

# electronics

**TODAY**  
INTERNATIONAL

**HI-FI**

January 1973 50c\*

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THE SKY**



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WORLDWIDE**

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# electronics TODAY INTERNATIONAL

January 1973

Vol. 2 No. 10

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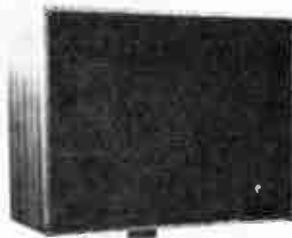
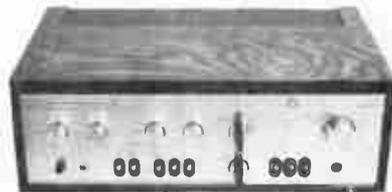
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Cover: Microphoto of T05 operational amplifier.

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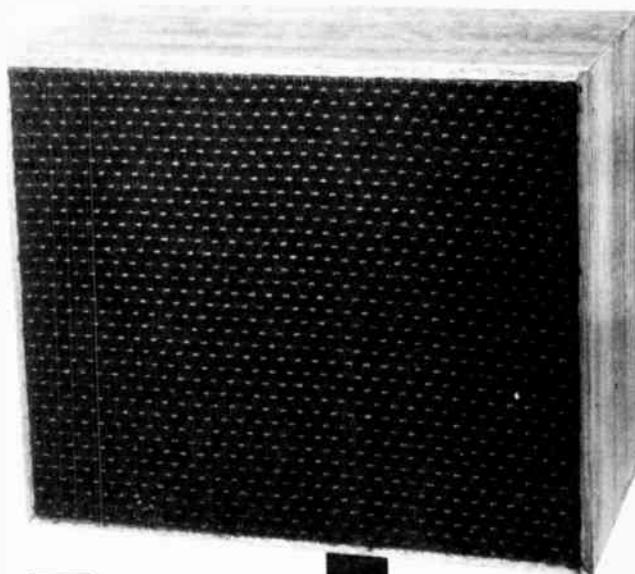
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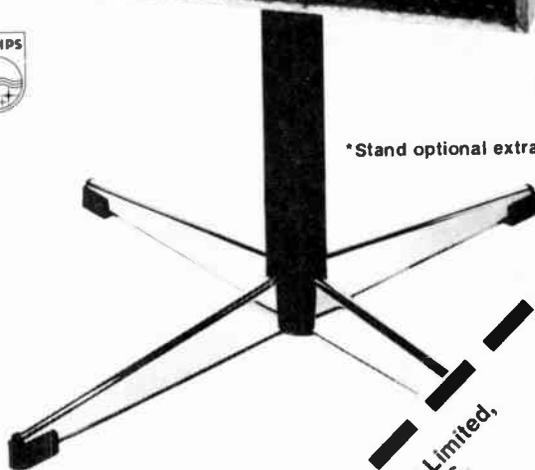
For the Quadreflect System Philips chose the superb ADO160/T8 Dome Tweeter and AD7065/W8 Woofer thus obtaining the maximum results in both the high and low frequencies.

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# A MATTER OF DUTY

There is overwhelming evidence that the former Minister for Trade intended to provide protection for the local colour TV manufacturing industry without referring to the Tariff Board – or by implication – to the public.

Statements from the previous government implied that no formal request for protection had been made by the manufacturing industry – but the accent must have been on the word 'formal' for it is a fact that secret discussions took place between manufacturers, and officials of the former Minister's department for some months.

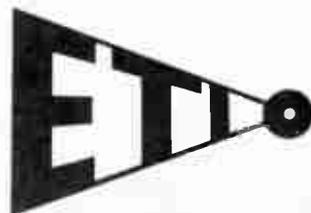
This arrogant attempt to legislate by fait accompli was thwarted by the action of Mr. G. A. Rattigan (Chairman of the Tariff Board), who, becoming aware that the matter would be withheld from the Tariff Board, had the courage to speak out in protest.

Legally, the issue seems clear cut. Section 15 of the Tariff Board Act provides that the Minister shall not take any action on tariff protection until he has received a report from the Tariff Board.

The level of protection afforded to the TV manufacturing industry is already very high. Imported receivers are taxed at the rate of 12½% on the picture tube, and 45% plus an additional loading of \$50 on the remainder of the set. This amounts to some \$100 per unit.

Deciding the duty to be charged is a complex matter, for the government must try to achieve an equitable balance between the interests of Australian consumers on one hand, and the prosperity of Australia's domestic electronics industry on the other.

It may well be that the TV manufacturing industry has a strong case for additional protection, but before such protection is granted, the views of all interested parties should be heard. It is to Mr. Rattigan's credit that they now will be.





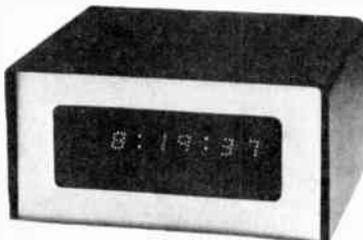
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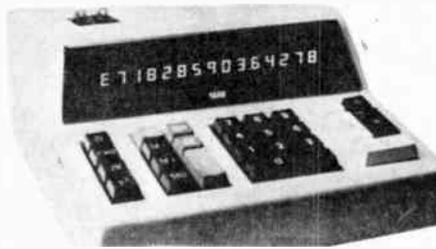
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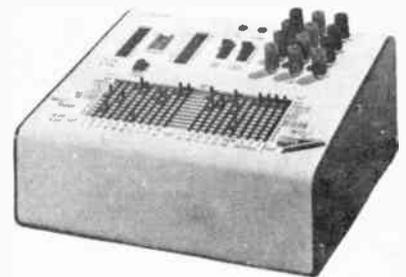
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14 digit input, 14 digits output. Function: addition, subtraction, multiplication division, squaring ( $X^2$ ), square root ( $\sqrt{X}$ ), one constant data memory, one independent data memory, decimal select key, change sign key, exchange operands key, etc. including 80 page manual. Available as kit and assembled unit (one year warranty on assembled unit). Also available for the 1440 Calculator: Plug in Programmer with 100 programming steps. Separate keyboard entry, two independent data memories etc. Printer Module giving hard copy records, prints 2.5 lines per second etc.



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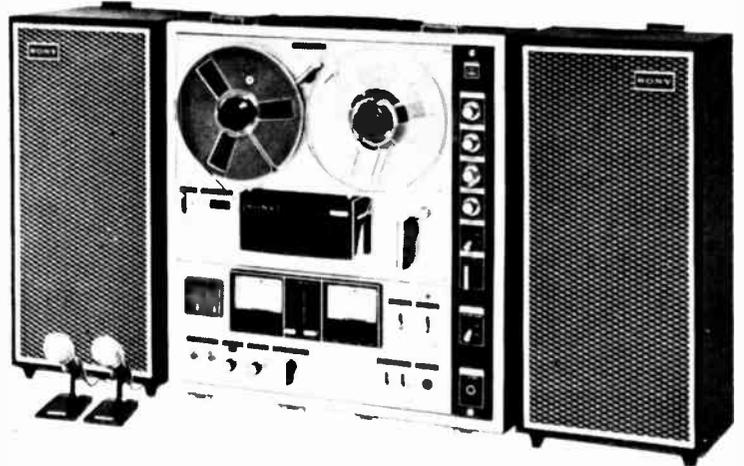
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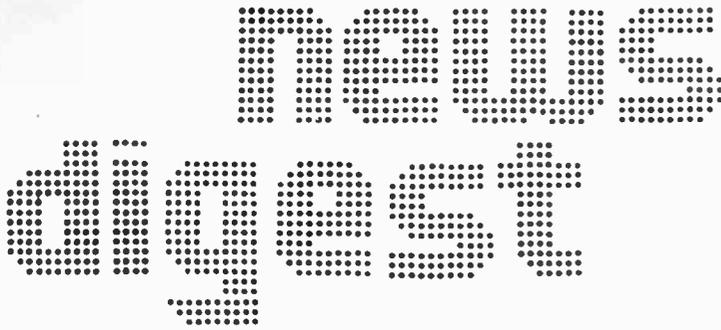
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## WORLD WEATHER WATCH



The first phase of the Marconi Automatic Relay System (MARS) — a computer-based message switching system — is seen here in operation at Britain's key meteorological centre at Bracknell in Southern England. MARS provides a high speed link with other major centres on the World Weather Watch network, and will enable Bracknell to undertake the first stage of its role as a regional telecommunications hub on the Meteorological World Trunk Circuit. This is the main circuit planned to span the world and carry raw data and processed information required by all countries under the World Meteorological Organization World Weather Watch Plan. Each hub is responsible for collecting, collating and retransmitting weather information over its own region and relaying it to the other hubs.

## RED-GREEN LED

A new light emitting diode (LED) from Monsanto produces a red light when energised in one polarity — and green light when the polarity is reversed.

It is expected that the new LED will be available to commercial users almost immediately.

## PROGRAMS NOT PATENTABLE

The US Supreme Court has ruled that patent protection cannot be granted for computer programs.

This decision reverses a previous lower court decision and thus brings the USA into line with most other nations.

Although the Supreme Court were trying what appeared to be a minor case between the Commissioner of Patents and a couple of private individuals, it was in fact a test case involving a \$15,000 million dollar investment. Firms such as ITT, IBM, Honeywell etc were very much involved.

Basically the fight is between computer users, who seek patent protection for their program investments — and computer manufacturers who say that patent protection would hinder development of programming.

Justice William O. Douglas, who wrote the High Court decision, said that 'phenomena of nature, mental processes, abstract intellectual concepts are not patentable, as they are the basic tools of scientific and technological work'.

'If any such discovery can be patented,' he went on to say, 'its patentability must come from the application to a new and useful end.'

US patent lawyers predict that the affair has not yet ended and that the fight will now be taken to Congress.

## LICENSING OF RADIO AND T.V. SERVICEMEN

The Electrical and Electronic Servicemen's Licensing Committee is currently renewing servicemen's licences for the period ending June 30, 1973 and has commenced a campaign to achieve the licensing of all servicemen in the electrical and electronic service industry.

The Committee is a voluntary, independent group comprising representatives from R.M.I.T., the Electrical Trades Union, Electronics Association Australia and Retra Service Association.

First formed many years ago under the chairmanship of Mr R.R. McKay, then Principal, R.M.I.T., the Committee set out to introduce a voluntary licensing scheme so as to protect the public from unethical practices, safeguard life and property from the effects of inferior servicing and to promote a high standard of workmanship within the industry thus protecting the livelihoods of servicemen.

