sold out the entire first shipment in only 10 days. Avoid disappointment by ordering now.

Back by popular demand

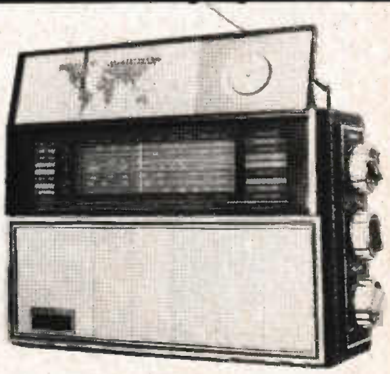
First shipment sold out in 10 days

WORLD WIDE RECEPTION
THOUSANDS OF TRANSMISSIONS, AND STATIONS THE WORLD OVER!

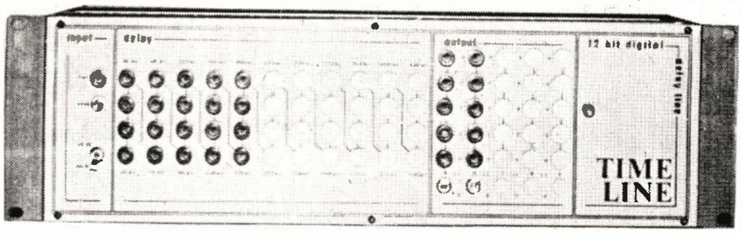
still $49.50

Solid State 13 transistor 5 diode Multiband/multifunction portable radio

Although it isn't a true communications receiver, the 250 covers 535kHz to 12MHz including Marine and Shortwave bands; FM (it's time to get ready!) from 88 to 108MHz and the VHF bands from 108 to 135 and 147 to 174MHz including aircraft and weather. Flip up lid has time zones calculator. 6V battery and mains operation. Ideal for NiCad cells having charger and indicator. Twin ferrite bar and telescopic antennas. Unique end controls give easier tuning. Hours and hours of fun as you listen to the world. Only $49.50 (P & P Free).



DON'T DELAY...TIME LINE IS NOW!



The time has come when digital delay for both the recording studio and sound contractor is no longer a luxury but a necessity. Pandora Systems has developed a unit which fulfills the needs of both, and has flexibility and technical excellence that surpasses any comparable device available on the market today.

High resolution 12 bit digital encoding produces a full 72 dB dynamic range naturally, making the use of signal altering noise reduction unnecessary. Coupled with less than .1% distortion (measured at full output 400 Hz) the Time Line literally is a black box that generates time delays without any alteration to the signal.

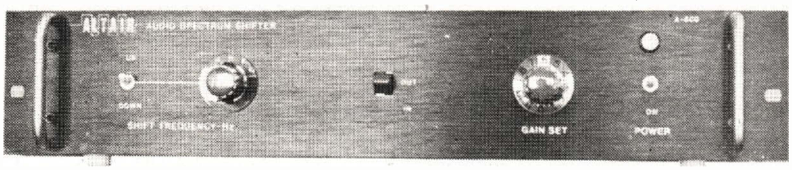
By using modular construction the unit can be expanded at any time. The main frame holds 449 ms. of delay and 5 outputs. Inter-connecting frames are available for longer delays.

Delay times are variable in 1 ms. steps by simple front panel patching or internal strapping for permanent installations.

Tie this all together with the lowest basic price in the industry, the Time Line becomes the ultimate time machine.

Manufactured by **PANDORA** NASHVILLE TENN.

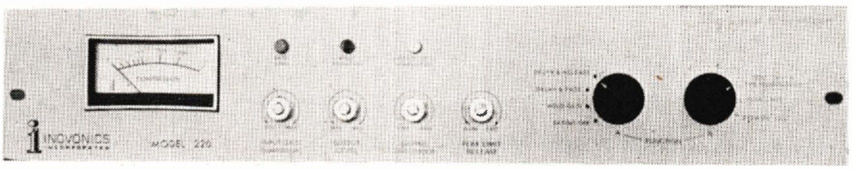
ALTAIR A-600 AUDIO SPECTRUM SHIFTER



- Acoustic Feedback Suppression
- Mix-Down Effects, Pitch Changing, Vibrato, Infinite Up-Tuning and Down-Tuning etc.

Shift select from 2 – 10 Hz to suit various acoustic and effects situations.
Up or down shift select. Balanced and unbalanced models available.
Standard rack mounting or free standing. Defeat Key – Bypasses electronics.

NEW!



AUDIO LEVEL OPTIMISER FOR AM, FM, TV

gives you — PROTECTION FROM PEAKS
HIGHER AVERAGE PROGRAM LEVEL
GATED TO ELIMINATE AUDIBLE EFFECTS

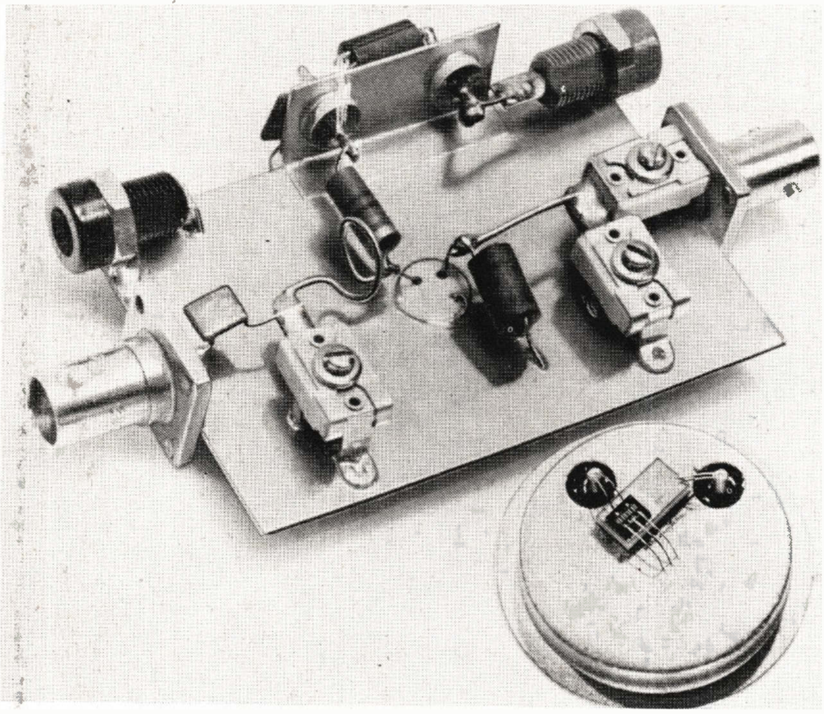
- Selectable peak limiting and average compression functions
- Fast peak limiting – no clipping
- Gated operation with Gain Hold, Hold and Release, Hold and Fade functions
- Adjustable limiting symmetry for full carrier modulation
- Built-in Frequency Selective Limiter for FM and TV

Klarion Enterprises Proprietary Limited

REGENT HOUSE, 63 KINGSWAY, SOUTH MELBOURNE, 3205. AUSTRALIA.
PHONE 61-3801 CABLES KLARIONMELB

COMPONENT NEWS

MAJOR PACKAGE INNOVATION



A unique beryllia-insulated die mounting technique is used to significantly improve the power dissipation and gain capabilities of a TO-39 style package. These improvements enable a designer to replace expensive stud mounted, medium-power devices, in RF applications, with a low cost alternative. A price savings of two-to-one over stud-mounted devices is projected.

This major package innovation enables the use of a TO-39 style package at medium power levels. By mounting the transistor die on a beryllia insulator, the collector is electrically insulated while still allowing heat to be conducted to the case header. The accompanying photograph shows an enlarged view of the die and insulator mounted on a TO-39 leader.

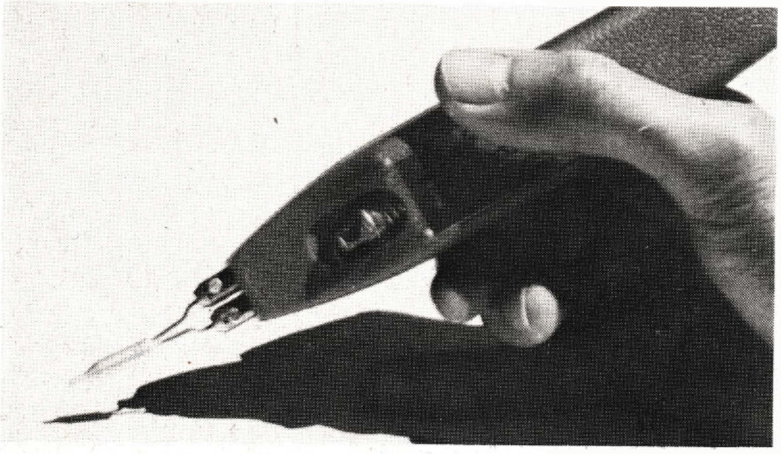
The emitter is connected directly to the case, which is soldered to circuit ground; this provides lower emitter inductance and reduced parasitics in the common emitter configuration. In a typical installation, also shown in the photograph, the device is mounted directly to a heat sink or the case of the equipment.

Compared to stud-mounted devices, where the collector is tied to the case for thermal considerations, this new technique can provide improved performance. A typical stud configuration requires bond wires from the transistor die to a substrate solder bridge. The bridge is connected to opposed package leads and these leads are then soldered to the circuit. The beryllia-insulated die mounting technique offers a lower cost part.

The first device available from Motorola on production volume basis is the MRF227. This device and packaging technique was originally developed for the proposed US class E citizens band. The MRF227 is conservatively rated at 3 W with a power gain of 13.5 dB minimum and an efficiency of 60%. The MRF227 is expected to find use in areas where cost effectiveness is a prime consideration. Two more devices are expected to follow the MRF227 to production. They are the MRF237, a VHF driver, and the MRF629, a UHF driver.

Further details: Motorola Semiconductor Products, Suite 204, Regent House, 37-43 Alexander Street, Crows Nest, 2065.

CORDLESS IRON SOLVES SOLDERING PROBLEMS



A new soldering iron, introduced to Australia by Dick Smith Electronics, will find many applications in the electronics industry.

The iron, made by leading US manufacturer Wall-Lenk uses a nickel cadmium rechargeable cell to heat the tip to around 700°F. Pressing the button gives soldering heat in five seconds plus a built-in light on the work area.

A convenient, light weight unit, the BP100 is only 200 mm inches long, including tip. It is capable of soldering up to 120 joints per charge.

The new iron will naturally be popular with servicemen since it requires no mains supply and can be charged from a vehicle battery. It will also be useful for field work in boats, cars and caravans etc.

The BP100 is also ideal for wiring modern IC circuitry, especially CMOS, which can easily be damaged by leakage currents to earth from conventional irons.

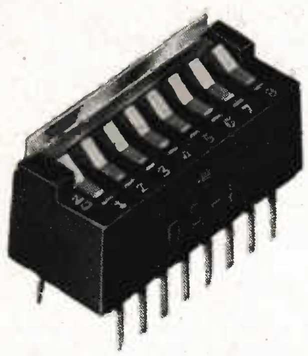
The Wall-Lenk BP100 sells at $19.95 including tip. A 240 Vac charger is available at $10.00. A simple kit for a charger, operating from a vehicle battery costs only 50 cents. Spare element-tips and a spare NiCad cell are available.

Further details: Dick Smith Electronics Pty. Ltd., 160-162 Pacific Highway, Gore Hill 2065.

DUAL-IN-LINE PROGRAMME SWITCHES

Dual-in-Line Programme Switches, designed for printed circuit board applications, are available with seven, eight

[redacted]



or 10 single pole, single throw switches per module.

Operation of separately detented rocker actuators makes or breaks each circuit independently. An exclusive locking bar is supplied to prevent accidental programming changes. A transparent plastic dust cover is also provided with each unit. An "ON" marking clearly identifies which circuits are open or closed.

Switches are fabricated of heat resistant black epoxy resin. Gold-over-nickel plated terminals and contacts are sealed to prevent contact contamination during the soldering process. Conventional .100 x .300 pin spacing permits use of standard IC sockets as well as direct soldering to PC boards. The gold plated contacts have a wiping action to assure low contact resistance and extended switch life. The switches are rated at 100 mA at 5 Vdc or 25 mA at 24 Vdc.

Further details: Namco Electronics, 239 Bay Street, North Brighton, Vic. 3186.

DUAL-CHANNEL HERMETICALLY-SEALED OPTO ISOLATOR

Two optically-coupled isolators in one hermetically-sealed 16-pin dual-in-line package are designed to be TTL compatible while providing maximum ac and dc isolation. This Hewlett-Packard Model 5082-4365 Hermetically-Sealed Isolator consists of a pair of inverting optically isolated gates, each with a light-emitting diode and a high-gain integrated photon detector. The output of the detector is an open-collector Schottky-clamped transistor.

Completely TTL compatible, the dual isolator has a propagation delay of only 55 nanoseconds, putting its speed within TTL range. Its operation is guaranteed over the full −55 to +125 degrees C temperature range and it is designed to meet the military mechanical environmental test requirements of MIL-STD-883 and MIL-STD-750.

Among applications for the 5082-4365 are logic ground isolation, power supply feedback and line receivers. For example, the isolator can be used as an interactive element from a flight computer to guidance controls where sensitive digital logic might be susceptible to ground or power supply transients. As a power supply feedback element, it isolates the unregulated signal from the regulated output.

As a line receiver, the isolator can be used in complex computer controlled test systems for missiles, aircraft and ships. The isolators are used to protect against large common mode voltages. They are also useful where data must be transmitted over distances of 20 metres or more.

Further details: Hewlett-Packard Australia Pty Ltd, 31-41 Joseph St., Blackburn, Vic. 3130.