Over 300 licences have been issued, each one carrying a photo of the serviceman and his signature together with the class of product which the Licencee is qualified to service. When fully implemented the scheme will ensure that only suitably qualified or experienced servicemen will be employed in the industry and already the public in increasing numbers are seeking licensed men to carry out service.

The licensing system provides for unqualified servicemen to obtain a temporary licence provided that they are over 18 years of age and working in the industry.

Applications for Licence forms, together with explanatory notes, are available from the Secretary, Electrical and Electronic Servicemen's Licensing Committee, 2nd Floor, 74 Eastern Road, South Melbourne.

## BRAIN TRANSPLANT

Dissatisfied with his brain-power, the Man enquired the cost of suitable transplants.

"Artist's brains," said the Surgeon, "are \$32 a pound lawyer's brains about \$50 a pound; doctor's brains are \$100 a pound and at the top of the line we have some politician's brains at \$2500 a pound.

"My God," said the Man, "why are politician's brains so expensive?"

"Do you have any idea" replied the Surgeon, "just how many politician's brains it needs to make up a pound."

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# WHY HIGH POWER?

The benefit of high power is clarity — not volume. The improvement in fidelity results from the elimination of the severe distortion caused by amplifier overload clipping.

Any good amplifier gives low distortion — when it's not clipping. Clipping generates high distortion — as high, or higher than 40% during low frequency passages and on musical peaks. Recent independent tests, such as those carried out by Hirsch-Houck Labs (see "Stereo Review" April, 1972), have shown that this distortion places severe restrictions on audio reproduction. Restrictions that, until recently, were sometimes misunderstood or attributed to other causes.

Generally amplifier clipping is confused with "speaker break-up". The listener cautiously turns down the volume until the undesirable effects of heavy bass notes "flat topping" (clipping) and the accompanying harshness of the middle and upper frequencies becomes acceptable.

Simply stated, an amplifier should be powerful enough to prevent overload and clipping when operated at a satisfying listening level. Instant overload recovery is not enough.

Power demands on the amplifier follow the logarithmic response of human hearing. Power output must DOUBLE for every 3 dB increase of volume. Plus 3 dB requires twice the power, plus 6 dB four times, plus 9 dB eight times, and so on. Remember that a 3 dB volume increase is barely perceptible, and could easily go unnoticed if applied during a pause in the programme. All other specifications being equal, only very substantial amplifier power increases will give an audible improvement in reproduction. A 12 dB boost demands sixteen times more power, for example.

Most of today's best speaker systems obtain their smooth, wide-range, low-distortion performance by significantly sacrificing efficiency. They need power and voltage. Lots of it. Some employ active equalization to obtain their wide frequency response. This network increases the power requirements by as much as ten times.

Available amplifier power also limits the use of tone controls. If a satisfactory amount of power is available with the bass controls set flat, then an increase of 9 dB will require eight times the previous power.

Room sizes and acoustics also have a great influence on power requirements. To attain a comparable listening level a large living room can easily require ten times as much power as a small study.

If the goal is to eliminate the severe amplifier distortion that occurs on musical peaks and during low frequency passages, and if the best wide range speakers available today are utilized, a minimum of 200 watts per channel is required. A maximum of over 500 watts/channel is required when using some of the very latest, highly inefficient speakers.

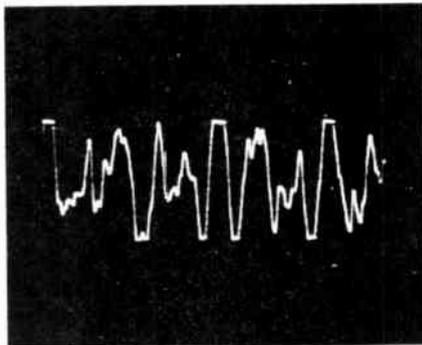


Fig. 1 120 watt/channel amp.

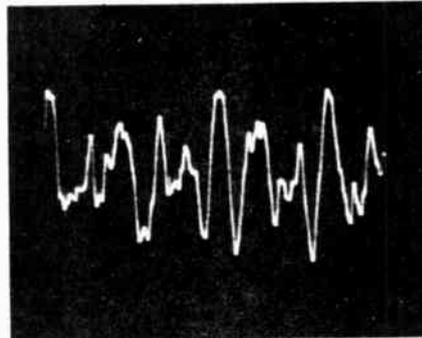


Fig. 2 350 watt/channel amp.

Figure 1 shows a 120 watt/channel amplifier reproducing the opening allegro piano note from Part III of Beethoven's "Emperor" concerto, performed by Rudolf Serkin. The

volume level has been adjusted so that the piano volume level approximates a live piano. The speaker system is a modern unit which employs active equalization. The piano note peaks are being clipped, which leads to harshness and may cause listening fatigue. Figure 2 is the same passage but with a 350 watt/channel amplifier. Clipping does not occur and the sound is smooth, sweet, and open. The subjective volume level is identical in both cases. The average power level is approximately 38 watts.

An important point to remember when dealing with these high power levels is that the peak to average power ratio of musical material is approximately 10:1. This means that when a 200 watt/channel amplifier is operating full tilt into a set of loudspeakers, the long time average power delivered to the loudspeaker is only 20 watts.

Past recommendations on amplifier power requirements were made within the framework of what was then technically possible. But yesterday's limitations belong to the past. Phase Linear technology now makes possible, and commercially available, amplifiers of sufficient power to eliminate the severe distortion caused by clipping.

Phase Linear power levels have their true meaning in the logarithmic context. A 700 watt amplifier provides headroom for musical peaks, but remember that it is only 10dB more powerful than a 70 watt amplifier and that a minimum gain of 3 dB is necessary to achieve a worthwhile audible benefit (other specifications remaining equal). We find that even the Phase Linear 700 is overloaded from time to time when driving low efficiency speakers with, for example, Stravinsky's Rite of Spring at realistic volume levels. We wonder if 700 watts is enough!

Impressive as the tremendous power ratings may be, the answer to the question "Why high power?" is not "volume". The listening benefit is the unequalled clarity in the reproduction of programme material at any level.

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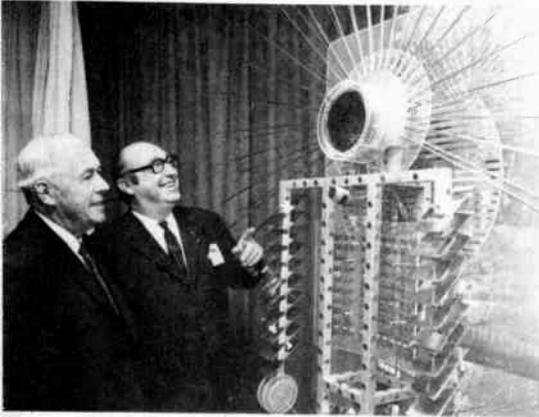
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## 'PETE'



The Hon. Sir Alan Hulme together with Philips Chairman and Managing Director, Mr. H. D. Huyer, examine PETE (or Philips Electronics Telecommunications Equipment). PETE was designed and built at Moorebank by Philips engineers. It is the work of Polish-born and now a naturalised Australian, Mr. Stan Ostojka Kotowski. PETE is designed in the form of an imaginary spaceman and conveys the image of space age telecommunications. The flashing lights in his face are the focal point and represent man's ability to be both inward and outward looking. PETE responds to external sounds in color, light and rhythm.

## AMPEX DROP INSTAVISION

Following repeated delays, the Ampex organization's long awaited 'Instavision' portable video cartridge recorder has finally been scrapped.

First announced in September 1970, the 'Instavideo' design incorporated a number of very advanced concepts including cartridge loading, colour capability, off-air recording etc.

We understand that the reasons for scrapping the project include difficulties in obtaining reliability, mass-production problems and excessive rf radiation.

## AIRBORNE SCANNING FOR POLLUTION, MINERALS

Advanced electronic scanning equipment employing infra-red or thermal imaging techniques is now available in Australia for non-military applications. Originally developed for — and restricted to — military and other 'classified' organisations, thermal imaging was first used for the detection of enemy troops at night. With the recent relaxing of security, this equipment and know-how — by now highly advanced — became commercially available for applications such as the detection or location of water pollution, geological structure surveys, tide and current measurements, mineral and petroleum exploration etc.

Basically, the equipment photographs the difference in thermal radiation between the subject body and its surroundings, with quite incredible sensitivity. For example, a pollutant being discharged into a body of water would almost certainly be at a different temperature to the water: and though invisible to the naked eye, would be recorded by the thermal imaging equipment. The record can be produced direct on film, or on magnetic tape for later processing in the laboratory, and aircraft scanning heights of 1,500 ft. are quite feasible. The illustration shows an enlarged section of an aerial photograph of Port

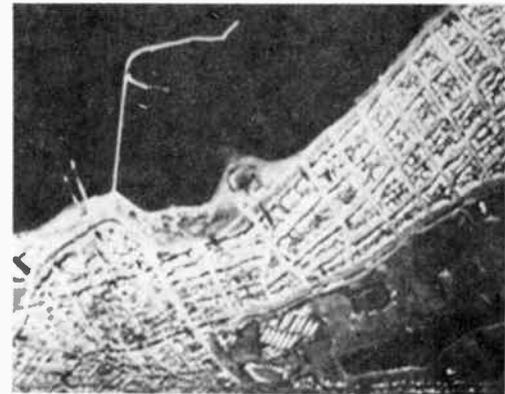
Phillip Bay, taken by a Newcastle University team. It shows what is believed to be a pollutant discharging into the bay — as revealed by the white smudge in the water. DC Electronics Pty. Ltd., suppliers of the equipment to the university, have some graphic evidence of its versatility. This includes IR photographs of otherwise invisible subterranean fires; mineral veins in the earth; forest fires, where the actual flame front is concealed by the smoke pall; nuclear power plant effluent discharging into a river, etc.

A Melbourne charter company, Forrester Stephen Pty. Ltd., is already involved with the technique having fitted out an aircraft for the job. They, in fact, provided the aviation for the Newcastle University team, and now offer a charter 'package deal' — aircraft, pilot, equipment and experience — for geological surveys, pollution research etc.

Mr Dieter Retz, DC Electronics sales manager, acknowledges that certain skills are necessary to interpret and evaluate the results.

"However," he points out, "our principals can provide adequate

(Turn to page 125)



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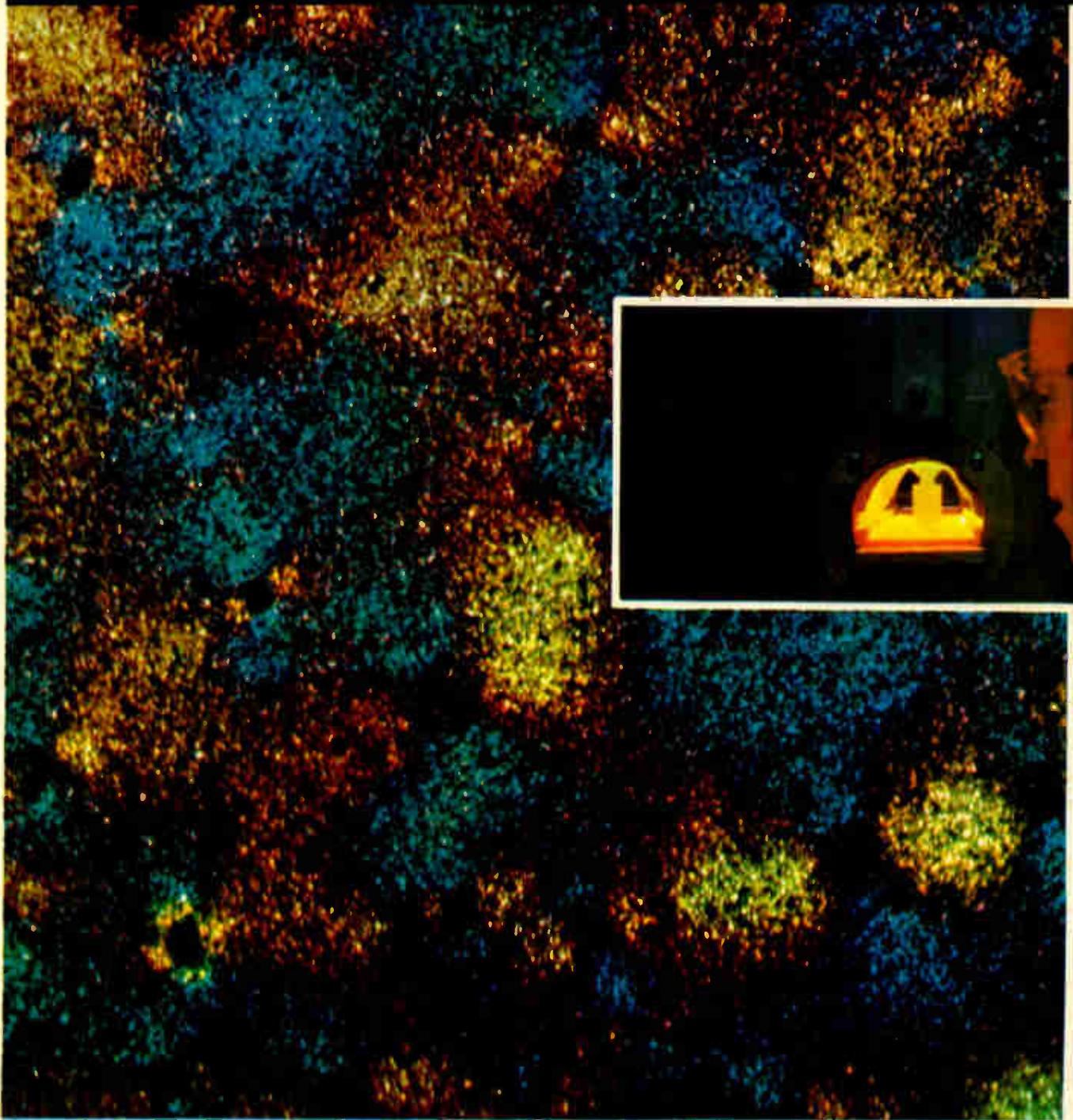


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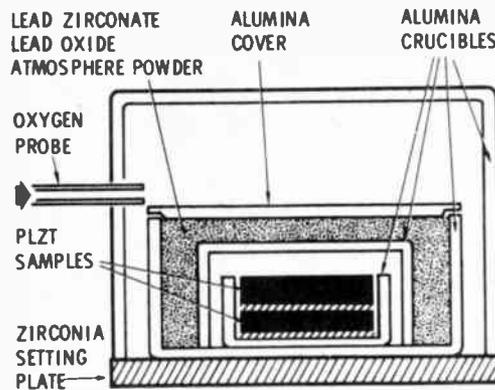
Revolutionary new material stores images without need for applied voltage.

# CERAMIC

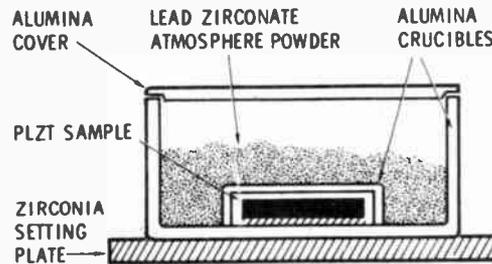


*Photomicrograph showing strains and their resultant colour phenomena in polarised light.  
Inset: PLZT inventor Haertling viewing specimen in hot press oven*

# SLIDES



Atmosphere Sintering Apparatus



New PLZT Process

Heat-Treatment Apparatus

no critical tolerances, is able to use white non-polarised light for storage and/or display, has uniform image quality over its surface and, by use of slightly modified procedures, permits positive-to-positive reproduction as for projection slides.

While the device does not yet store pictures of exceptional quality, the inventors believe it is only a question of further materials development. Applications include image displays in computers, facsimile equipment, xerography, and document verification.

## PLTZ CERAMIC

The basic operating medium of Ceramic devices is PLZT 7/65/35 ceramic containing 7% lanthanum, 65% lead zirconate and 35% lead titanate. In the original process, this solid solution was chemically prepared by co-precipitation and hot pressed in an oxygen environment to give the near theoretical density and an average grain size of 4 to 5 microns. The plate is typically 0.0123" thick and 1" in diameter.

Recently Sandia have developed a simplified process for the production of transparent PLZT ceramics. This process involves atmospheric sintering and bypasses the essentially more expensive and less versatile hot-pressing technique. It is readily adaptable for mass production of large plates of PLZT and fabrication of 'green' (unprocessed) ceramic shapes by traditional techniques such as dry pressing and slip casting. Chemically prepared PLZT powders containing 6% (by weight) excess lead oxide is sintered in an alumina jacket whose double walls are filled with an 'atmosphere powder' consisting of lead zirconate and lead oxide, providing a relatively high pressure of lead oxide vapour in the sintering cavity. Oxygen introduced to the system is allowed to diffuse to the ceramic sample as it is sintered at a nominal 1200°C for 3 hours, resulting in a dark orange coloured PLZT wafer. This colouration is removed in a subsequent heat treatment at 1200°C for a further 30 hours in a controlled 'atmosphere' of lead zirconate.

## CERAMPIC DEVICE

The 1" diameter, 0.013" thick 'Cerampic' device itself is a four-layer sandwich consisting of a transparent layer on top of a photo-conductive film (whose electrical conductivity changes with the intensity of light striking its surface), a 0.012" thick PLZT ceramic (which performs the actual image storage and display), and a second

**S**ENDING pictures from point to point on a radio beam has been the subject of much discussion for manufacturers, users and communication specialists. Television is relatively expensive, requires high frequency signals (which, because they propagate in straight lines, need relay stations to circle the curvature of the earth) and expensive storage equipment for long-term display. Other techniques developed specially for sending documents and still photos, for example by using telephone lines, are either slow or suffer from lack of definition (resolution) which limits them to certain types of information only.

A new device, developed by Sandia, stores and displays images at high

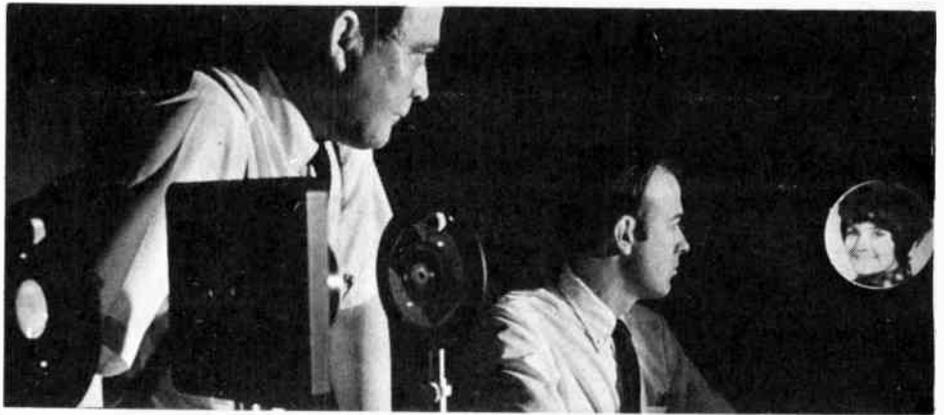
resolution in a few seconds from signals received by telephone or radio.

It is called 'Cerampic' and uses a simple transparent ceramic material. To store an image, the device is simply exposed to the image, just like a photographic film is exposed. However, the ceramic picture needs no processing, may be erased (and the device re-used), may be viewed directly or projected like a transparency.

Previous ceramic imaging devices proved impractical for varied reasons such as requiring polarised and essentially mono-chromatic (of one pure colour) light or mechanical stretching/compressing prior to image storage.

Cerampic is simple to fabricate, has

# CERAMIC SLIDES



*Image projected directly from a Cerampic*



**IMAGE STORED BETWEEN THERMALLY DEPOLED AND ELECTRICALLY DEPOLED STATES**



**IMAGE STORED BETWEEN ELECTRICALLY POLED AND ELECTRICALLY DEPOLED STATES**



**PRINT FROM ORIGINAL NEGATIVE USED TO STORE THE TWO IMAGES**

transparent electrode. The photo-conductive film is PCK poly-vinyl carbazole and the transparent electrodes are of indium oxide doped with tin oxide.

## HOW IT WORKS

The ceramic material consists of an aggregate of many tiny crystals, each a distorted (rhombic) cube, composed of oxygen, and the metals, lead, titanium and zirconium. Like many crystalline ferro-electric materials, the ceramic has the ability to organise its physical structure into regular geometric formations. When a strong electric voltage is applied across the two electrodes, the crystals align themselves in the direction which permits light to pass through the ceramic. If a voltage of opposite polarity is applied for a short time, some domains lose their original alignment and block light passage through them.

In the virgin or thermally de-poled state, the ceramic is essentially strainfree and many crystal domains in each grain are oriented at 180° with respect to each adjacent crystal domain.