"HOT SPOT" TEMPERATURE RECORDER HAS ACCURACY OF 1%

"Hot Spot" a tiny single increment heat sensor available from NS Electronics, provides a permanent record of temperature reached at selected critical points with an accuracy of 1%. "Hot Spot" temperature recorders are available to cover the range between 100° and 350°F in 10°F steps. The 0.15 mm diameter window turns irreversibly black from a silver colour when exposed to its rated temperature value. Overall diameter is 0.45 mm. To apply to the surface to be measured, simply remove the "Hot Spot" from its protective backing and adhere through the use of its own adhesive.

"Hot Spot" was designed specifically for the electronics industry to detect faulty components such as power resistors, T03 power transistors and heat sinks, T05 cans (IC and discrete) – excellent for use in supporting a claim that your product has been exposed to a temperature above that warranted!

Further details: NS Electronics, Cnr. Stud Road & Mountain Highway, Bayswater, 3153.

HIGH EFFICIENCY STEP-RECOVERY DIODES

Fourteen new high-efficiency step recovery diodes are now available from Hewlett-Packard. Designed for use as high and low order harmonic generators, the new diodes are available in a variety of packages.

Designated the Hewlett-Packard 5082/0800 series, the diodes have typical outputs of 0,3 watts from 10.20 GHz and 6 watts in the 3 to 5 GHz range at midband as doublers. Junction capacitance in the 10 to 30 GHz range is specified as minimum 0.1 pF; maximum junction capacitance in the 3 to 5 GHz range is only 3.5 pF.

Transition times range from 50 picoseconds typically for the high band units to 250 picoseconds for low band units. This fast transition time contributes to improved linearity and efficiency for frequency multiplication.

All of the 5082-0800 Series diodes meet reliability requirements of MIL-S.19500.

Further details: Hewlett-Packard Australia Pty Ltd 31-41 Joseph St. Blackburn. Vic. 3130.

INTERNATIONAL ELECTRONICS UNLIMITED

LOGIC PROBE KIT

Checks TTL and DTL logic states in circuit or isolated
Dual slope memory for pulse detection
Ten nano sec capability
Internal 5V regulator
Kit is complete with 5 IC's, FET, PC Board & all necessary components, case, probe, instructions & logic chart $19.95

10% OFF ON ORDERS OVER $25.00

CLOCK KITS

12-24 hour selection
Long life, large LED displays

6 DIGIT
MM5313, 6-MAN 1's (.270"), trans, diode, perf. board and necessary components except pwr transformer and case.
With instructions $29.95

4 DIGIT
MM5312, 4-MAN 1's same except 4 DIGIT . . $26.95

TRANSISTORS



DEVICE	FUNCTION	CROSS REF ** SK	HEP	HFE	VCEO	VCBO	VEBO	IC(A) AMP	IB(A) AMP	TOT DIS (WATTS)	FREQ MHZ	CASE	PRICE
	PWR AMP AUDIO												
40411	"	3036		35-100	80	90	5.0	30	15	150	1.5	TO-3	$3.75
40636	"	3027	704	20-70	95*	95*	7.0	15	7.0	115		TO-3	1.95
2N3714	"	3036	704	25-90	80	100	7.0	10	4.0	150	4.0	TO-3	2.59
2N3715	"	3036	704	50-150	60	80	7.0	10	4.0	150	4.0	TO-3	2.75
	RF PWR AMP												
2N5320	"	3512	53002	30-130	75	100	7.0	2	1.0	10	50	TO-5	1.65
2N5322 (P)	"			30-130	75	100	-7.0	2	-1.0	10	50	TO-5	1.75
2N5321	"	3512	53010	40-250	50	75	5.0	2	1.0	10	50	TO-5	1.65
2N5323 (P)	"	3513		40-250	50	75	-5.0	2	-1.0	10	50	TO-5	1.65
	PWR DRIVER												
2N5679 (P)	Audio/RF		53031	40-150	100	100	-4.0	-1.0	-0.5	10	30	TO-5	1.70
2N5681				40-150	100	100	4.0	1.0	0.5	10	30	TO-5	1.70
	AUDIO DRIVER												
40594	"	3024	53002	70-350	95*		4.0	2.0	1	10	1.0	TO-5	1.45
40595 (P)	"	3025	53031	70-350	95*		-4.0	-2.0	-1	10	1.0	TO-5	1.65
2N5781 (P)	"			20-100	65	80	-5.0	-3.5	-1	10	1.0	TO-5	1.75
2N5784	"		53002	20-100	65	80	5.0	3.5	1	10	1.0	TO-5	1.75
2N5864 (P)	RF & Audio			25-500	70	90	5.0	1.5		8.75	50	TO-39	1.35
40348	"	3044	243	30-125	40	60	7.0	1.5	0.5	8.75	1.6	TO-5	1.72
40544	"	3045		35-200	50*	50*	5.0	0.7		7.0	100	TO-5	.79
	GEN PURP AMP												
2N2895	RF & Audio	3024		40-120	65	120	7.0	1.0		1.8	120	TO-18	1.25
2N930A	Lo Noise	3039	50	100-300	60	60	6.0	.03		1.8	45	TO-18	.95
2N2219A	Audio UHF Amp/SW	3024	53001	75-375	40	75	6.0	.8		1.8	300	TO-5	1.05
2N2846	High Speed Sw	3024		30-120	30	60	5.0	.8		3.0	250	TO-5	1.55
	HF GEN PURP												
2N3933	VHF/UHF Amp	3039	56	60-200	30	40		.002		.2	750	TO-72	1.55
40894	VHF/UHF RF Amp	3039		50-250	12	20	2.5	.05		.3	1200	TO-72	1.10
40895	VHF/UHF Mix, Osc	3039		40-250	12	20	2.5	.05		.3	1200	TO-72	.95
40897	VHF/UHF IF Amp	3039		70-250	12	20	2.5	.05		.3	800	TO-72	.90
2N5179	LoNoise, Amp, Osc, Mix, Conv	3039	709	25-250	12	20	2.5	.05		.3	2000	TO-72	1.10
2N918	VHF/UHF Amp Mix, Conv	3039	709	20 Min	15	30	3.0	.05		.3	600	TO-72	.95
2N2905A(P)	DC, VHF, Amp Hi Sp Sw	3025	708	100-300	60	60	5.0	.6		3.0	200	TO-5	1.15

** Manufacturers' (SK – RCA, HEP – MOTOROLA) Suggested Cross Reference. * External Res (R_{BE}) = 100 OHMS

TRANSISTORS ARE NEW, FIRST QUALITY, BRANDED DEVICES – ON HAND FOR IMMEDIATE SHIPMENT

RESISTORS

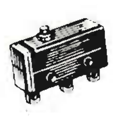


15	ohm	5%	1w Corning	Film	.08
15	ohm	5%	25w Ohmite	WW	.75
28.7	ohm	1%	1w Dale	Film	.25
75	ohm	5%	8w Ohmite	WW	.39
102	ohm	1%	½w Corning	Film	.15
200	ohm	5%	5w Intl. Tect.	WW	.30
220	ohm	10%	½w Stackpole	C Comp	.07
330	ohm	5%	½w Stackpole	C Comp	.10
390	ohm	5%	2w Allen Bradley	C Comp	.25
450	ohm	5%	5w Dale	WW	.30
500	ohm	5%	1w Allen Bradley	C Comp	.19
620	ohm	5%	½w Stackpole	C Comp	.10
681	ohm	1%	¼w Dale	Film	.20
750	ohm	1%	¾ Dale	Film	.20
1	Kohm	1%	½w Corning	Film	.15
1	Kohm	5%	10w Dale	WW	.35
1.2	Kohm	1%	1w Intl. Rect.	C Comp	.25
1.6	Kohm	5%	½w Stackpole	C Comp	.10
2	Kohm	1%	¼w Dale	Film	.20
2	Kohm	5%	5w Intl. Rect.	WW	.30
2.15	Kohm	1%	½w Corning	Film	.15
2.4	Kohm	1%	5w Intl. Rect.	WW	.50
2.5	Kohm	5%	25w Ohmite	WW	.75
2.7	Kohm	5%	5w Dale	WW	.30
3.01	Kohm	1%	½w Electra	Film	.15
4	Kohm	5%	10w Dale	WW	.35
4.7	Kohm	1%	½w Corning	Film	.15
5.6	Kohm	5%	2w A.B.	C Comp	.25
7.5	Kohm	5%	½w Burroughs	C Comp	.10
8.25	Kohm	1%	½w Electra	Film	.15
9.09	Kohm	1%	½w Corning	Film	.15
9.1	Kohm	5%	2w A.B.	C Comp	.25
10	Kohm	1%	½w Corning	Film	.15
15	Kohm	10%	½w Stackpole	C Comp	.07
17.4	Kohm	1%	½w Corning	Film	.15
20	Kohm	5%	1w A.B.	C Comp	.19
23.7	Kohm	2%	¼w Corning	Film	.15
39	Kohm	1%	½w Corning	Film	.15
51	Kohm	5%	½w Burroughs	C Comp	.10
75	Kohm	1%	½w Corning	Film	.15
100	Kohm	1%	½w Corning	Film	.15
120	Kohm	5%	½w Burroughs	C Comp	.10
130	Kohm	5%	½w Stackpole	C Comp	10

CAPACITORS

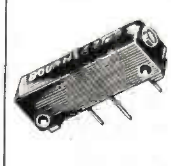
.0033	mfd	100V	5%	Skottie mylar axial	S .10
.0047	mfd	100V	10%	G.E. mylar axial	.09
.0047	mfd	100V	10%	Gen. Inst. mylar axial	.09
.01	mfd	200V	20%	Aerovox paper axial	.05
.02	mfd	100V	1%	Sprague mylar axial	.15
.1	mfd	600V	3%	Aervox paper axial	.20
.1	mfd	400V		Aervox paper axial	.20
.1	mfd	200V		CDE paper axial	.15
.1	mfd	200V		Aervox paper axial	.15
.5	mfd	400V	10%	Gen. Inst. mylar axial	.35
1.0	mfd	350V	.68%	Mallory Elec axial	.50
2.0	mfd	200V	20%	Aerovox Elec axial	.20
4.0	mfd	350V		Sprague Elec axial	.45
5.0	mfd	25V		Gen. Inst. Elec axial	.15
10	mfd	150V		Sprague Elec axial	.30
30	mfd	300V		Mallory Elec axial	.35
60	mfd	350V		Mallory Elec axial	.75
1,000	mfd	100V		Sangamo Comp grd can	2.65
1,000	mfd	50V		CDE Elec axial	1.25
2,000	mfd	15V		Mallory Elec can	.85
6,000	mfd	25V		Sangamo Comp grd can	3.75
50	mfd	285V		I.C.C. oil imp bathtub	.60

SWITCHES



SPST	1A Momentary Return P.B.-A.H.&H.	.25
SPST	15A Micto switch Flat leaf	.50
DPST	5A Micro switch Pin plunger	.75
DPST	10A Micro switch-mini Pin plunger	.65
DPST	10A Pin plunger	.65
4P3T	6A Slide Stackpole	.25

MISC. COMPONENTS



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7404	.22	7453	.27	74153	1.29
7405	.22	7454	.39	74154	1.59
7406	.39	7460	.19	74155	1.19
7407	.39	7464	.39	74156	1.29
7408	.25	7465	.39	74157	1.29
7409	.25	7472	.36	74161	1.39
7410	.19	7473	.43	74163	1.59
7411	.29	7474	.43	74164	1.89
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74L20	.33	74L78	.79	74L165	2.79
74L30	.33	74L85	1.25		
74L42	1.69	74L86	.69		

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74H04	.33	74H30	.33	74H61	.39
74H08	.33	74H40	.33	74H62	.39
74H10	.33	74H50	.33	74H72	.49
74H11	.33	74H52	.33	74H74	.59
74H20	.33	74H53	.39	74H76	.59

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8092	.59	8220	1.69	8812	1.10
8095	1.39	8230	2.59	8822	2.59
8121	.89	8520	1.29	8830	2.59
8123	1.59	8551	1.65	8831	2.59
8130	2.19	8552	2.49	8836	.49
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MAN3M	Red 7 seg. .127" claw	1.15
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MAN6	.6" high solid seg	6.95
MAN7	Red 7 seg. .270"	1.35
MAN8	Yellow 7 seg. .270"	3.95
MAN64	.4" high solid seg	4.50
MAN66	.6" high spaced seg	4.65
DL707	Red 7 seg. .3"	2.15
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MCT2	Opto-iso transistor	.69

DTL

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319	Hi Speed Dual Comp	DIP	1.29
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709	Operational AMPL	TO-5 or DIP	.29
710	Hi Speed Volt Comp	DIP	.39
711	Dual Difference Compar	DIP	.29
723	V Reg	DIP	.69
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741	Comp Op AMP	mDIP TO-5	.35
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748	Freq Adj 741	mDIP	.39
1304	FM Mulpx Stereo Demod	DIP	1.19
1307	FM Mulpx Stereo Demod	DIP	.82
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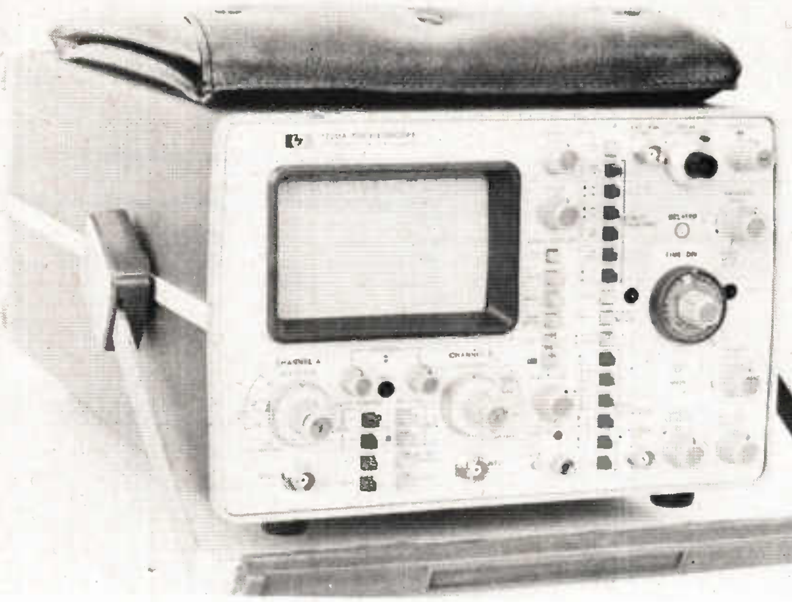
EQUIPMENT NEWS

PRECISION HIGH-FREQUENCY OSCILLOSCOPE



A new high-frequency oscilloscope, Model 1720A from Hewlett-Packard, has two channels with deflection factors to 10 mV/cm, sweep speeds to 1 ns/cm and frequency response to 275 MHz. It will be valuable in the design, manufacture and testing of systems using fast logic – computers, peripherals with fast interface logic, high-speed digital communications equipment, high-speed digital instrumentation, and logic component evaluation. It will also be valuable in wideband analogue work – radar and communications systems for example.