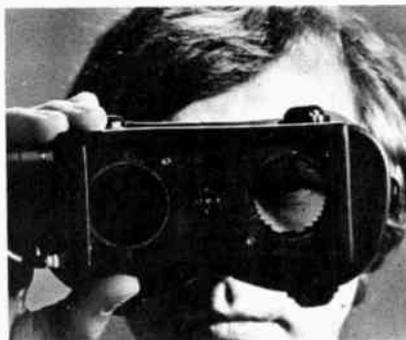
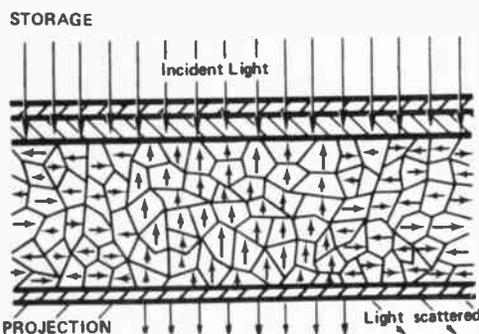
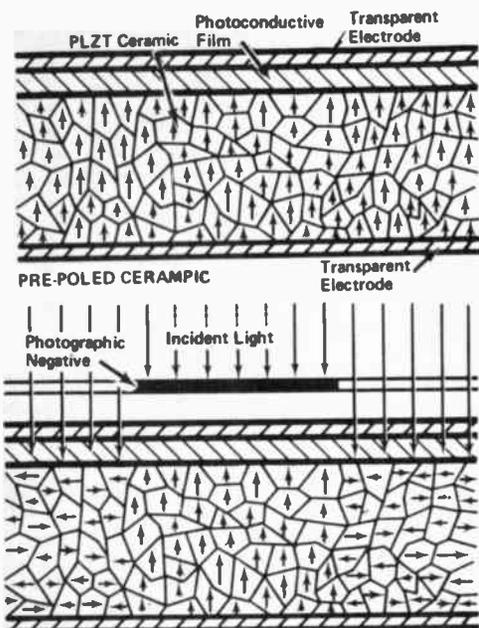
Before an image can be stored, the Cerampic is pre-poled by flooding it with incident light and applying a dc voltage of 12kV per cm thickness; this aligns the domains in each grain along one of the crystallite axes, creating internal strain and increasing the light scattering (and hence reducing somewhat the transparency) of the ceramic uniformly over the area of the plate. Pre-poling is used in order to establish a repeatable maximum level of electrically controllable transparency to the device. The pre-poled Cerampic is less transparent than the virgin ceramic; to restore the full transparency would require thermal de-poling which is only feasible in slow-switching electro-optic devices.

## IMAGE STORAGE

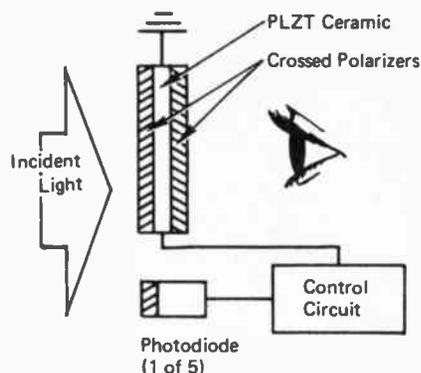
An image is stored in the device by projecting it on to the photo-conductive film (through a photographic negative or positive medium or by scanning it with an intensity-modulated pin-point light beam), while simultaneously applying a voltage, across the transparent electrodes, of opposite polarity to the

pre-poling voltage. In the dark areas of the image (as incident on the Cerampic), the photoconductive film acts as an electrical insulator, permitting only part of the voltage to appear across the ceramic layer, depending on the relative darkness of the area. In the light areas, the film acts as a conductor and more of the applied voltage appears across the ceramic layer depending on the relative lightness of these areas. Thus variations of light intensity (determined by the details of the image exposed to the Cerampic) produce, in effect, local (and corresponding) differences in the electrical conductivity of the device which are translated, in the crystal, into corresponding degrees of alignment or misalignment of the ceramic domains.

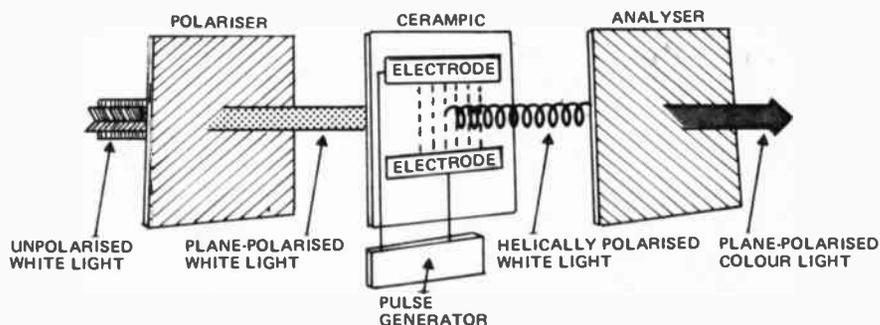
Little or no domain switching occurs in the darker areas where the crystal orientations remain in the strain-relieved mode (which results in scattering of incident light away from the field of view). Significantly more domain switching from the pre-poled to the opposite poled state occurs in the lighter areas where crystal



Prototype Flash-blindness goggles (with one lens 'on' and the other 'off') and System schematic



Principle of Cerampic operation in Negative-to-Positive mode



orientations are aligned to permit passage of light of corresponding intensities. A stored image thus corresponds to an array of aligned or misaligned areas correlated to the details of the original image.

If the image is exposed on to the Cerampic through a photo 'negative', the resulting stored image, as seen by the unaided eye, is a 'positive' mosaic of shades of grey with a typical resolution of 40 line-pairs per mm (five times the resolving power of the human eye at 10") in a 0.25mm thick plate. Line resolution (definition) of the stored image should decrease with thickness of the ceramic plate due to increased light scattering.

To store 'positive' images from 'positive' originals or 'negative' images from 'negative' originals, an additional step is required. After pre-poling, the Cerampic is switched to the near de-poled state so that the entire PLZT is relatively opaque. Image storage then consists of 'erasing' (rendering transparent) parts of the darkened plate in proportion to the pictorial details of the image.

Whatever storage method is used, image storage is effected by applying a

voltage of polarity opposite to that used to establish the initial state, and of at least half the value of the poling voltage.

### VIEWING THE IMAGE

Once the image is stored, it remains in the ceramic permanently, until it is intentionally 'erased' (see below). It is viewed simply as one would view a transparency, either by the unaided eye or through an enlarging viewer or projector.

### ERASURE

To erase a stored image, the entire surface of the Cerampic is uniformly flooded with incident light while, simultaneously, a poling voltage is applied of polarity opposite to that used to store the image.

### APPLICATIONS

Since image formation and storage is by spatial variations of light scattering (instead of by bi-refringence as in other ceramic image storage devices), this simplifies storage, viewing and erasing procedures and eliminates the need for polarisers or analysers. The device has a variety of potential usage

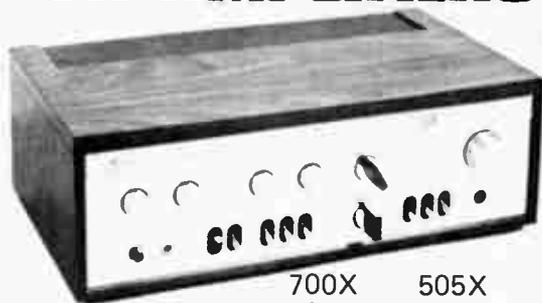
in any application involving optical information storage, processing and retrieval including display.

One promising application is the generation of images (of documents, photographs, diagrams etc.) from signals received by telephone or radio. Facsimiles can be generated in a few seconds and the user would be able to inspect them at leisure and make permanent paper (or other) copies at will.

When successive lines are swept by an intensity modulated light beam in raster patterns, pictures and data can be reproduced in a manner analogous to TV systems. Sandia researchers believe that raster rates up to 15,000 lines per second are possible, permitting the ceramic to display TV-like images. In adapting the device to TV, the digital and logic technologies developed to store and retrieve bits of data in computer memories can be used along with the new fast-response photo-conductors being developed.

Along with such and other more familiar image storage and display applications, the newly discovered 'longitudinal scattering effect' in the

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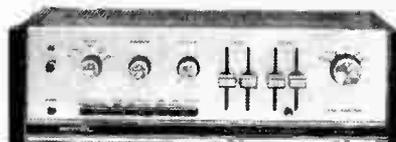
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ceramic may also prove useful in such devices as electronic shutters, optical memories and page composers for holographic memories. In such applications, the photo-conductive film in the ceramic sandwich will be replaced by patterns or arrays of transparent electrodes.

Electro-optic goggles using PLZT ceramic were described in our November 1972 issue. In the prototype device, the lenses are a sandwich comprising a polariser, an electroded PLZT ceramic and a second polariser oriented at 90° to the first. The PLZT surface is overlaid with an interdigital electrode array with sputtered copper or vacuum deposited chromium-gold electrodes 2 mils wide separated by 40 mil gaps. In the 'ON' state, light transmission is 21%, ie, 6% more than conventional sunglasses, and is essentially colourless. A simple rheostat control can be used to set any 'on' level between 21% and the opaque value of 0.003%. Flash hazard is detected by an array of five photodiodes located between the lenses and forming integral parts of a discriminator circuit which senses the light intensity threshold and switch the goggles to the opaque state; the threshold can be adjusted by a variable resistor in the circuit.

Similar filters having areas of 10" sq or more can be controlled by the same pocket-size power pack.

The same general principle can be used also in image intensifiers and vidicon tubes to protect sensitive photo detectors, as electronic shutters in photographic applications, as optical switches (light gates), or as variable transmission windows.

At higher voltage levels, the device has also been used as a colour filter. White light passing through a thin sandwich of the ceramic (provided with patterned electrodes) between two polarisers emerges as a mono-coloured light when specific voltage pulses are applied to the various cells in the ceramic. Each pulse aligns the dipoles in the ceramic in the direction of the electric field and across the path of the incoming light. The greater pulses required are precise (eg. +90, -30 for red; +90, -30, -30 for orange; +90, -30, -30, -30 for yellow; +90, -30, -30, -30, -30 for white) with typical switching times of 100 μs per pulse. Faster switching is possible by using higher voltages.

(PLZT Ceramic material is available from Ceramic Dept. MSU-1864, Honeywell Ordnance Division, 1885 Douglas Drive, Minneapolis, Minnesota 55422 USA)

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Some twenty years ago the USA's largest telephone company made a decision to convert its entire nation-wide switching system to a technique using 12 electronically generated combinations of six master tones.

And in so doing they made a decision that has left many of their major telephone networks as vulnerable as a MOSFET in a Van de Graff generator factory, for in order to save equipment costs, they decided to carry these (toll traffic signalling) tones within the voice transmission band.

Because of this it became possible for anyone with the required technical knowledge to construct a tone generator which could be used to initiate and switch telephone calls, through national and international circuits, from any one of countless millions of private and public telephones.

But knowing how the system works is not in itself sufficient — it is also necessary to know the frequencies of the control tones used.

Ironically enough this information was made publically available by A.T. & T. — the telephone company that initiated the system in a technical article published in the Bell System Technical Journal. Included in the article was the complete list of all frequencies used to control the company's entire trunk network.

Publication of the article was a catastrophic error. Within days, technically minded young Americans had built devices to generate the required audio switching tones — and were hard at work finding out how to use them.

The magnitude of the error was quickly realized by Bell and every possible copy of the paper was withdrawn — but not before many photostat copies had been made.

Some time later the (US) semi-underground magazine 'Ramparts' published full details of the techniques used. This publication was found to be in violation of the California Penal Code and was seized — but again not before a large number of copies found their way into the hands of interested recipients.

So far the only country seriously affected is the USA. For whilst calls can be made by phone phreaks to practically anywhere in the world (they can even set up complex loops in which calls are directed right around the world — terminating at an adjacent phone!) it is only possible to initiate these calls within an in-band signalling telephone system. The USA is the only country using this technique to any major extent.

Nevertheless other countries propose to convert to the system, and full details of such proposed in-band systems continue to be published.

Britain for example, is actively planning to convert to the in-band system within the next five years. There the British government attempts to use its powers, inherent in their Official Secrets Act, to prevent publication of information of value to phone phreaks — yet the signalling frequencies to be used in the proposed system have been made publicly available in the (British) Post Office Engineering Journal since 1969.

Another source of information was an article by two senior Post Office engineers published in The Institute of Post Office Electrical Engineers quarterly. The article entitled 'Signalling System AC No 9' provided ample data for phone phreaks to work on.

It is practically impossible to restrict this type of information for it is essential for technical information of this nature to be available to many thousands of telephone engineers. It is just not possible for systems as large and complex as international telephone networks to be designed, installed and operated without a large number of engineers having access to 'sensitive' information. Hence the existence of standard reference works, such as Atkinson's 'Telephony', which contain full details of practically every piece of telephone gear used today; apart from this, details of all international and many national communications channels is contained in International Telegraphs and Telephones' 'White Book'.

## EXPANSION OF SWITCHING NETWORK

At present only a small percentage of the US telephone network uses electronic switching. The great majority of exchanges still use direct-control and/or electro-mechanical switching. But it is planned to extend the electronic switching network to cover the whole system by the year 2000.

We have found it virtually impossible to establish just what techniques are being used to detect phone phreaks. Certainly though, the FBI are taking the problem very seriously — prosecuting under a Federal felony statute (Title 18 of the United States Code, paragraph 1343 entitled 'Fraud by Wire, Radio, or Television').

# PHONE

## Electronic pranksters turn telephone systems

Penalties include fines of up to \$1000 and/or imprisonment for 'not more than five years'.

The only really practical long term solution to the problem is the removal of the signalling tones from within the voice frequency band — but this is a long and extraordinarily costly operation.

Above all, the situation has again emphasized what a growing number of engineers and hopefully — accountants — are beginning to accept. And that is that the social implications of their actions must be given as much consideration as engineering techniques — or cost/benefit factors.

An ex-phone phreak was recently in Australia and gave the following interview to one of our staff.

ETI: You've asked us not to use your name — so we will call you 'Mike' during this interview. Mike, just what is phone phreaking?

MIKE: *Well it started in the 'States a few years back. Phone phreaks use a specially designed box to give them access to the trunk telephone network. Once they've switched themselves in they can use the entire system without paying.*

ETI: What do you mean by 'the entire system'?

MIKE: *Just what I said. For example in the space of one hour I've rung the talking clock in London, I've listened to the Sydney Stock Exchange report, I've spoken to a switchboard operator in Moscow and listened to a pre-recorded music programme from Munich.*

ETI: Did you do all this from your home phone?

MIKE: *Hell no! — that would have been too easily traced. We used pay phones — but it didn't cost us a cent.*

ETI: That box you spoke about must be a complex device.

MIKE: *Not at all. The phone companies call them 'blue boxes'... they're just a simple tone generator controlled by push buttons. They are quite small — about the size of a pocket calculator. I designed mine around a few IC's I bought from the local electronics parts supplier.*

ETI: Where did you get the circuit from?

MIKE: *That's the easy bit. It's just a sine-wave oscillator — it generates*

# PHREAKING

into electronic playgrounds.



discrete frequencies individually selected by push-buttons. The hard bit's finding out what frequencies to use.

**ETI:** We can understand that! But can you tell us how you found out?

**MIKE:** Sure. Actually the whole thing's a bit of an embarrassment to the phone companies. It was a bit incredible. What happened was that the whole concept of the multi-frequency switching system was published in the *Bell System Telephone Journal* a few years back. It told everything. How it worked and even the frequencies used.

It must have been the world's biggest printing mistake! The top brass realised what they had done almost immediately... but it was just too late. Photostats were already in circulation... It was just what the kids needed — and within a few days the initial boxes were in use.

Actually the American magazine *'Ramparts'* also ran the article but the authorities stepped in pretty smartly and the issue was withdrawn. (Actually the issue concerned was openly available in Australia — Ed.)

**ETI:** We've heard that it is possible to get into the network without actually using one of these boxes.

**MIKE:** That's right. It can be done without any equipment at all — there's a couple of stories I can tell you about this if you've got time.

The first concerns a blind kid called Joe Engressa. The story goes that Joe was born with perfect pitch. He could actually whistle the tones better than the phone company's gear could generate them. He used to whistle long distance connections for fellow students at the University of South Florida!

Then there was this breakfast cereal called *Captain Crunch*... A few years back they had this big sales thing going and offered a toy whistle in each packet as a treat for the kids. Somehow a phone phreak discovered the whistle would produce a perfect 2600Hz tone — one of the basic tones used in the multi-frequency system. The fellow who found this out — he is always called *Captain Crunch* nowadays — was transferred to England with his Air Force unit, and he used to receive scores of calls from his friends Stateside and 'mute' them — make them free of charge — by blowing his *Captain Crunch* whistle at his end.

**ETI:** So a few phone phreaks don't use any equipment to speak of — but most use blue boxes like yours?

**MIKE:** That would be right.

**ETI:** When you spoke of Joe Engressa and *Captain Crunch* you spoke almost as if they were some sort of folk heroes.

**MIKE:** Sorry I got a bit carried away.

**ETI:** We get the impression that blue boxes are organized into some sort of a club. Is this right?

**MIKE:** Yes, in a way. But you must remember that phone phreaking is highly illegal... if the FBI catch you, you can go away for five years.

**ETI:** Is that why you stopped doing it?

**MIKE:** Well I don't want to get all moralistic about it. But you see the whole thing started off with a group of technically minded kids doing it for kicks. Sure it was illegal but we only did it at night and the loss in revenue to the phone companies was negligible.

But it's not like this anymore. The commercial boys have got into the act. I've heard of large gambling syndicates tying up coast-to-coast trunks almost

for days on end. It's gone a long way past a hobby.

**ETI:** What about Europe — or England?

**MIKE:** There're a few there... nothing like the number there are in the States though. The British Post Office system is more 'sluggish' than ours (USA's — Ed.), it's not quite so easy. But I've heard that they are upgrading their system and they may soon have to face the problem themselves.

**ETI:** What about Australia?

**MIKE:** Well Australia is a favourite call for blue boxers ringing from the States... No, I don't know of any blue boxers originating calls from here.

**ETI:** How widespread is the phone phreaking today?

**MIKE:** Well like I said, it's gone way beyond the kids. Bell Telephone says that its losses are around \$150,000 a year — but I think they've put it as low as this so as not to encourage people to have a go themselves. Some authorities put it as high as \$150 million! I suppose a lot depends upon how you calculate the losses.

**ETI:** What are the US phone companies doing to combat phone phreaking?

**MIKE:** There is not a great deal they can do. The system is so automated you see. One way they spot phone phreaks is by using sophisticated computer programs to analyse call distribution patterns. This highlights abnormal activity.

In England — and I imagine here in Australia also — the Post Office use STD call meters. These were originally designed for companies to monitor STD calls, they recode the extension making the call, number called and length of call. They enable any 'illegal' calls to be tracked down to the extension used.

I don't know if it works the same way here but in England the Post Office can hang one of these STD meters on to a line without infringing their wire tapping laws.

**ETI:** Thanks for the story Mike... it's been fascinating talking with you. Just one thing finally — do you have any comments for readers who want to have a go?

**MIKE:** Yes — don't. I'm not taking any moral stand on this mind you... but as I said earlier it's gone way beyond a game for the kids — there are a lot of 'heavies' mixed up in it now. I don't know if you read this in the (US) IEEE paper recently but they reported that individuals said to have built fraud devices for organized crime syndicates have either disappeared or died violently. (I.E.E.E. Spectrum, August 1972 — Ed.) That's an extreme situation of course... but there's no doubt that telephone security engineers will find ways of trapping phone phreaks. It just isn't worth the risk.

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The compact tape cassette has always had its obvious advantages.