Accuracy specifications of the 1720A are unequalled in its class. Calibrated sweeps are accurate to 3%, and even better, 2%, in the 50 ns/cm to 0.5 s/cm range. This accuracy is specified over the full 10 cm of horizontal deflection. A X10 magnifier increases the maximum sweep to 1 ns/cm. Differential time measurements are within 2% accuracy for most applications.

Vertical attentuator accuracy is 2% at all settings from 10 mV/cm to 5 V/cm. Input impedance is selectable – 50 ohms or 1 megohm with only 11 pF shunt capacitance. The 50-ohm input is internally compensated for low reflections, ensuring faithful pulse reproductions.

The 275-MHz response specification is held in both 50-ohm and high-impedance conditions. Bandwidth and risetime specifications are also maintained across the full 6 x 10 cm display area, not only when in calibrated modes but also when vernier settings are in use.

Perhaps most important of all, these performance characteristics are held over the full range of environmental specifications, including temperatures from 0° to 55°C. That's important in many circumstances, especially in the field; the 1720A can be trusted, even for example when it has just been pulled out of a car's boot in mid-summer.

Delayed sweep is standard and has the same 2 and 3% accuracy specifications as the main time base. The ratio of main to delayed intensity is adjustable for clear separation and mixed or intensified portions of the delayed signal. Main and delayed sweep controls are interlocked so the main sweep can never be faster than delayed; this prevents confusion.

Triggering is solid for displays, only requiring 1 cm vertical deflection to 300 MHz (only 0.5 cm from dc to 100 MHz). Because the trigger sync take-off is immediately after the attenuator, the same trigger point is maintained when changes are made in such other settings as vertical position, polarity, or vernier. Thus the display remains stable when these controls are adjusted.

The brightness capability of the 1720A cathode-ray tube is compatible with its 1 ns/cm sweeps. This is important for effective display of very fast transitions or low repetition-rate signals. Without compromising fast traces, beam intensity is regulated at slower sweep speeds so as never to exceed safe limits, increasing CRT life. The display, 6 cm high, is a full 10 cm wide, placing emphasis correctly on horizontal resolution for clarity in critical timing measurements. Focus is automatic, although a front panel control may be used for fine adjustments. Flood gun graticule illumination prevents uneven illumination, assuring even exposure of trace photos.

While there is a variety of operating modes, selection of the desired one is made easy by using colour-coded pushbuttons in clearly-identified relations – blue for display modes, green for trigger operations, and grey for secondary features. Familiarisation is easy and fast.

Low weight, (12.9 kg), makes the scope easy ,to carry from bench-to-bench or in field service applications. Power consumption is approximately 70 watts.

Several things account for attaining precision measuring performance at a low price. A high level of integration has been incorporated into the design. The whole vertical amplifier, for example, consists of three IC's and a small number of discrete components. By this means, and by innovations in layout, the complexity of printed circuit boards has been reduced.

Checkout time, one of the costliest ingredients in a precision oscilloscope, has been minimised by reducing the number of adjustments; there are only 55 controls to be adjusted inside the 1720A. (Upwards of 100 are common in scopes of this type.) However, minimising adjustments has not compromised ability to optimise critical functions. For example, the three fastest sweeps retain separate adjustments for maximum timing accuracy on these important ranges.

Further details: Hewlett-Packard Australia Pty. Ltd. 31-41 Joseph St., Blackburn, Vict. 3130.

DELAY BY EVENTS MODULE PROVIDES JITTER FREE VIEWING OF LONG PULSE TRAINS

Tektronix, announces the new DD 501 Digital Delay, a delay by events counter packaged as a plug-in for the modular TM 500 line of test and measurement instruments.

The DD 501 is a digital events delay with a high impedance signal input. Using five thumbwheels on the control panel, the operator can set any desired digital count from 0 through 99 999. When the number of input pulses reaches the preset count, the DD 501 will put out a trigger pulse which can be used for triggering an oscilloscope.

Because the DD 501 creates it delay by counting a number of pulses rather than by analogue timing of an interval, jitter is not a problem even when viewing a group of pulses toward the middle or end of a long train. Events can be counted at frequencies up to 80 MHz and divide by N operation extends to 40 MHz.

With the selected number of events clearly displayed on the thumbwheel dials, the operator knows at all times what part of a pulse train [he is viewing on the accompanying oscilloscope. Meaningful measurements can be made on data trains up to 100 000 bits long.

Delay by event **is particularly useful in**

Continued on page 117

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REPRESENT that goods or services have sponsorship, approval, performance characteristics, accessories, uses or benefits they do not have.

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MAKE false or misleading statements concerning the existence or effect of any warranty or guarantee.

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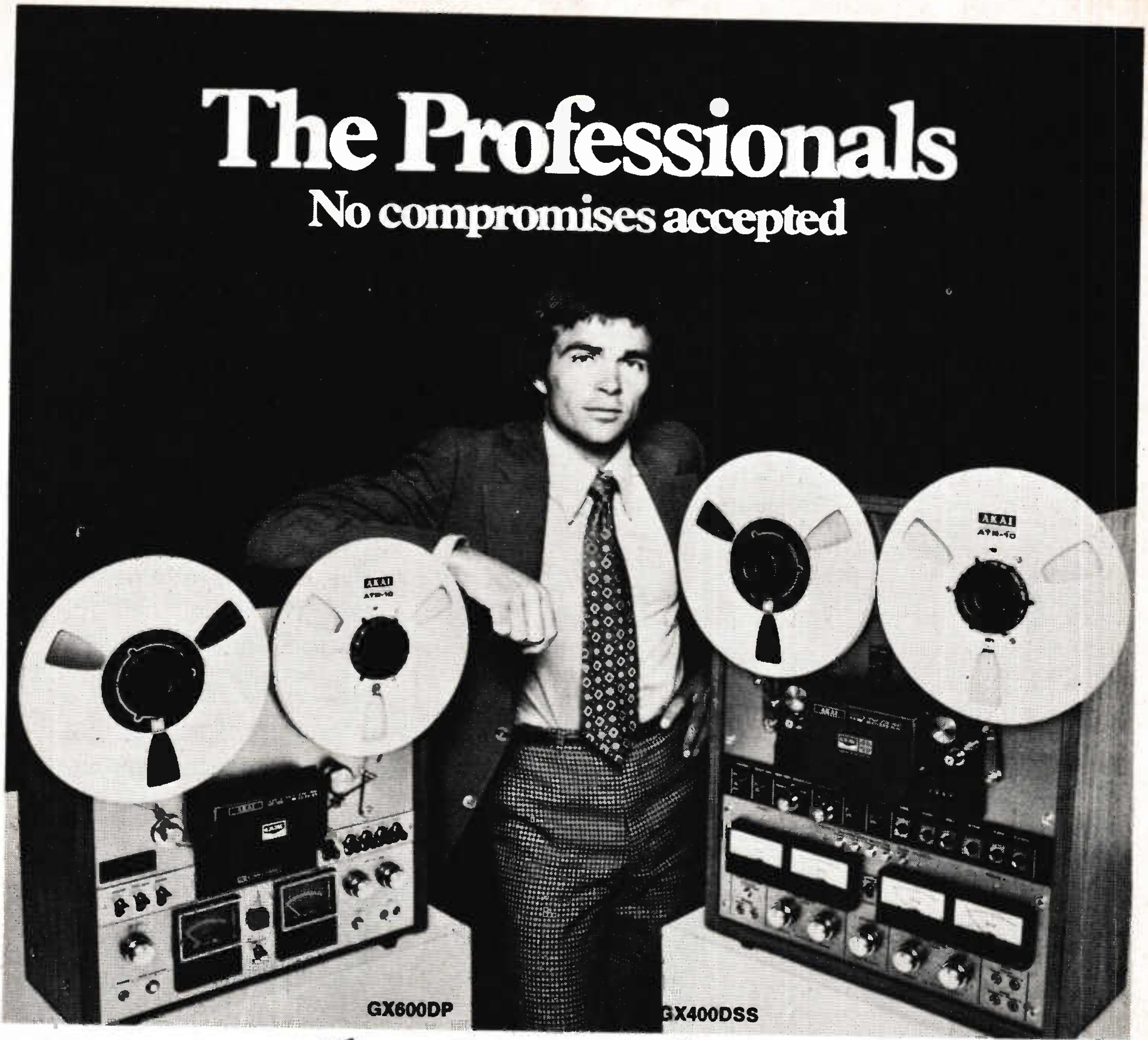
In cases of doubt, consult your lawyer.

ELECTRONICS TODAY INTERNATIONAL



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Less than 0.07% RMS at 7½ ips
Frequency Response: 30 Hz to 25,000 Hz (±3 dB) at 15 ips
30 Hz to 23,000 Hz (±3 dB) at 7½ ips
Distortion: Less than 0.7% (1,000 Hz "0" VU)
Signal to Noise Ratio: Better than 59 dB
Erase Ratio: Better than 70 dB
Cross-Talk: Better than 60 dB (monaural)
Better than 40 dB (stereo)
Bias Frequency: 150 kHz
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One GX 2 track playback head,
One 2 track erase head.

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Available in 4 track 4 channel, 4 track 2 channel and 2 track 2 channel.
Reel Capacity: Up to 10½" reel
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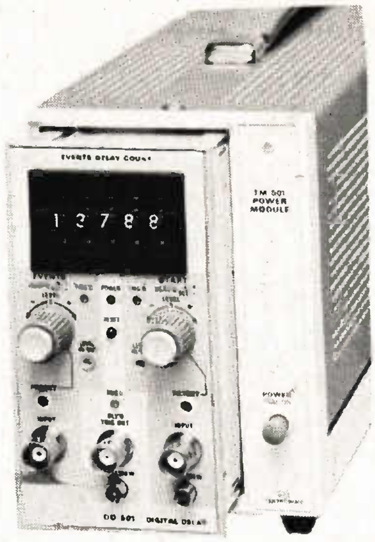
Wow & Flutter: Less than 0.35% RMS at 15 ips
Less than 0.05% RMS at 7½ ips
Less than 0.08% RMS at 3¾ ips
Equalization: NAB curve
Frequency Response: Using low noise tape
30 Hz to 20,000 Hz (±2 dB) zero VU/15 ips
Distortion: Less than 1% (total harmonic distortion 1,000 Hz zero VU)
Signal-To-Noise Ratio: Better than 58 dB
Erase Ratio: Better than 70 dB
Cross-Talk: Better than 45 dB
Recording Bias Frequency: 160 kHz (±10 kHz)
Heads (4): 2-track recording GX head, 2-track playback GX head, 4-track playback GX head, full track erase head.



troubleshooting asynchronous logic systems. It is very difficult for the observer to predict how much time will elapse prior to the pulse group he is interested in observing. The number of "clocking" events preceding the period of interest is, however, usually known and can be easily set on the thumbwheel switches.

The DD 501, together with a TM 501 Power Module, forms a low cost, easily portable means of providing an oscilloscope with delay-by-event capability for field service, production, or design laboratory applications. Almost anywhere long trains of serial data are handled, measurements can be made easier by the DD 501, Viewing selected information in data communication pulse trains, examining peripheral to central processor data transfer, studying individual indexing pulses or data segments in disc, drum or tape memory systems – all are potential uses. Rotating memory systems are excellent examples because the jitter caused by mechanical speed variations is eliminated.

Further details: Tektronix Aust. Pty. Ltd., 80 Waterloo Road, North Ryde, N.S.W. 2112.

DO IT YOURSELF SECURITY PRODUCTS

Two new kits of security products have been designed especially for the home handyman by Applied Technology Pty Ltd.

For the home, the company's system 250 is a complete control unit disguised as a speaker box. To install the system all that is required is to attach the necessary sensors to the points to be protected and connect them back to the XL250 control unit.

Heart of the system 250 is the XL250 module which is a combined alarm unit, siren driver and automatic reset timer in one unit. Custom designed CMOS technology is utilized to ensure low current drain (for battery operation) and long reliable operation.

The system 250 is supplied as a fully assembled nd factory tested kit completely ready to install.