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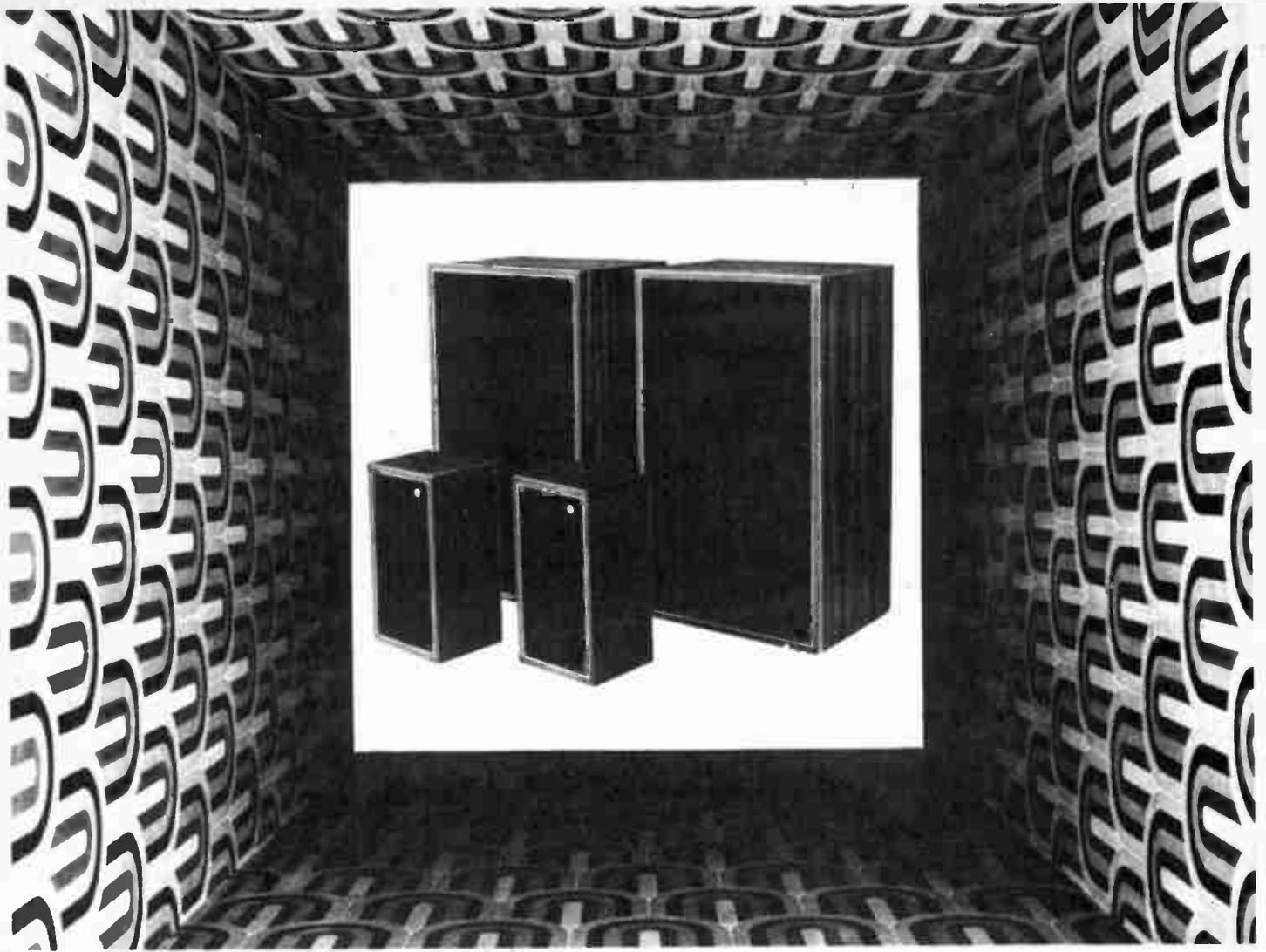
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# AWA ...leaders in audio

# SCHOOL IN THE SKY

Brazil's imaginative proposal to use satellite-relayed educational TV.

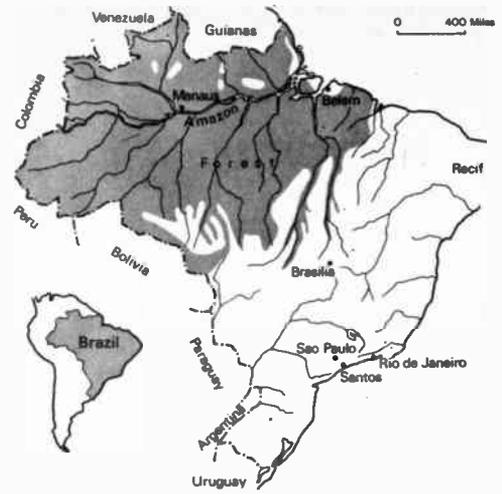


Fig. 1. — Brazil — more than half of South America and the fifth largest country on Earth.

**A**USTRALIA and Brazil have much in common. Both countries are around three million square miles in size, and, although Brazil's population of around 100 million mark is much larger than Australia's, this population is settled in a few dense areas of intense activity with many widespread and sparsely-populated smaller communities.

The nation, fortunately, speaks one main language, but to provide even the most basic education for such a large and growing (two million increase per year) community is a challenging social problem not easily solved by traditional methods.

For it is estimated that, of the 55

million people over the age of 15 in Brazil, around 16 million cannot read or write; and using traditional methods, half a million teachers will be needed — with a growth in number of 50,000 per year.

To solve this problem, some most imaginative techniques have been devised. For a start, the government has established a TV channel in Sao Paulo which transmits solely educational material from 6 p.m. to midnight every night of the week. Viewing centres exist for those not able to afford their own receivers.

TV CULTURA, as this is called, is unusual in many ways; its aim is to provide education for all, and by the best means possible, regardless of

traditional patterns of teaching and learning.

Further evidence of the government's awareness of the need to provide education is that all other TV channels must provide 45 minutes broadcasting time per day for the government's purposes; this time is usually devoted to education.

Educational facilities and activities like the above are co-ordinated by the Space Research Centre (INPE) based near Sao Paulo.

But TV CULTURA is certainly not a complete solution to the educational problem faced by the nation as a whole. The CULTURA programmes, for instance, can serve only those areas currently served by the country's

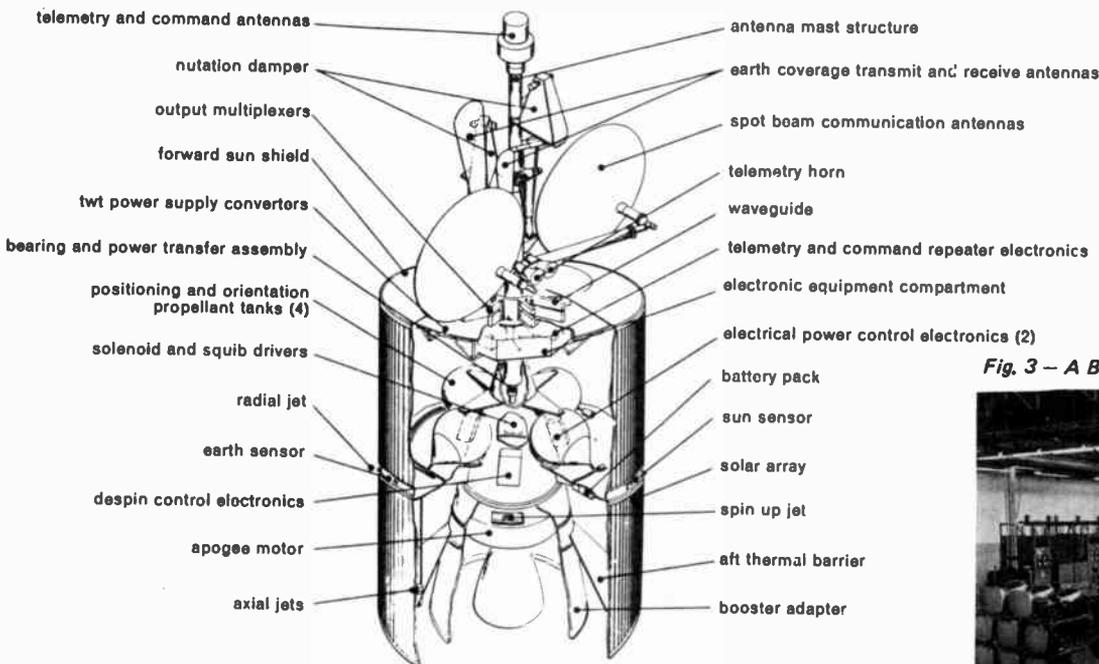


Fig. 2 — Intelsat IV telecommunications satellite with solar cells on its surface to provide power and, on top, the transmitting and receiving antennae and the earth-seeking sensor.

Fig. 3 — A Brazilian TV tube factory.



limited TV network.

Other methods, therefore have been sought to deal with this total problem, and a logical step was to consider nation-wide extension of the existing TV teaching medium and to institute the necessary studies to evaluate such a large-scale programme.

## TEACHING BY TV

In mass education, teaching by television has considerable merit especially if operated through a single transmitting station. At the broadcasting end, it enables the material to be better and more efficiently prepared, and a uniform standard to be maintained. At the receiving end, a teacher is still required to co-ordinate each class of pupils and ensure continuity of effort but projectors, films, slides, record players and lesson planning are eliminated; so is the risk of non-arrival of lesson material.

INPE was founded and inspired by Fernando de Mendoza who has also been responsible for the project SACI (Advanced Satellite for Interdisciplinary Communications) described in this article.

The aim of SACI is to provide a method for relaying educational television by means of a stationary satellite positioned above Brazil. The British Aircraft Corporation (BAC) were consulted by the INPE to study the possibilities of teaching the entire country by television.

As a vast expenditure (\$A300 million or £150 million) is involved, considerable paper studies have been, and are still being, made to ensure that the final system is reliable and socially viable from both educational and economic points of view.

It is envisaged that the programme will be fully operational by 1976. In the meantime, a pilot project is under way to aid assessment.

In the early stages, there was considerable difficulty in assessing whether microwave links or a central satellite should be used to relay the programmes. The latter was found to be the cheaper. Firm decisions have been taken where possible and details of the transmission system have been more or less finalised. The satellite will be very like Intelsat IV (shown in Fig. 2). The launching rocket and nose-cone stage are already available. In fact the technology used at this end of the system is now regarded as more or less routine.

The problem is not so much how to relay the programmes as how to receive them at 200,000 stations with adequate reliability and at a low enough cost. The receiving antenna, sensitive head amplifier, power supply and picture unit must together cost no

This report has been written by ETI correspondent Dr. Peter Sydenham. It was prepared from interviews and reports made available by Mr. Marcos Azumbuja, First Secretary to the Brazilian Embassy in London; and Professor Sparkes, of Britain's Open University.