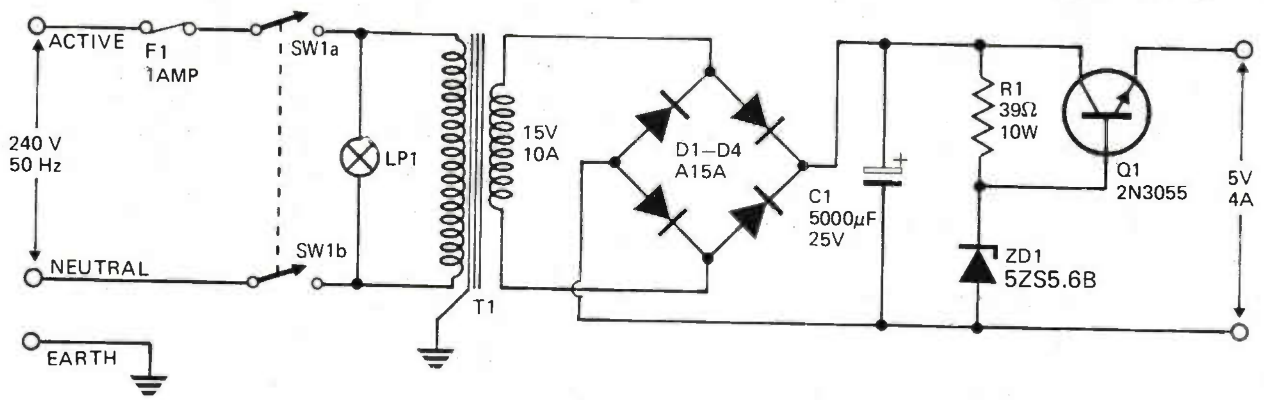
A full range of optional accessories such as remote loudspeakers, pressure mats, fire detectors, magnetic contacts, emergency switches etc. is readily available.

For the car, the RD200 car alarm is the very latest version of the popular 100 HR and incorporates extra refinements (including a self contained electrical horn) which makes it even easier to install. The RB200 works on the principle of detecting minute changes in the electrical system of the car (for example, when a door is opened and the courtesy light goes on). The RB200 eliminates all the usual wiring, door switches and other gadgets and only requires the installation of three wires to ensure full protection.

The alarm has a built in exit/entry delay so that you can activate the alarm before you leave the car, thus eliminating the need for an external key switch. The output is a pulsating horn blast (one second on/one second off) which automatically resets after three minutes to eliminate flat batteries.

Further details: Applied Technology Pty. Ltd., Suite 101, 25 Spring St., Chatswood, N.S.W. 2067.

DES TROYER POWER



THE CORRECTED CIRCUIT

Here is the best entry.

OUR DES TROYER CONTEST was remarkably popular — over 250 entries were received. Most were of a very high standard.

Two entries have been reproduced here to enable readers to gauge their own entries.

The first, (from Mr Ian McAllister), was humorous as well as reasonably accurate. We thought it well worthy of a prize!

The second from Mr R.T. Burgess, was judged to be the most complete and well-explained entry. There were five or six other entries of a very similar standard and it was difficult to choose between them.

One of the most interesting aspect of this contest was that not one entrant gave a full list of errors, nor did anyone provide a design procedure which covered all the variables.

Mr Burgess was remiss in only two main factors. Firstly the base-emitter voltage of a 2N3055 transistor typically varies from 0.8 volt at a collector current of one ampere, to 1.1 volts at a collector current of four amperes. Thus a Zener of 6.1 volts rating would have been more appropriate. The typical value of 0.6 volts for V_{be} of silicon transistors is only applicable to small signal transistors — not to power types.

Secondly, although Mr Burgess mentions that there will be voltage drops across the diodes, he does not include this — or transformer regulation — in his calculations. At full load there would be about three quarters of a volt drop in the transformer (if correctly designed) and about one volt across each diode. Thus the voltage available to the regulator would fall by about 2.5 volts.

Taking this into account would necessitate changing the value of R1 and would affect the regulation and ripple specifications.

We leave it to readers to incorporate this factor in the calculations and determine its effect.

At least thirty entrants complained that the contest was too simple — not one of those entrants however spotted more than half the errors!

Congratulations to all who entered, and to our prize winners in particular, for a splendid effort.

From Mr. Ian McAllister.

HAVING just returned from taking my mother-in-law to a hermitage in the bush (she believes they will never have electricity) I should like to express my thanks for Des Troyer's article in August.

It all started a week ago. After a long day of tracing intermittent faults, I arrived home to find M.I.L. in my favourite armchair as usual. "Why don't you make this?" I suggested slyly, holding out a clipping from your article. "You've been at night-school for a month now."

"Isn't this fuse symbol wrong?" she criticised.

"You'll learn about that later in the course. It's a bit like a lightning arrestor symbol, to indicate an ordinary fuse used with currents reminiscent of thunderbolts."

"I already knew that," she lied, picking up my soldering iron.

Next morning I got home just after she had blown the fuse, so I showed her how to cut a ten inch nail to the same length as the fuse, to fit in the holder.

"The heater doesn't heat, but the light's on."

Try throwing the switch I suggested fiendishly, then went out for the evening, leaving her to explain to the linesman how she blew the pole fuse.

When I got back she had replaced the switch, which had developed welded contacts, and I was disappointed to find that she had put the fuse in series with the transformer and the light in parallel with it.

"Why does it say D1-D5 here?"

"Because there should be another decoupling diode across the transformer there." I pointed out.

Shortly after I ducked as pieces of IN 914 flew by. "Those were signal diodes." I yelled, "Don't they teach you anything?"

"Everything's wrong," she teared, "you say that any fool would know

SUPPLY UNIT

not to expect a transformer with these ratings to be air cored, and now you expect . . . " her voice trailed off helplessly.

Moments later I ducked again, and showed her which way round the 4 amp diodes should be. "200pF is too small; make that 2000µF" I suggested.

As I helped her clean capacitor electrolyte off the walls – "Don't tremble like that, just use a higher voltage capacitor." I advised, grinning at the thought of the switch-on surge that would go through the diodes with no limiting resistor before C1.

Next evening I got home to find smoke curling up from the resistor as she wiped pieces of Zener out of her eyes.

"Try using a 1 W resistor and putting the Zener the other way round."

M.I.L. threw the soldering iron at me. "How do you expect me to finish this if you only tell me afterwards?" she whinged.

So I told her "Change the Zener to about 6.3 volts. Add another transistor here to make a Darlington pair because this 2N 3055 (which isn't PNP) has low gain."

After she switched on again I distracted her attention, but she soon noticed the smell of burning transformer enamel as the 2 amp winding tried to supply 4 amps. Her goldfish were electrocuted as an interwinding short developed.

"At least the fuse is undamaged," I consoled her "That's the only advantage of using a fuse rated at more than 500 mA in the primary."

M.I.L. threw the soldering iron at me again, so I hope that I win a new one now that she has left.

This entry, from Mr R.T. Burgess of Maryborough Queensland, was judged to be the most complete and well explained.

1. The fuse F1 should be in series with the transformer primary – not in parallel. The best place is as close as possible to the input (before the switch) so that it protects as much of the circuit as possible. The fuse should be before the switch and the switch should be a double-pole type so that both active and neutral are broken. (Actually, if an unprotected fuse is used, it should be after the switch so that it may be changed safely – Ed).
2. The symbol for F1 is incorrect (The symbol shown is for an alarm-type fuse).
3. F1 should be rated at 1 amp not 10 amp (See design).
4. LP1 should be in parallel with the transformer primary (as shown it will come on when SW1 is off).
5. LP1 is not given a voltage rating in the parts list. A neon indicator should incorporate a suitable series resistor for operation on 240 volts ac.
6. SW1 is not listed. It should be rated for 1 amp at 240 volts ac.
7. The current rating of T1 should be 10 amps and the circuit symbol should show an iron core (see design for points 7, 11 – 17).
8. The polarity of two of the diodes is incorrect. (Actually the bridge was rotated through 90° – Ed.)
9. The circuit shows D1 – D5 instead of D1 – D4.
10. The current rating of the diodes listed is too low. They are in fact small signal diodes.
11. The capacity of C1 should be 5,000 µF not 200 pF.
12. The voltage rating of C1 should be 25 volts not 16 volts.
13. The value of R1 should be 39 ohm not 560 ohm.
14. The power rating of R1 should be 10 watt not ¼ watt.
15. The polarity of the Zener diode is incorrect.
16. The voltage of the Zener diode should be 5.6 volts not 4.4 volts (That is, Destroyer subtracted 0.6 volt for V_{be} of 2N3055 instead of adding it – Ed.)
17. The power rating of the Zener diode should be at least 2.5 watts but need not be as great as 400 megawatt!
18. The transistor Q1 is shown as pnp type, whereas a 2N3055 is an npn type.
19. Sundry items are not listed. (The circuit won't hold together and work without them. In particular a heat sink is required for the 2N3055.)

Continued on next page

DES TROYER POWER SUPPLY UNIT

Continued from previous page.

DESIGN

(1) Zener Diode Voltage

The output voltage equals the Zener diode voltage plus the voltage drop across the emitter-base junction of the transistor. Therefore, to produce 5 volts the Zener voltage should be 5.6 VOLTS. (Actually the V_{be} of a 2N3055 rises from 0.8 volts at 1 amp to 1.1 volts at 4 amps. The usual assumption of Vbe = 0.6 for silicon transistors does not hold for power transistors – Ed).

(2) Capacity of C1

The maximum current drain will be 4 amps continuous plus the Zener diode current.

Current gain of 2N3055 = 20 min i.e. base current = 5% of collector current

∴ emitter current = 105% of collector current
∴ maximum base current = 4 x 5/105 = 0.19 amps or 190 milliamps.

The Zener diode current will not be steady and must not approach zero. To allow for this in choosing the capacitor size, I will allow an average of 120 milliamps, making a total load current on the capacitor of 4.12 amps.

To keep the power dissipation required for the Zener diode down, the ratio of maximum to minimum voltage across the series resistor must also be kept down.

Maximum voltage = $15 \times \sqrt{2} = 21.2$ say 21 volts.
less the Zener voltage (there will be some forward voltage drop in the diodes)

$$\therefore 21 - 5.6 = 15.4 \text{ volts.}$$

We don't want this voltage to drop below half, i.e. 8 volts approximately, otherwise regulation will suffer and ripple will be high (see Fig. A).

∴ Minimum voltage across capacitor = 8 + 5.6 = 13.6 or 14 volts say.
The voltage at any point on the waveform = 21 sin $\theta 1$

$$\therefore \sin\theta_2 = \frac{14}{21} \quad \text{and} \therefore \theta_2 = 222^{\circ}$$

Hence between 90° and 222° the voltage can drop from 21 volts to 14 volts.
i.e. 7 volts in 132°

$$\text{From } V = \frac{it}{C} \qquad C = \frac{it}{V}$$

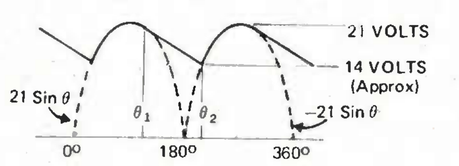
$$\therefore C1 = \frac{132}{360 \times 50} \times \frac{4.12}{7} \times 10^6 = 4316 \text{ say } 5000\mu F$$

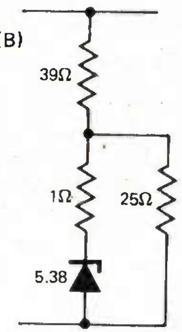
(3) The Value of R1

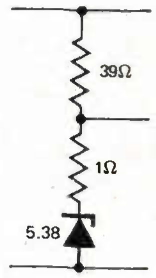
The maximum value of R1 is determined by the minimum voltage across C1. Using a 5,000 μF capacitor the voltage will drop at a rate of

$$\frac{4.12}{5{,}000} \times \frac{10^6}{360 \times 50} = 0.0458 \text{ volts/degree}$$

The diodes will cease to conduct when supply and capacitor voltages are







$$i^2 = 441\,C^2\,\omega^2 \cos^2\theta + 173\,C\omega\cos\theta + 17$$

$$i^2\,av = \int_{\theta_1}^{\theta_2} 441\,C^2\,\omega^2\cos^2\theta + 173\,C\omega\cos\theta + 17)\,d\theta \times \frac{97\text{-}43}{180}$$

$$i^2\,av = 0.3 \quad (441\,C^2\omega^2\,½\,(\sin\theta\cos\theta + \theta) + 173\,C\omega\sin\theta + 17\theta)\Big|_{43}^{97}$$

$$= 0.3 \quad (221\,C^2 \times 0.993 \times (-0.122) + 221\,C^2 \times 1.69 + 173\,C \times 0.993 + 17 \times 1.69)$$
$$- 0.3 \quad 221\,C^2 \times 0.682 \times 0.731 + 221C^2 \times 0.75 + 173C \times 0.682 + 17 \times 0.75$$
$$= 0.3 \quad (71\,C^2\,\omega^2 + 54\,C\omega + 15.98)$$
$$= 21.3\,C^2\,\omega^2 + 16.2\,C\omega + 4.79$$

But C = 0.005F $\omega = 2\pi f = 100\pi$ ∴ $C\omega = 1.571$

∴ i^2 av = 52.5 + 25.4 + 4.79 = 82.69 ∴ i rms = $\sqrt{82.69}$ = 9.09 amps (rms)
∴ The transformer should be rated for at least this. Hence use a 10 amp transformer.

Primary Fuse Rating

Primary current = $9.09 \times \frac{15}{240} = 0.57$ amps rms
The energising current will be much smaller
∴ Use 1.0 amp fuse (any larger will be less likely to blow on a fault).