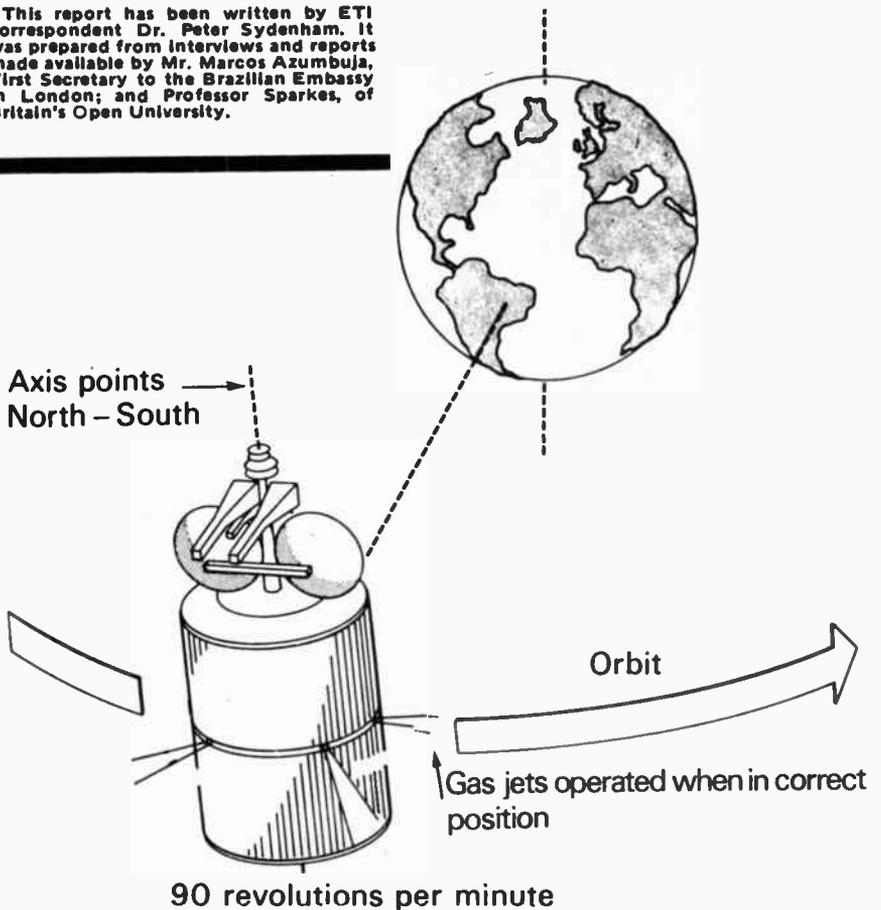


Fig. 4 - A spinning satellite with its 'de-spun' antennae platform.

more than two or three times a domestic black and white receiver. Nevertheless, Brazil is able to build the equipment. It has a domestic TV production of 500,000 sets per annum and an additional 200,000 sets can be produced with only a temporary boost in production.

Not all areas of Brazil have 240V ac mains supplies; so the sets will need to operate on 12V dc and 120V ac supplies as well. In areas without mains supply, bicycle-driven generators will be used. (In this respect, there is a strong resemblance to the pedal-wireless developed in Australia many decades ago - a concept that changed the pattern of life in the outback areas by enabling education and everyday communications to develop - as well as providing a means to summon medical aid).

Problems of tropic-proofing have been mainly overcome and a high standard of equipment and component reliability is expected. Since failures are nevertheless bound to occur, the receiving sets will be made on a modular basis to eliminate the need for specialist servicing.

The design of the receiving antennae has received special consideration. International agreements restrict the

transmitted power of a TV channel from a satellite to around 340W. Calculations however show that a transmitted power of around 930W is needed if a reasonably small dish antenna is to be used. Compromises will therefore have to be made.

Main problem is that the power level of the received signal is minute. For example, a parabolic dish of 1 sq metre area captures only  $10^{-15}$  of the power radiated by a transmission antenna covering the whole of Brazil. Reception problems will therefore exist and a specially sensitive pre-amplifier will be needed at the dish terminal.

To comply with the low-cost requirements, three antenna designs are being considered. First, an assembly of aluminium petals fastened together to form an approximate parabola; this is ideal for transport and easy to erect. Secondly, the dish could be formed by using wire-mesh moulded into an expanded polystyrene support. Finally, it is also possible to use pressed-steel dishes fabricated in the presses of the Volkswagen motor works in Brazil. In each case, for prolonged operation in the Brazilian climate, the design should have built-in corrosion resistance.

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Of course, a lot of other quad receivers will play stereo too. But how well?

When you switch them to stereo, you literally disconnect the two back channels and the amplifiers that power them. So if a receiver was 60 watts in four-channel, it becomes a thread-bare 30 in two. Or something considerably less than full-powered stereo.

The 75+, on the other hand, has a unique bridging circuit that combines the power from four channels into two. From 18 watts RMS per channel in quad, it more than doubles to 45 watts RMS per channel in stereo. So it's not only full-powered, but sounds as good as the best stereo receiver available.

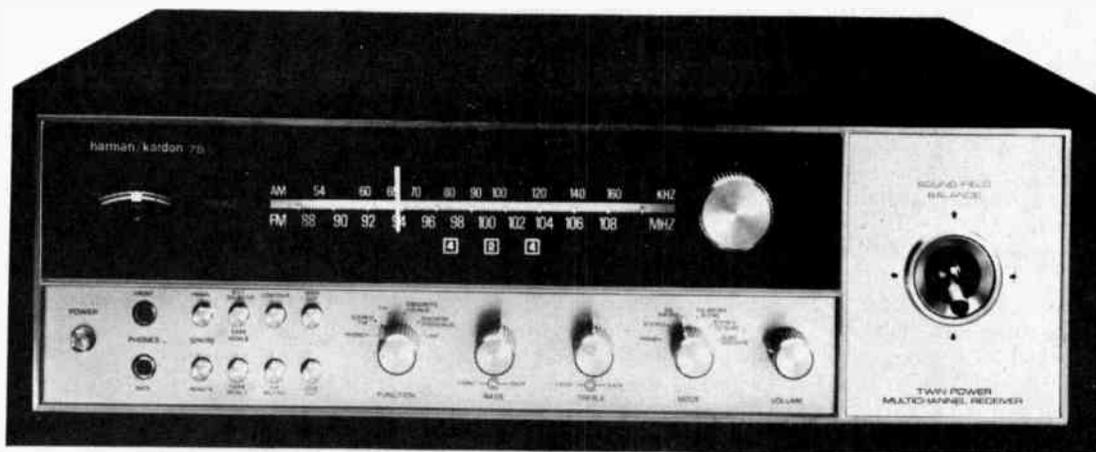
(In fact, it's practically indistinguishable from the stereo receiver many regard as the best available — the H/K 930. Circuitry is almost identical.

So if you are interested in the best, most technologically advanced quad receiver around, you can buy a Harman/Kardon 75+.

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# SCHOOL IN THE SKY

## SATELLITE REQUIREMENTS

The simplest satellite to build and launch is one without attitude or orbit control. But, a changing orbit would mean the need for the transmission and receiving antennae to have automatic tracking systems, and this is not a viable proposition due to the immense number of receivers involved. Instead, it is more economic to build a control system into the satellite which will hold it stationary above the Earth — so that its relative position to the receiving stations remains the same.

The first requirement for a 'stationary' satellite is that its position above Earth is constantly maintained and it remains in one place. This involves correction of any drift which occurs.

To correct orbital drifts, small gas jets are operated, as shown in Fig. 4. Hydrazine is used for this purpose, and is stored as a liquid which is turned into the gaseous state as it passes over a catalyst in the nozzle. The normal liquid state enables storage, in the satellite, of enough hydrazine for seven years of operation, which is the design life of the unit. Hydrazine also has three times the specific thrust of the next nearest fuel. A remote link to the ground enables the controlling station to make the minor changes in orbit as required.

The next requirement for the stationary satellite is that its receiving and transmitting antennae remain pointed towards the earth. To do this, the main body of the satellite is made to spin at 90 rpm, providing a gyroscopic thrust that holds the satellite's axis in one orientation. The

antennae do not spin with the main body of the satellite. Photo-electric detectors are used to lock the antennae towards the luminous disc of the Earth as seen by the sensors.

Power for the satellite comes from the by-now conventional method of using solar cells and the radiation from the sun. Some 45,000 cells are used to provide up to 1kW of power.

## COST STUDIES

Professor Sparkes has made cost studies of the various alternatives available for this satellite project based on a four-channel TV system and a plan to manufacture two satellites, launch one initially and keep the second one as a spare for 18 months — when it will be launched in any case, to provide the extra capacity which is expected to be needed by then.

The estimated costs, using current technology, are shown in Fig. 5. It can be seen that the total cost of placing a satellite in orbit rises with the power requirements. The steps in the curves are due to jumps in cost as the launch rocket is changed to the next larger type available. The greater the available transmitted power, the smaller (and therefore the cheaper) the receiving end can be. At the other extreme is the case where a large receiving antenna could be used with a low-power transmitter in the satellite.

Combining all the costs, Professor Sparkes has derived a graph (Fig. 6) in which transmitted power of around 300W is seen to be an optimum value as it provides the cheapest cost per station. There are, however, other factors that must also be considered, as the cost figures given are, in fact, over-simplifications of the total economics. Our rapidly changing technology could also affect the decision overnight and continuous

appraisal is required until the project design has to be frozen.

## PILOT PROJECT

Paving the way toward the final 1976 plan is a pilot project that commenced in early 1972. This involves schools in the region near Recife where 20,000 pupils and 1000 teachers from 500 schools are to take part in an education by TV scheme. Another hundred schools in or near this area will be taught by conventional methods so that an objective study can be made of the effectiveness of teaching by TV.

Programmes have been prepared and the schools briefed. Parents have also been informed since they are also to be involved in the study. The first six months of programmes are being used to train the teachers.

Until 1973, microwave links will be used for transmission in this pilot area. Transmission in 1973 will be from the experimental ATS-3 United States satellite. Once the ATS-3 is available, the antennae will be redirected.

## CONCLUSION

This report deals only with a possible technological solution to a real and growing problem in many countries of the world today. A solution in terms of educational technology itself may be inadequate since, in all such nation-wide problems, there is always a characteristic inter-dependence between the sociological and technological aspects and objectives.

The Brazilian project is being watched closely by many countries, as it may not only provide the answer for nation-wide integrated education, but could also indicate the way for global education and international co-ordination of many common aspects of life on this planet. ●

Fig. 5 — Cost comparison of two satellites and the necessary launching rocket.