Diode Current Rating

Pairs of diodes conduct only on alternate half-cycles therefore the average forward current through each diode equals $\frac{4.12}{2}$ = 2.06 amps. The peak forward current will occur at $\theta 2$ = 223°

From (7)

∴ i peak = 21 Cωcos 223 + 4.12

supply voltage equals 0.0458 volt/degree.

This occurs when $\frac{d}{dt}$ 21 sin θ_1 = -0.0458 $(\frac{180}{\pi})$

i.e. 21 cos θ_1 = -0.0458 $(\frac{180}{\pi})$

∴ cos θ_1 = -0.125 and hence θ_1 = 97°

The voltage at θ, will thus be 21 sin 97° = 20.8 volts.
∴ The voltage across C1, while it is discharging will be: 20.8 – (θ-97) 0.0458

= 24.4 – 0.0358 θ (This is an arithmetical error, should be 25.2435 – 0.0458 θ but does not affect results greatly – Ed.)

C1 will begin charging again when this voltage reaches –21 sin θ. That is, diodes start conducting when 24.44 – 0.0458 θ_2 = – 21 sin θ_2

i.e. when θ_2 = 223°

Capacitor voltage at θ_2 = -21 sin 223° = 14.32 volts

∴ Minimum voltage across R1 = 14.32 – 5.6 = 8.72 volts

Base current = 0.19 amps

∴ Maximum value of R = $\frac{8.72}{0.19}$ = 45.9 ohms

The highest preferred value = 39 ohms

(Taking above error into account 47 ohms would be more correct – Ed.)

(4) Rating of Zener Diode

The maximum current will pass through the Zener diode when the load current is zero. Assuming the voltage across C1 will be 21 volts and steady, the voltage drop across R1 = 21 -5.6 = 15.4 volts.

∴ Current through Zener diode = current through R1 = $\frac{15.4}{39}$ = 0.395 amps

∴ Power in Zener diode = 0.395 x 5.6 = 2.21 watts

∴ Use 2.5 watt (min) Zener diode

(5) Rating of R1

Power in R1 = 15.4 x 0.395 = 6.08 watts ∴ Use 10 watt resistor

(6) Voltage Rating of C1

From (4) the maximum voltage across C1 will be 21 volts steady.
∴ Use 25 volt capacitor.

(7) Current Rating of Transformer

The transformer must be rated to take the RMS current at full load. Current flows only while the capacitor is charging i.e. between 43° and 97° and then again between 223° and 277°. The current will consist of the capacitor charge current plus the load current.

i.e. i = C $\frac{d}{dt}$ 21 sin ωt + 4.12 (ω = angular velocity)

= 21 Cωcos ωt + 4.12

diodes.

Checking Output voltages and ripple

It is necessary to select a particular Zener diode to allow for Zener voltage changes due to a dynamic characteristic of the diode known as slope resistance. The Mullard range does not include a suitable Zener diode. For example, the lowest voltage 2.5 watt Zener diode is BZX70C5V6.

This has a Zener voltage of 5.6 volts to which must be added the extra voltage due to the slope resistance. The resultant voltage is too high.

∴ Use 1RC type 5ZS5.6B.

This is a 5 watt Zener diode giving 5.6 volts at 220 milliamps and a slope resistance of 1 ohm.

The base current of the transistor will in fact vary with the change in base voltage.

At maximum load current the load resistance = $\frac{5}{4}$ = 1.25 ohms.

This is reflected into the Zener diode circuit as 1.25 x 20 – 25 ohms. The Zener diode may be represented as a perfect Zener diode in series with a 1 ohm resistor. The voltage of the perfect Zener diode being 5.6 – 1 x .22 = 5.38 volts. (see Fig. B).

When e_1 = 21 volts

$\frac{21 - e_2}{39} = \frac{e_2}{25} = \frac{e_2 - 5.38}{1}$

∴ 525 – 25e_2 = 39e_2 + 1015e_2 – 5461

i.e. 5986 = 1079e_2 Hence e_2 = 5.55

Allow for an emitter-base voltage of 0.5 volts. The output voltage at full load rises to a maximum of 5.05 volts.

Similarly when e1 = 14.32 volts, e_3 = 5.3 volts and the output voltage falls to a minimum of 4.89 volts i.e. ripple = 0.16 volts.

At small output currents the equivalent circuit becomes as in Fig. C.

e_1 = 21 volts

i = $\frac{21 - 5.38}{39 + 1}$ = 0.3905 amps

e_2 = 5.38 + 0.3905 = 5.77 volts

∴ output voltage = 5.27 volts

At zero output the voltage will be 5.27 volts.

Average output voltage on full load will be approximately

$\frac{5.05 + 4.89}{2}$ = 4.97 volts.

Regulation 0.1 to 4 amps = 5.27 – 4.97 x 100% = 6%

Estimated Performance

Ripple @ 4 amp output – less than 0.2 volts peak to peak
Regulation 0.1 amp to 4 amps output – 6%.
Output voltage at 3 amps output – 5 volts ±6%.

Get ready NOW for COLOUR TV

TEAM UP WITH GRUNDIG PAL ...the right

COLOUR PATTERN GENERATORS for the PAL colour TV system

Colour Generator FG5

A powerful colour generator for the service department, using IC's in the frequency divider stages. The unit covers both the VHF and UHF range and delivers maximum 5mV RMS with 60 Ohm and is provided with a 40 dB attenuator. A variable video output of 3.5 V p/p 75 Ohm, either positive or negative, is provided. All operating modes, including the insertion of an electronic circle and other special signals, are selected by press buttons. The sound carrier is switchable and can be modulated through an internally generated frequency of approx. 1 kHz.

● Signal for standard colour test pattern ● Signals for red, green and blue raster ● Four-colour vector test signal ● Phase angle test signal for PAL decoder, using screen as indicator ● Electronic circle ● Grey scale, chessboard pattern, with 8 steps from white to black ● Three convergence pattern signals ● Positive or negative audio signal ● Modulated at 5.5 MHz or unmodulated ● Dimensions: 300 x 112.5 x 227 mm ● Weight: 4.3 kg.

PAL Service-Generator FG21

A small, handy, lightweight unit for rapid checking of colour TV receiver functions in the home or service department. The RF output level is either 30 mV or 1 mV into 240 Ohm. An electronic circle provides rational and precise methods for linearity alignments. The use of IC's affords high levels of reliability in the frequency divider stages. The colour sub-carrier and 5.5 MHz sound carrier may be switched off when not required.

● Four-colour vector test signal ● PAL phase angle test signal – decoder alignment employing screen display ● Convergence pattern signal with electronic circle ● Grey scale ● Red raster ● 5.5 MHz sound carrier ● Test Patterns: grid raster, 12 horiz. lines; 16 vertical lines; electronic circle faded-in; 4 colour bars, corresponding to the colour difference signals ● Dimensions: 220 x 80 x 165 mm ● Weight: 2 kg ● Accessories Supplied: 1 aerial cable 241; 1 protective cover for back of FG21.

For full information
contact Australian Representatives:

JACOBY MITCHELL

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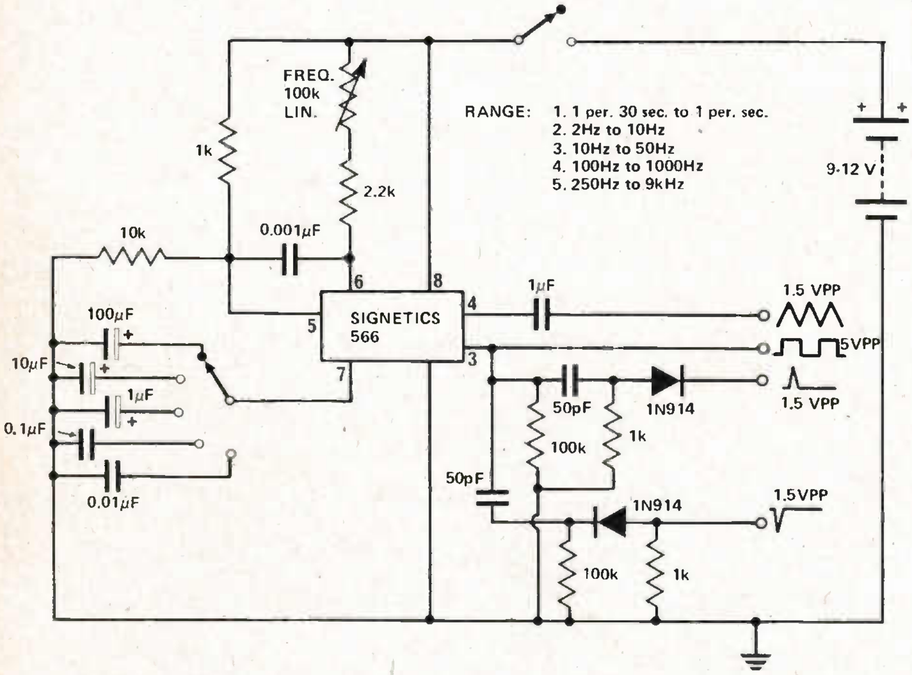
IDEAS FOR EXPERIMENTERS

VARIABLE FREQUENCY MULTIPLE WAVEFORM GENERATOR



Signetics 566 IC chip lends itself ideally as a test generator by utilising its internal voltage controlled oscillator (VCO).

The circuit will deliver separate outputs giving triangular and square waves and both positive and negative going spikes.

The square wave amplitude is 5 V pk-pk, all other waveforms are 1.5 V pk-pk.

Frequency is determined by the value of the capacitor connected to pin 7.

It is preferable to use tantalum capacitors rather than electrolytics.

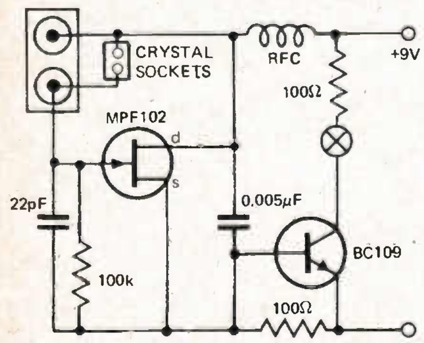
The outputs are designed to operate into high impedance loads. A transistor buffer stage is needed to match to low input impedance devices.

As the name of this section implies, these pages are intended primarily as a source of ideas. As far as reasonably possible all material has been checked for feasibility, component availability etc, but the circuits have not necessarily been built and tested in our laboratory.

Because of the nature of the information in this section we cannot enter into any correspondence about any of the circuits, nor can we provide constructional details.

Electronics Today is always seeking material for these pages. All published material is paid for — generally at a rate of $5 to $7 per item.

CRYSTAL TESTER



There are still many crystals around of fairly old vintage — especially from the World War Two period. More than often before utilising one of these one wants to quickly test them to see if they are still operable.

This simple circuit will give a quick indication if a crystal is servicable or not. It will work on any crystal over the range of 100 kHz to 10 MHz. The indicator light remains on if the crystal is not oscillating.

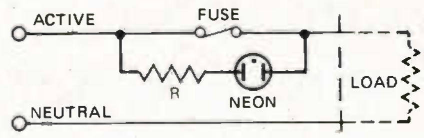
The oscillator uses a FET transistor and when not oscillating draws about 10 mA. The voltage drop across R2 is such as to turn the BC 109 on and operate the lamp.

When a good crystal is connected, the current drawn by the FET drops to around 1-2 mA and the the BC 109 is cut off, extinguishing the lamp also.

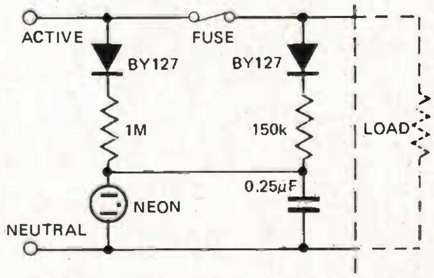
The circuit is constructed on a piece of matrix board with leads kept as short as possible. A multiple socket assembly to accept various type crystals is fitted and a small 9 V battery is used to power the unit.

NEON FUSE FAILURE INDICATOR

(a) SIMPLE NEON FUSE FAILURE INDICATOR



(b) FLASHING FUSE FAILURE INDICATOR

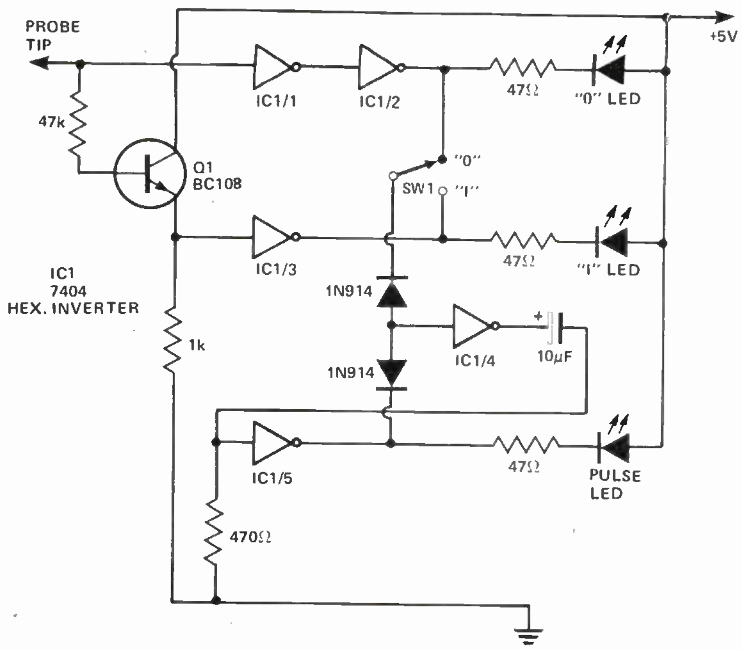


Here are two circuits showing how a neon can be used to indicate a blown fuse. The first is a simple continuous light wired in parallel with the fuse. The second has a capacitor charging circuit, which when the value of the neon's striking voltage is reached discharges through the neon and starts charging again, thus giving a flashing indication of fuse failure.

(Continued on page 124)

IDEAS FOR EXPERIMENTERS

LOW COST LOGIC PROBE CUM PULSE CATCHER



When working on digital equipment it is very often desirable to know the state of various points of the circuit. Usually an oscilloscope is used, however a very short duration pulse is usually hard to see unless the scope is a sophisticated wide-bandwidth type.

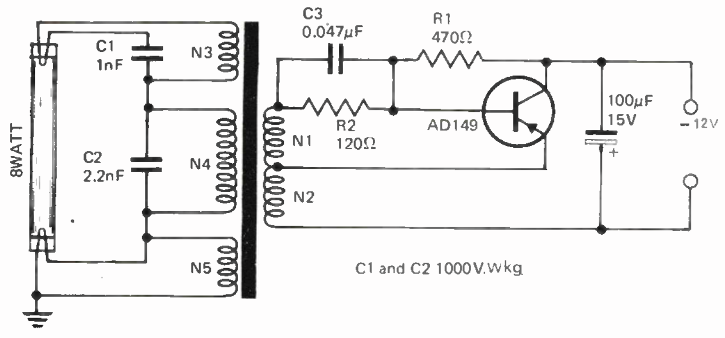
This logic probe has its own readout which illuminates a LED indicating whether the point tested is a logical "0" or "1".

It also indicates the presence of a high speed pulse, whether positive or negative going, (SW1 selects the polarity). This LED will also indicate a pulse train.

An inexpensive TTL Hex inverter is used. Power is derived from the five volt supply to the circuit being tested.

Having connected the earth and +5 V leads a simple check is to connect the probe tip to the 5 V supply and then to earth. The "1" and "0" LEDs should light in turn.

FLUORESCENT LIGHT INVERTER



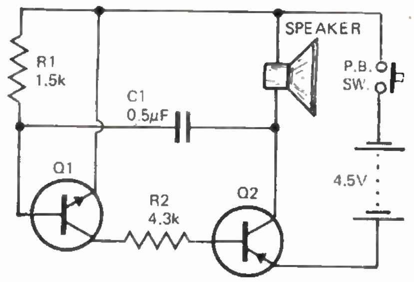
This inverter enables an 8 watt fluorescent tube to operate from a 12 V DC supply. Light output is equivalent to a 25 watt globe.

With a negative earth system a PNP germanium transistor is used. This can be mounted directly on a heat sink without any insulating mica spacer. If the system is positive earth, an NPN 2N3055 can be used. In this case some adjustment to the values of R1 and R2 will be necessary. Increase slightly the value of R2 and decrease R1. The polarity of the electrolytic condenser will also have to be reversed.

The transformer is wound on a ferrite "E" core with a minimum size of 30 mm.

Windings N1 and N2 are seven and six turns respectively, using 0.5 mm enamelled copper wire. The other three windings are wound with 0.2 mm wire seven turns for N3 and N5; 230 turns for N4.

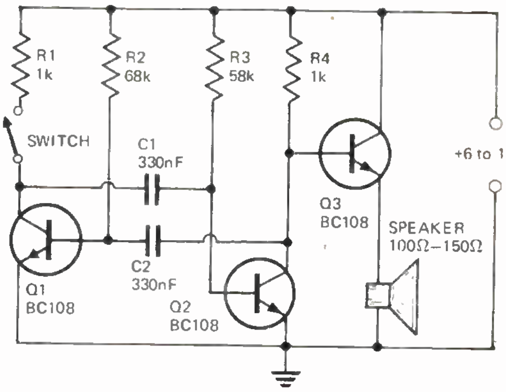
TRANSISTORISED BEEPER



This circuit consists of an assymetric multivibrator activated by a pushbutton. The loudspeaker is a transistor radio type with a voice coil impedance of about 25 to 40 ohms. Earpieces up to 500 ohms can be used for lower power output. R1 varies frequency over the audio range.

Transistor Q1 can be any LF small signal type (NPN), either germanium or silicon. (AC127, BC107, BC108 etc). Q2 is a small signal germanium type of up to 1A collector current. (AC128, AC132, AC188 etc). The battery size should be determined by the drain current of Q2.

ELECTRONIC SHIP SIREN



This circuit will give a sound like a ship's siren. It can be used with the low power output source for model ships if fed into a more powerful amplifier/speaker, as an alarm tone.

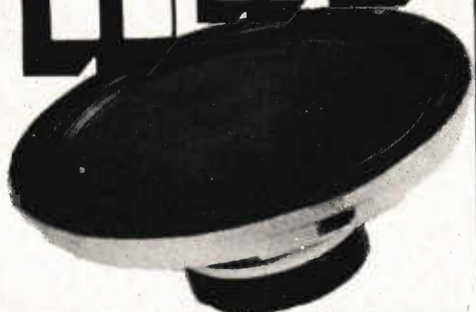
The circuit consists of a multivibrator (Q1 & Q2), and a low power output stage Q3. The speaker should have an impedance in the region of 100 to 150 ohms.

C1 and C2 determine the pitch of the siren and the values specified will provide a tone of about 300 Hz. Quiescent current is negligible.

Should a more powerful output be desired then the output at the collector of Q2 can be fed into an amplifier input via a 1 μF electrolytic, in series with a 12 k resistor.

(Continued on page 125)

FANE



HI-FI BASS LOUDSPEAKERS FROM ENGLAND

12" The model B122/10LR is a 12" bass speaker featuring a rubber suspension which allows a fundamental resonance of 17Hz in free air. This low-resonance, combined with a 2" voice coil working within a carefully selected magnet structure makes the speaker ideal for a sealed cabinet of about 2 cu.ft. capacity. Efficiency of the B122/10LR is surprisingly high for this type of loading and the speaker is ideal for amplifiers with an output of 20-25watts r.m.s. per channel at 8ohms. **$39.50**

12" The model B122/12LR, like the B122/10LR described above, is also suitable for sealed cabinets but because of its more powerful magnet structure a volume of about 3 cu.ft. is required to ensure the speaker gives its optimum performance. **$49.50**

15" The Fane model B152/12LR is a 15" bass driver with a fundamental resonance of 15Hz in free-air. Once again a sealed cabinet provides ideal loading for this unit and the volume can be varied from 3 to 5 cu.ft. The performance in 5 cu.ft. is particularly outstanding as the resonance is kept in the region of 30Hz. This results in firm, non-resonant bass without any of the "boxiness" often associated with conventional speakers. Efficiency is reasonably high and power-handling is up to 30watts r.m.s. at 8ohms. **$59**

ES801 TONE ARM

$39.50

The ES801 Tone Arm is a high-quality product of excellent performance. All facilities are provided and include removable headshell, adjustable anti-skate, lateral balance, stylus pressure scale, oil-dampened cueing lift and plug-in connecting cable. The acoustic performance is characterised by lack of arm resonance and consistently low bearing friction. All in all a very reliable unit which fills the requirements of most domestic hi-fi systems. The ES801 is the best buy currently on the market at only **$39.50**

CROSSOVER CAPACITORS

Some examples from our wide range include 3.3mfd mylar film **$1.45** each, 2.2 mfd mylar film $1.20 each, 3.3 mfd mylar film $1.40 each. 5 mfd NP Electrolytics **45c** each, 30 mfd NP Electrolytics **60c** each and 60mfd Electrolytics **90c** each.

CROSSOVER CHOKES

A comprehensive range is now available of high power, high efficiency inductors in the following values 0.25 Mh, 0.35 Mh, 0.5 Mh, 0.75 Mh, 3.55 Mh. Prices range from $1.00 to $5.00 each.

SPEAKER GRILLE CLOTH

An attractive selection of speaker grille cloths are available ex stock at very reasonable prices. Free sample pieces are available on request and will be forwarded per post anywhere in Australia together with our price list.

CROSSOVER NETWORKS

A wide range of professionally designed networks are now available at very reasonable prices. Recommendations and quotes can be supplied, providing full details of loudspeakers intending to be used are provided.

INTERSTATE DEALERS! We are expanding our operations to include interstate merchandising. Please contact us if any of the above items are of interest.

SUPER VALUE! AM/FM STEREO TUNER

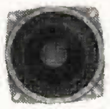
The new ERC-724 tuner is a carefully designed unit which will become a welcome addition to your existing stereo system. The AM section features an internal ferrite rod aerial which provides interference-free reception, for local stations, and allows good interstate reception for evening listening. The FM stereo section covers the range 88-108MHz. The ERC-724, is a compact unit (23.5cm x 15cm x 8.5cm) attractively presented in a walnut cabinet. Guarantee is 12 months, including parts and labour. An excellent buy for only **$64.50**

NEW 3-WAY SPEAKER SYSTEMS OF EXCEPTIONAL QUALITY

Developed by exhaustive and thorough testing, these new 3-way speaker systems combine wide, flat frequency response with genuine high power capability. (Available in Kit form or completely assembled.)

CHALLENGE SYSTEM 1 (available in Kit form or completely assembled)

CHALLENGE H-22 DOME TWEETER
The development of dome tweeters has been a major project of most loudspeaker manufacturers of recent years. The H-22 dome is one of the latest designs. The 1" diaphragm is made of carefully selected metallized polyester material which is free from resonances or rattles, and is of very small mass to allow maximum efficiency. **$8.50**



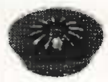
SPECIAL MID-RANGE SPEAKER
An outstanding 5" mid-range loudspeaker developed by one of Germany's leading loudspeaker manufacturers. It employs carefully selected cone material and a special cone termination to ensure flat response and high efficiency. A protective cover is fitted to the rear of the loudspeaker to prevent interference from air pressure developed within the cabinet by the bass speaker. **$15.90**

CHALLENGE 10L-24 WOOFER
This robust 10" unit features a 4 layer wound 1½" voice coil which allows it to handle 30 watt r.m.s. comfortably. The combination of extremely rigid cone and low-fundamental resonance of 35 Hz in free-air ensures deep, positive bass when used in the recommended enclosure sizes. **$16.90**

CHALLENGE HP 1 HIGH-POWER CROSSOVER NETWORK features 4 inductors including a high-efficiency air-wound 3.55 Mh choke in series with the bass speaker. 3 crossover capacitors are also used. Crossover points are 500 Hz and 4 000 Hz and the rate of roll off is 12dB/oct. **$14.50**

The **CHALLENGE SYSTEM 1** can be purchased as components only as above or completely assembled and tested in 2 cu.ft. walnut veneered cabinets at **$179 pair**

FANE 15" 3-WAY



HOKUTONE HT-60 1" DOME TWEETER
This magnificent unit features a combination of aluminium diaphragm and powerful magnet structure to produce an exceptionally clear non-resonant treble response. Efficiency is very high and dispersion is enhanced by the special acoustic diffuser surrounding the diaphragm. **$13.50**

Special Mid Range Speaker, Details as above in system 1. **$8.50**

FANE B152/12LR 15" WOOFER
Details as per FANE advertisement on this page **$59**

CROSSOVER NETWORK $14.50

This system, based on the Fane 15" woofer, can be purchased as components only as above, or completely assembled and tested in 3 cu.ft. walnut veneered cabinets for **$300 pair**

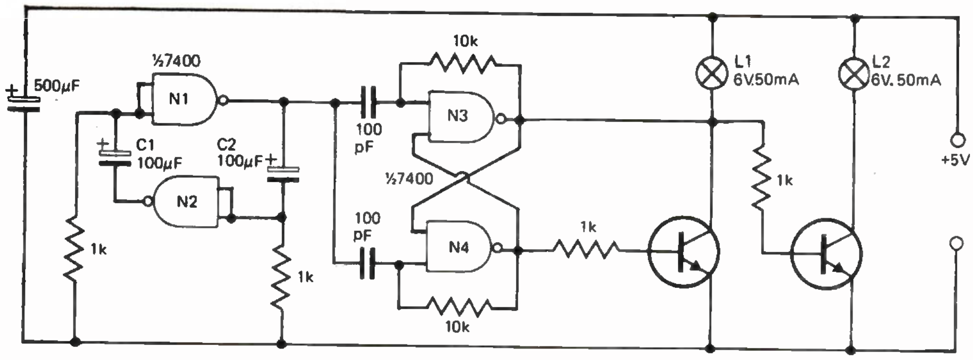
Challenge

HI-FI STEREO PTY LTD

96 PIRIE ST.
ADELAIDE
STH. AUST. 5000
PHONE: 223 3599

IDEAS FOR EXPERIMENTERS

INTEGRATED CIRCUIT FLASHER

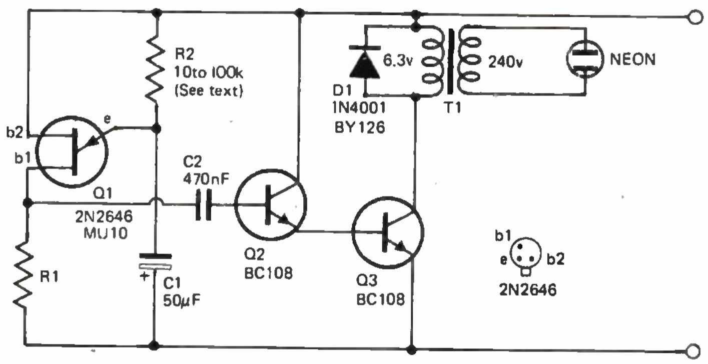


In this circuit a TTL quadruple NAND gate is wired as a multivibrator to actuate two lamp drivers.

Gates N1 and N2 drive the flip-flop consisting of gates N3 and N4.

The outputs of the flip-flop switch the transistors alternately. Capacitors C1 and C2 determine the flashing rate. The power supply must be stabilised at 5 V. If higher wattage globes are to be driven transistors of higher power rating must be used.

NEON TUBE FLASHER



Flashing neon globes have use in many applications, however their relatively high working voltage precludes their general use where a mains supply is not available.

This circuit enables neon tubes or globes to be operated from a low voltage dc supply.

The voltage required to ignite the neon tube is obtained by using an ordinary filament transformer (240-6.3V) in reverse.

Battery drain is quite low – being in the region of 1 to 2 milliamps for a nine volt battery.

Q1 is a unijunction transistor and operates as a relaxation oscillator. Its frequency of operation is determined by R2-C1.

The pulses from Q1 are directed to Q2 which in turn drives Q3 into saturation.

The sharp rise in current through the 6.3V winding of the transformer as Q3 goes into saturation induces a high voltage in the secondary winding causing the neon to flash.

The diode D1 protects the transistor from high voltage spikes generated when switching currents in the transformer.

LIGHT SENSITIVE OSCILLATOR

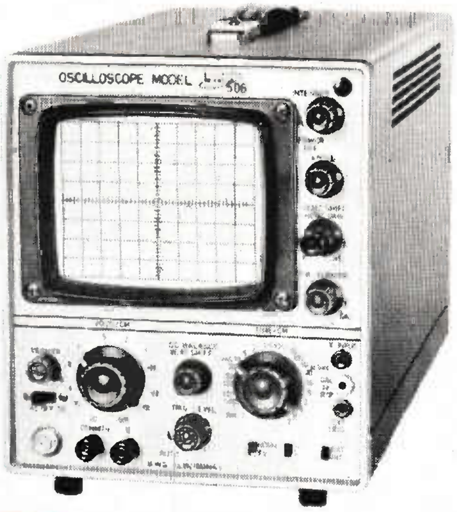
This circuit uses a voltage controlled oscillator (VCO) coupled with a photo-resistor type ORP 12.

Varying degrees of intensity of light falling onto this resistor will give different frequencies of sound. RV1 shifts the center frequency of the note obtained.

Q1 and Q2 are connected to form a multivibrator circuit. Q3 is connected so that it can determine the voltage on the base of Q2.

D.C. TO 15MHz 5mV/cm

b.w.d 506



A superb single beam oscilloscope providing wide band width with high sensitivity, extremely stable TV triggering and an isolated ground for those difficult to obtain 'in circuit' measurements.

Bandwidth:	DC to 15MHz – 3db
Sensitivity:	5mV to 50V/cm with vernier
Time Base:	200n Sec – 10 Sec/cm with vernier
Magnification:	x1 to x5 calibrated
Triggering:	5Hz – 15MHz 1 cm deflection or 1V p-p ext.
Trig. Facilities:	AUTO. Level select Int, Ext and TV
Horz. Amplifier:	DC to 1MHz – 3db
Sensitivity:	.6V to 6V/cm
Z Modulation:	20V neg. to blank trace at normal, intensity, input T.C. 5mSec (DC coupled option available)

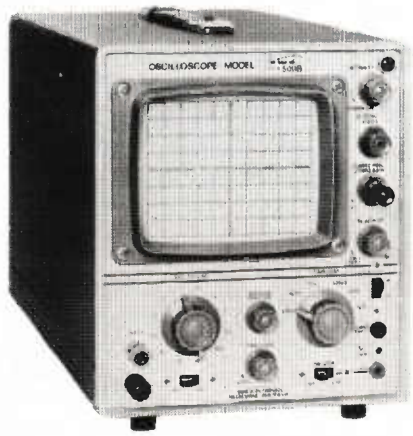
PRICE: $340 F.I.S. Capital Cities plus tax applicable

D.C. TO 7MHz 10mV/cm

b.w.d 509B

The finest value low cost 100% solid state oscilloscope available today. Thousands in use around the world serving education, colour T.V. servicing and industry.

Bandwidth:	DC to 7MHz – 3db
Sensitivity:	10mV to 50V/cm
Time Base:	1μSec to ≥1 Sec/cm with vernier
Magnification:	x1 to x5 calibrated
Triggering:	2Hz to 10MHz 1 cm deflection or 1V p-p ext.
Trig. Facilities:	AUTO, Level select, Int and Ext.
Horz. Amplifier:	DC to 1MHz
Sensitivity:	.6V to 6V/cm
Z Modulation:	20V pos. blanks trace at norm inten.



PRICE: $235 F.I.S. Capital Cities plus tax if applicable

WINNER OF AWARD FOR OUTSTANDING EXPORT ACHIEVEMENT

B.W.D. ELECTRONICS PTY. LTD.
Designers and Manufacturers of the finest electronics instrumentation.
329-333 Burke Road, Gardiner, Vic. 3146 PH: 25 4425 (3 lines)
127 Blues Point Road, North Sydney N.S.W. 2060 PH: 929 7452 92 6756
- S.A. A.J. Ferguson Pty. Ltd. PH: 51 6895
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- TAS. Associated Agencies Pty. Ltd. PH: 23 1841

Douglas·hifi

MELBOURNE: 185-191 Bourke St., City. Ph. 63 9321.
SYDNEY: 65 Parramatta Rd., Five Dock. Ph. 798 4177, 798 4533, 798 4355, 798 4711.
Trade Enquiries: BJD ELECTRONICS P/L., Phone 799 3156.
PERTH: 883 Wellington St. Phone 22 5177.
CANBERRA: 53 Wollongong St., Fyshwick. Phone 95 3459.

DOUGLAS HI-FI

PERTH

883 Wellington St., Perth, W.A. 6000. (Opposite the markets.) Phone 22 5177.

If you're not impresed by Australia's biggest Hi-Fi showrooms, you'll certainly be impressed by the range and qual of our equipment – and our low prices.
More than 30 top brands, from 4 continents, displayed in a single showroom. There are hundreds o different models to choose from. And to make it easy for you to make the right selection, custom-built electronic comparators enable you to compare any combination of record player, tape deck, amplifie and speakers instantaneously. Because we buy bigger than anyone else, we buy cheaper. An we pass the savings on to you. Call in and prove for yourself that Douglas sells sound for less!

BUY FOR CASH, LAY-BY OR EASY TERMS ARRANGED

HUGE NATION·WIDE BULK BUYING OFFERS SPECIAL LOW PRICES

DOUGLAS HI-FI

Here are just some of the typical savings from Douglas Hi-Fi in Melbourne, Sydney, Perth and Canberra.

LINEAR DESIGN 169 HI-FI SYSTEM, features Garrard automatic turntable. Shure magnetic cartridge, diamond stylus, connection for tape recording/playback, 24 watts RMS power. Heavy duty twin cone 8" speakers in acoustically-correct cabinets. $189 complete, with 2 year warranty.

LINEAR DESIGN 2500 SYSTEM. • GST-II transcription turntable with Shure 55E cartridge, ydraulic lift, magnetic anti-skate, gimbal bearings, dynamic balance • Amplifier has 50 watts RMS power output, complete range inputs and auxiliary rcuits, tape dubbing facilities • 12" bass speakers, 3½" tweeters. Douglas Hi-Fi price $459 complete.

KAI MODEL GXC 46-D. THE GREATEST VALUE IN HI-FI CASSETTE STEREO TAPE RECORDERS ODAY! Famous Dolby system, chrome tape switch, glass crystal ferrite head, automatic distortion reduction system. DOUGLAS HI-FI PRICE WITH 12 MONTHS WARRANTY $289.

ENSEN SPEAKERS MODEL 15. The finest speaker system Jensen has ever made. 15" woofer with 11 . Syntox 6 ceramic magnet structure, 8" mid-range driver, 5" rear damped tweeter, two 1" drivers, ensen's 'Sonodome' ultra-tweeters. 100 watt power rating. Douglas Hi-Fi price $1099 PAIR.

JENSEN MODEL 6, features 15" woofer for hundering no-strain bass, 8" and 5" Flexair drivers or crisp clean mid-range. Douglas Price $550 PAIR.

* 5-Year Parts and labour warranty on all Jensen Speakers.

KAI 4000DS PROFESSIONAL 3-HEAD TAPE DECK. Exclusive One-Micron Gap Head extends frequency sponse flat to 23,000 Hz, auto-stop for editing, tape selector switch, sound mixing, 4 track stereo and mono operation with up to 7" spool. $219 with 12 months warranty.

LINEAR DESIGN SA 8000 AMPLIFIER. 100 watts RMS power, every possible control including 2 tape monitors, A & B speaker switching, microphone mixing, plugs for pre-amp/power amp connection. $199.

LINEAR DESIGN 169B AMPLIFIER. 32 watts RMS power, both channels driven at 0.3% distortion, magnetic/auxiliary inputs, stereo headphone outlet, bass/treble controls, loudness filter and tape monitor circuit. $99.

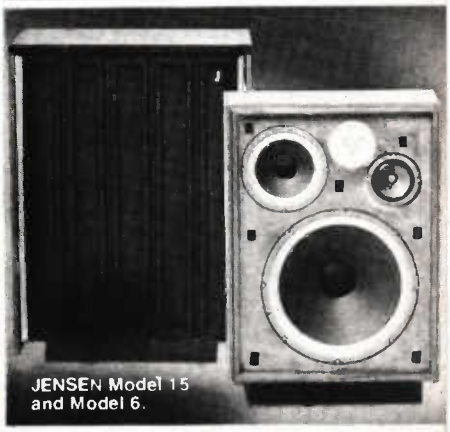
LINEAR DESIGN 2500 AMPLIFIER. 50 watts RMS power; 0.2% distortion; complete range inputs and auxiliary circuits; rumble, scratch and loudness filters, twin tape monitors, switching for 2 pairs of speakers $149.

ALL LINEAR DESIGN UNITS ARE COVERED BY AN EXCLUSIVE NO-FUSS 2-YEAR WARRANTY!


LINEAR DESIGN 169 SYSTEM.


AKAI 4000DS 3-HEAD TAPE DECK.


LINEAR DESIGN 2500 SYSTEM.


JENSEN Model 15 and Model 6.


AKAI GXC 46-D STEREO CASSETTE RECORDER.


LINEAR DESIGN AMPLIFIERS.

MAIL ORDERS A SPECIALITY!
ALL ORDERS SENT FREIGHT-FREE (and Insurance-Free) ANYWHERE IN YOUR STATE.

DOUGLAS SELLS SOUND FOR LESS! Douglas·hifi

PEAK

FULL FIDELITY SOUND

PEAK Speaker Systems with their matched sets of tweeters, mid range speakers and woofers, their simple but elegant cabinet design, and their crisp pure sound offer maximum performance and long lasting enjoyment from your stereo system.
Choose from the small book shelf NS-90 through the NSW250S and NSW-350 models to the superb NSW-550 deluxe with a power rating of 70 Watts and frequency unit response 25-20000 Hz.

The PEAK BD-2000U stereo record player is equipped with a heavy cast aluminium turntable, 30 cm dia, which is belt driven and dynamically balanced for utmost resilience and lowest wow and flutter levels. Both 45 and $33^{1}/3$ RPM speeds are readily obtained by operating a switch on the top panel.
Normally fitted with the PEAK MC-7 magnetic cartridge for widest frequency response and fidelity.
Available with or without the matching base/cover set illustrated.

The PEAK KA-400 Stereo Amplifier has a full 20/20 Watt RMS power rating and frequency response 20 to 20k Hz. All wanted controls are incorporated with ultra-modern push button switching on main parameters. Spring loaded speaker switches enable quick connection of the two pairs of speakers which can be connected to this amplifier. Jet black facia with oiled walnut cabinet give this unit a most attractive appearance to complement its fine performance.

ADELAIDE
BRISBANE
HOBART
MELBOURNE
PERTH
SYDNEY

H.ROWE & CO PTY LTD

A Member of the Hecla Rowe Group

FM STEREO BROADCASTS will begin before the end of December in NSW.

This follows Senator Doug McClelland's approval that a licence be issued to the Music Broadcasting Society of NSW Co-operative Limited allowing the co-operative to transmit FM stereo broadcasts on an experimental basis for a period of one year — subject to normal Broadcasting Control Board regulations. The Senator expects that the co-operative will be eligible to renew their licence at the end of twelve months.

Transmission is expected to commence by mid-December in NSW and later in Victoria following the completion of a 30 metre tower and final organisation of a separate Victorian co-operative.

The NSW studio will be located at Artarmon and will be known by its call sign 2MBS-FM, transmitting on 92.1 or 93.7 Megahertz.

A monthly programme guide will be available to the public on a twelve month subscription (costing $25.00). Revenue from the subscriptions is expected to cover most of the studio's running costs.

Any members of the public may buy ordinary $1.00 shares in the co-operative and, although no dividend will be paid their purchase will be tax deductible.

Shareholders will be entitled to one vote at general meetings.

A board of twelve directors was selected at a general meeting on the 5th of November 1974. A programming committee was also selected. This committee will be responsible for general programming, music 'type', scheduling, etc.

Detailed programming will be arranged in two hour segments by 'Programmers'. These will normally be shareholders who have a special interest in the particular type of music required by the programming committee. Programmers will work voluntarily and may submit segments regularily or only occasionally.

Two copies of all disc or tape recordings will be held by the co-operative. One will be the studio master, the other will be used by the programmers in working out a particular segment. Listings of all recordings will be held in computer memory, and any relevant recordings can be made available to a programmer given an appropriate description of the music required.

At present, programming is expected to fall into several historical and 20th century periods and be given air time as follows;

Medieval and Renaissance music — 10%
17th Century — 10%
18th Century — 20%
19th Century — 20%
20th Century — 40%

These classifications are further broken down into Orchestral, Solo Instrumental, Ensemble Operatic and Vocal. Twentieth century includes Rock, Jazz, Country and Western, Popular, Avant-Garde and Electronic music. There is also provision for ethnic and non-Western music such as the Indian Sitar. Special Educational, Live and Technical broadcasts are also expected to be transmitted.

There will be no commercial advertising transmitted on air although sponsor advertising will be accepted in the programme guide.

STUDIO EQUIPMENT

By the time the co-operative goes to air only about $7,000 will have been spent. This has been possible because most of the equipment has been built by the technical members of the co-operative. Most of the Studio equipment has been donated by Harmon Australia (previously Jervis Australia), distributors of JBL, Harmon Kardon etc.

The transmitter has been designed to high standards by the technical members of the co-operative. Initially its output power will be 50 watts, but this will soon be raised to an effective 1000 watts or higher. The co-operative is licenced to transmit up to 10 000 watts.

Subscriptions to the programme guide may be obtained by returning the application form on this page together with a cheque or postal note for $25.00.

APPLICATION FOR SUBSCRIPTION

Music Broadcasting Society of NSW Co-operative Limited, Box 176, The Union, Sydney University, 2066.

Please register me as subscriber to the Co-operative's programme guide and find $25.00 enclosed being payment for twelve issues.

NAME ....

ADDRESS ....

.... Postcode ....

☐ Please send application form for membership as a shareholder (Optional)

ADVERTISER'S INDEX

HOBIPAC

P.O. Box 224 South Carlton, Vic. 3053

RESISTORS

CARBON FILM

Range	Power	Range	Tol.	Price
E12	1/20W	82-220K	5%	30c
E24	1/8W	10 ohm	5%	5c
E12	1/4W	1 ohm-10M	5%	4c
E24	1/2W	1 ohm-22M	5%	4c
E12	1 W	10 ohm-22M	5%	5c

(note — In the high value, resistors are 10% tolerances).

METAL FILM

1/2W 10 ohm-270K 2% 10c

Stock is limited as manufacturer is now quoting delivery on order received after February, 1975.

WIRE WOUND

1/2W	1 ohm	1%	45c
1/2W	10 ohm	1%	38c
1/2W	0.47 ohm	10%	25c

POTENTIOMETERS — SLIDE

Linear 5k, 10k, 25k, 50k, 100k 70c
Logarithmic 5k, 10k, 50k 70c
Knobs — chrome 23c
— black 18c

ROTARY

Linear 25k, 250k 60c
Logarithmic 500k 60c

SPECIAL RESISTORS — CARBON-FILM

10% — 1/8 watt

10 ohm — 10 M ohm .... 4c each.
100 resistors (our selection — not more than 2 of any one value 90 + E12 series, values) **$3.28**

MIN HOOK-UP WIRE

7/101 .... 6c yd.
11/0032 .... 7c yd.

HARDWARE NUTS & BOLTS

STEEL NUTS AND BOLTS ZINC PLATED 1/8" WHITWORTH ROUND HEAD

Length	Each
3/8"	1c
½"	1c
1"	2c
1/8" hex. nut	1c
1/8" shakeproof washer	1c
1/8" flat metal washer	1c

B.A. SIZE, CHEESE HEAD

½" x 4BA	1c
4BA hex. nuts	2c
½" x 6BA	1c
½" x 6BA cheese head	1c
1" x 6BA cheese head	1c
6BA hex. nut	1½c
8BA (brass)	3c
8BA hex. nut (brass)	2c

CAPACITORS — ELECTRONICS

PIGTAILS

µF	Volts	Price
2	12	.15
4.7	500	.40
8	350	.43
10	16	.18
10	160	.33
47	25	.24
100	25	.25
220	25	.56
250	50	.62
470	16	.50
470	25	.58
2000	25	.92
2200	16	$1.00
4000 (lugs)	6	1.00

P C B MOUNTING

4.7	25		.14
5	10		.13
8	235	(lugs)	.45
10	10		.14
25	25		.14
30	12		.14
47	50		.26
100	16		.20
100	25		.24
220	25		.54
470	16		.46
470	25		.56

TANTALUM TAG. TYPE

35 Volt rating	1-9	10+
1µF, .22, .33, .47, 1.µF, 1.5, 2.2	29	28
3.3, 4.7, 6.8, 10µF	30	29
Other ratings 15µF/16V, 22µF/16V, 33µF/10V, 47µF/6.3V, 100µF/3V	32	30

CERAMIC TYPE

60 volt	1-9	10+
100 220 330 470 PF .001 .0022 .0033 .0047 .01 .033 .047 UF	.10	.08
.1	.14	.12
.22	.20	.17

POLYESTER

	DCW	1-9	10+
.01	50	.16	.14
.0047	100	.16	.14
.01, .012, .015, .022	100	.18	.16
.027, .033, .039	100	.22	.20
.047, .056, .068	100	.27	.26
.1, .12	100	.37	.34
.15, .22	100	.39	.36
.27, .33	100	.44	.40
.39,	200	.48	.45
.56,	250	.80	.75
1 MFD	250	.90	.80

SATO COMPONENTS

CF 1352	4 pin coil former 1"	60c
CF 1352	8 pin coil former 1"	60c
P 7005	40mm x 17mm dia coil former	40c
K 4071	Knob 14mm x 18mm dia black with white dot	40c
SW 7530	Switch Snap 250V 6 pin	1.50

DENCO COILS

Plug in coils for either Transistor (T type) or value (DP type) applications.

T types available:— $2.20

Blue	Aerial coil with base input windings
Yellow	Interstage RF coil with couplings
Red	Oscillator coil for IF of 465 Kc/s
White	Oscillator coil for IF of 1.6 Mc/s

DP Types available:— $2.20

Blue	Signal grid coil with aerial coupling windings.
Yellow	Signal grid coil with intervalue couplings windings.
Green	Grid coil with Reaction and coupling windings.
Red	Superhet Oscillator for IF of 465 Kc/s.
White	Superhet Oscillator for IF of 1.6 Mc/s.

Ranges available — T type 1-5 — DP type 1-7

Range 1 .150 to .525 Mc/s (2000 to 570 Metres).
2 .515 to 1.545 Mc/s (580 to 194 Metres).
3 1.67 to 5.3 Mc/s (180 to 57 Metres).
4 5. to 15 Mc/s (60 to 20 Metres).
5 10.5 to 31.5 Mc/s (28 to 9.5 Metres).
6 30 to 50 Mc/s (10 to 6 Metres).
7 45 to 78 Mc/s (6.6 to 3.8 Metres).

Type	Description.
IFT/18/1.6	1.6 Mc/s Double Tuned I.F. Transformer $3.25.
IFT/18/465	465 Mc/s Double Tuned I.F. Transformer $3.25.
IFT/16/1.6	Minature Single Tuned IF 1.6 Mc/s Freq. $2.85.
IFT/17/1.6	Minature Single Tuned Last IF $2.85.
BFO/.2	Beat Frequency Oscillator coils for 1.6Mc/s, 465Kc/s, 85Kc/s $2.65.

Plug in sockets for (B9A Noval) for coils .30c.

SEMI-CONDUCTORS

ACY19	2.25
AS302	.68
BC107	.50
BC212	2.05
BC212L	2.10
BF185	.80
BFS61	1.69
BFS98	1.60
BFY51	4.00
BSX20	1.80
LM381	3.00
MC1455P	3.00
MEO413	
MEO453	
ME512	
ME513	
ME6003	.75
ME8003	1.09
MEL12	2.00
MFC4000B	3.50
OA47	.94
SC45D	7.00
SC50D	9.05
TT2926	.99
ZN414	4.00
ZTX102	1.24
ZTX108	.92
ZTX107	.95
ZTX109	1.15
ZTX114	2.00
ZTX300	1.15
ZTX301	1.14
ZTX304	1.90
ZTX382	1.15
ZTX500	1.15
ZTX501	1.18
ZTX502	1.25
ZTX531	2.00
ZTX550	1.55
ZTX503	1.38
IS44	.24
2N2926 —	
— Brown	1.10
— Yellow	1.05
— Red	1.00
2N3053	2.00
2N3693	.50
2N3704	1.04
2N3705	1.17
2N3706	1.14
2N4121	.50
2N5133	.85
2N5134	.87
2N5137	.86
2N5138	.90
2N5139	.78
7489	4.85
7490	7.65
8223	9.00

Prices subject to alteration without notice.

A & R TRANSFORMERS

A+R SOANAR GROUP

A & R Output Transformers

Type	Power Watts	Impedance Primary	Impedance Secondary	Dimensions Kg	Price
E5/3.5	3.2	5000	3.5	.2	$3.60
E5/15	3.2	5000	15	.2	$3.60
E7/3.5	3.2	7000	3.5	.2	$3.60
E7/15	3.2	7000	15	.2	$3.60

A & R Rooster Transformers

Type	Primary Volt	Secondary Volt	Secondary Amps	KG	Price
1239/110	6.3	7.5,8.5,9.5	0.8	.23	$11.10

A & R Low Voltage Transformers 240 V. Primary

Type	Secondary	Kg.	Price
2150	6.3 or 12.6V (4 or 2A)	.65	$7.75
2155A	6.3,7.5,8.5,9.5,12.6,15	.43	$6.50
5502	22 or 44V (2.5 or 1.25A)	1.26	11.00
5503	17, 11.5V (4A)	1.7	16.16
5504	15V (2A)	.9	6.94
5508	6.3 or 12.6V (4 or 2A)	.85	8.30
5509	12.6 or 25.2V (5 or 2.5A)	1.7	13.40
5577	3.3V (100 VA Int.)	1.8	11.91
5579	6.3V (1A)	.2	6.60
6413	32V (2A)	1.8	17.33
6474	12.6CT (0.15A)	.2	6.50
6672	30, 27.5, 24, 20, 17.5, 15V (1A)	.9	11.10
6978	15, 12.6, 9.5, 8.5, 7.5, 6.3V (2A)	.9	12.50
7243	50, 40, 33, 25, 19V (2A)	2.0	18.36
9129	30V CT. (1A)	.9	8.50

A & R Special Lines

PS82A	Battery Eliminator 0.1A	14.85
PS164	Battery Eliminator 0.3A	18.36
PS293	Solid State Car Convertor 6, 7.5, 9V @ 300mA	5.10

Please add appropriate freight for transformers.

HOBIPAK, P.O. Box 224, Carlton South, Vic., 3053

Please supply . . . .

BLOCK LETTERS PLEASE

. . . .

. . . . Postcode . . . .

Quantity	DESCRIPTION	Unit Price	$	c
	Freight on transformers			
	Resistors ordered on back			
If goods are to be sent C.O.D. — Please sign		C.O.D. charge	1	00
Packing and postage				30
Enclosed Cheque/P.O./M.O. for		TOTAL $		

news digest

Continued from page 6

developed from direct contact with leading Japanese industrial companies, universities, and private and government research institutions. The International Technical Information Institute (ITI) supplements these sources by continually monitoring Japanese trade journals and business press, and following up by investigation where warranted.

The New from Japan clearinghouse is divided into five categories of broad technical interest; mechanical devices and manufacturing processes; electronic, electrical devices, and measurement instrumentation; metallurgy and materials; chemicals and chemical processes; and environmental and pollution control.

Every two weeks, each New from Japan associate is sent information on technical developments in each of the categories he has chosen to receive. The information includes a description of the technology, its applications, quantitative data about it, and an assessment of its stage of development. In addition, each report includes the name and address of the source company directly responsible for the specific development, allowing direct contact with the company or individual concerned.

Details of the service can be obtained from Mr. A. E. Byrne, Chairman & Managing Director, Australian General Electric Ltd., 86 Bay Street, Ultimo, NSW 2007.

ELECTRONIC SHOCK FOR SHOPLIFTERS

Shoplifters and others who steal from stores may soon be in for a shock. A new electronic security system which has already proved remarkably successful in protecting London's West End and shopping centres throughout Britain is to be available in Australia early next year.

Called Senelco, the system can best be described as making every article of merchandise its own watchdog. The installation consists of electronic scanners which create a protective field at the exit to a store or department. Linked to the scanner is a discreet alarm unit. Small, sensitised tags are attached to articles within the store and are so designed that they can only be removed by the sales clerk at the time of purchase. Anyone attempting to leave with stolen goods will automatically be detected because the tags will activate the exit field and trigger the alarm.

Senelco was first developed in the United States and now protects thousands of stores including some of the best known like Bloomingdales, May, Goldblatts, Carson Pirie Scott and Bonwit-Teller. It was introduced in Britain only two years ago and rapidly established itself as the most effective security device available.

There are now over 300 Senelco installations in Britain and this number is growing month by month. Amongst British users are Miss Selfridge, House of Fraser, Owen Owen, Liberty's, Fenwicks, Laura Ashley, Wallis Shops, Peter Robinson and many fashionable boutiques and menswear stores. Senelco is also being used to protect books — there are several Senelco installations in British libraries — as well as electrical goods, records and cassettes, fine art, jewellery and other high priced and attractive merchandise.

Malcolm Barker, managing director of Senelco Ltd is in Australia now (end of November) to recruit staff for his new Australian company — Senelco Pty Ltd which will be based in Smithfield, New South Wales. ●

OLD McDONALD

The BBC in London have an Engineering Information External Inquiries Officer.

This character is rapidly gaining world-wide fame by answering his telephone with a short sharp 'EIEIO'.

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