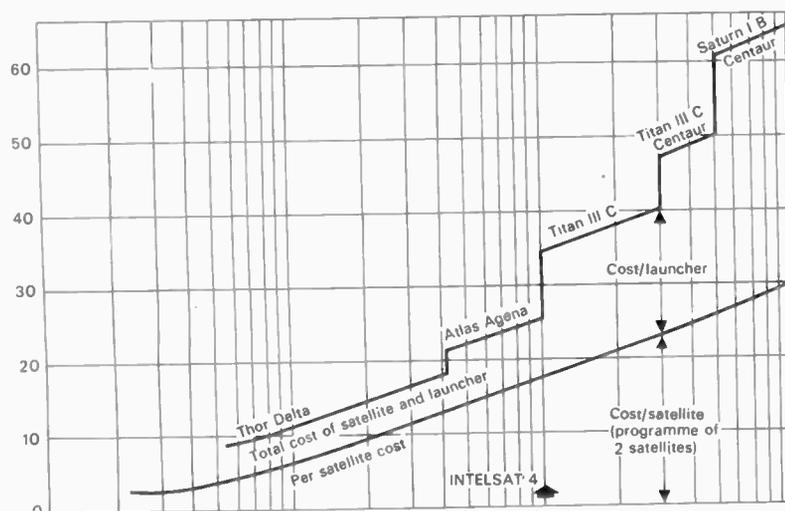
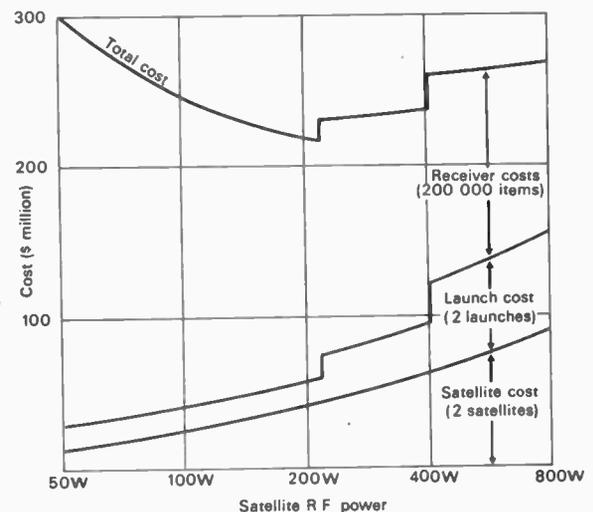


Fig. 6 — Overall costs for a 4-channel educational TV system



# ELECTRONIC DECISION MAKER

ETI PROJECT 517

right decision which will please everybody.

The best he can hope for is to be right half the time.

Once this fact of executive life has been accepted, the next obvious step is make quick decisions on a totally random basis.

Hence the ETI decision maker.

Armed with this device, the man on the way up can earn himself an enviable reputation as a quick decision maker, and as often as not he'll be right!

Basically the device is an electronic coin spinner which provides a 'YES' or 'NO' answer a few seconds after a button is depressed and released — but this is not all — the device has sporting connotations as well!

As A. J. Lowe points out, that time-honoured Australian game 'TWO-UP' has never been the same since decimal currency — and whilst we are not for one moment suggesting that this device should be used for such a purpose . . .

## WHAT IT DOES

Have a look at Fig. 1. On switching on, two of the four lamps will light up — the 'Heads' or 'Tails' light, and the 'Win' or 'Lose' light. A call is made simply by moving the slide switch in the centre of the panel to the desired position. To spin, just press the 'Spin' button. The lights start to flash at an increasing speed, and will continue to flash as long as the button is held down.

On releasing the button, the lights will go on flashing but gradually they slow down, and then cease flashing. Two steady lights show — a 'Heads' or a 'Tails', and one to show whether you 'Win' or 'Lose'.

For simple decision-making between two alternative lines of action — ignore the 'Call' switch, and just equate 'Heads' with one action, and 'Tails' with the other.

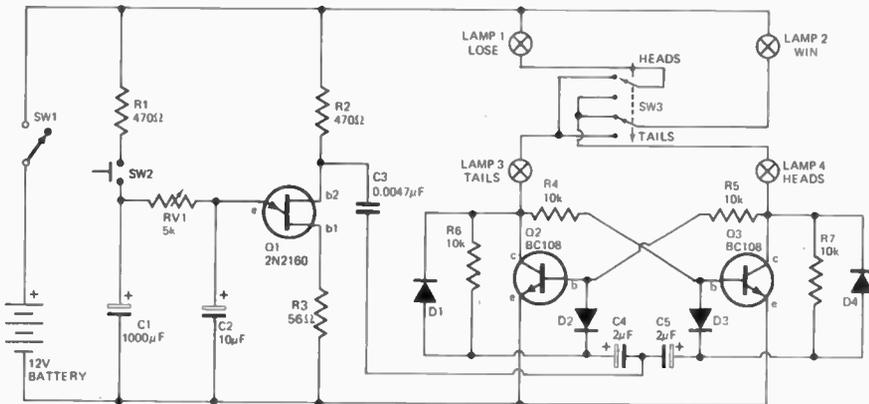
## CONSTRUCTION

The device is constructed in a plastic box measuring 5½" x 4" x 3" deep, all the works being attached to an aluminium panel.

The electronic components, other than lamps and switches, are mounted on veroboard the copper side of which is shown in Fig. 2. The component layout on the board is shown in Fig. 3:

The battery consists of eight pen torch cells (AA size), contained in two flat battery cases. These are held in another aluminium bracket, which is

*How to be right at least half the time!*



## PARTS LIST ETI 517

R1, R2 — resistor 470 ohms ¼ watt  
 R3 — resistor 56 ohms ¼ watt  
 R4, R5, R6, R7 — resistor 10k ¼ watt  
 RV1 — variable resistor — preset 5k  
 C1 — capacitor, electrolytic 1000 µF 25 volts  
 C2 — capacitor, electrolytic 10 µF 10 volts  
 C3 — capacitor 0.0047 µF  
 C4, C5 — capacitors 2 µF 25 volts  
 Lamps 1, 2, 3, 4 — six volt pilot lamps 60mA  
 rating — colours red, green, blue, yellow  
 Q1 — unijunction transistor 2N2160,  
 Q2 and Q3 — NPN transistors BC 108 or similar  
 D1, D2, D3, D4 — small signal diodes BA 100 or  
 similar  
 SW1 — on-off toggle switch  
 SW2 — push button switch  
 SW3 — double pole change-over slider switch  
 Battery — 12 volts  
 Battery case, box, veroboard etc.  
 Veroboard — 5" x 1 5/8" x 0.15" spacing.

In quite a few companies, the standard of executive decision making is so poor that decisions settled on a purely random basis have a statistically greater chance of being correct than decisions made after executive deliberation.

If one is employed by such a company there is little one can do but leave.

But for up and coming young executives, decision making can also be a trial. For as no decision can possibly comply with all the conflicting policy statements and standing orders existing in a company, the young executive can never make a

Fig. 2. Veroboard is shown here full size — a sharp drill should be used to interrupt the copper tracks where shown.

## HOW IT WORKS

The device is a combination of two basic electronic circuits – (Fig. 1). Q2 and Q3 form a bistable. At any time, only one of these transistors can be conducting. Suppose Q2 is conducting and Q3 is off. This state may be reversed, so that Q3 is conducting and Q2 is off, by applying a negative-going pulse to the junction between capacitors C4 and C5. Each time a pulse arrives the bistable will change state.

Q2 and Q3 collector circuits each include two lamps in series. They are coupled through change-over slide switch SW3. This is the 'Call' switch, and it is arranged so that when it is in the 'Heads' position, and Q3 is conducting, i.e. the 'Heads' lamp is alight, then also the 'Win' lamp is alight. If the switch is in the 'Tails' position and Q3 is conducting, then the 'Lose' lamp lights up.

Q1, and associated components form a unijunction transistor relaxation oscillator, which provides pulses, via capacitor C3, to cause the bistable to change state. The oscillator generates triggering pulses shortly after SW2 is pressed.

The rate of oscillation, i.e. the rate

at which pulses are generated and the bistable changes state, varies with the voltage at the top of C1, and the value of the variable resistor RV1. At first the pulses come slowly and then increase in speed as C1 becomes fully charged. At that time they reach the maximum (which can be set by RV1). This maximum rate should be adjusted so that the flashes are as rapid as possible but not so that each flash is so short that the lamps do not achieve adequate brilliance. When SW2 is released, pulses continue to be generated – the energy being supplied by C1. As C1 slowly discharges, the pulse rate decreases. The magnitude of the pulses also decrease until they are too low to switch the bistable. This then stays in a steady state with the 'Heads' or 'Tails' lamp showing, and the 'Win' or 'Lose' lamp showing – depending upon the setting of SW3. The run down takes several seconds – just like a well spun coin.

The flashing rate is so high that it is quite impossible to force a win by attempting to release SW2 at just the right moment – knowing that the run down takes so many seconds. Thus the device is 'random' and not biased.

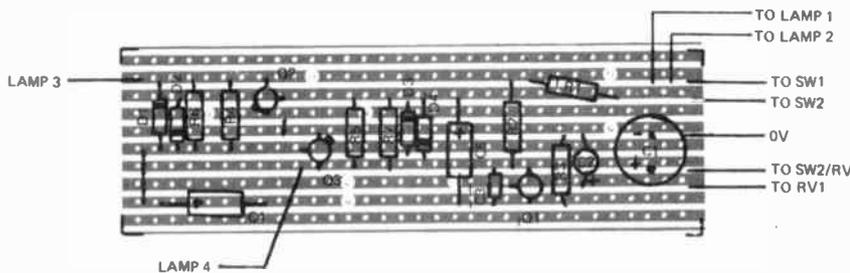


Fig. 3 – Component layout.

attached to the panel by the push button switch.

Component values are not critical except the unijunction which must be as specified. Diodes D1 to D4 may be any small signal diodes, such as BA100 etc. Diodes from disposal computer boards should work satisfactorily. The lamps must be of a rating less than the rating of the BC 108 transistors – i.e. less than 100mA. The original unit used pilot lamps which take the LES bulbs – with a rating of only 60 mA. The low rating also helps to get the bulbs flashing at a high rate. Higher rating bulbs take too long to heat and cool and because of this have a limited flashing speed.

This unit may be constructed to provide just 'YES'/'NO' answers, i.e. without the 'TWO-UP' facility, by omitting lamps 3 and 4 and switch SW3.

## DISCLAIMER

This project is presented as an electronic novelty and neither the author nor the publishers of this magazine accept any liability should it be used in any way which is contrary to any law.

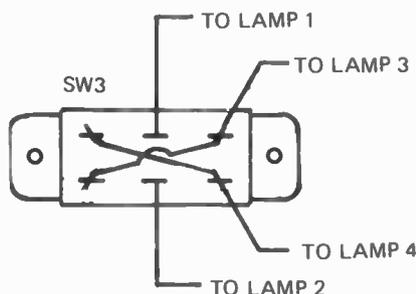


Fig. 4 – Wiring to SW3.



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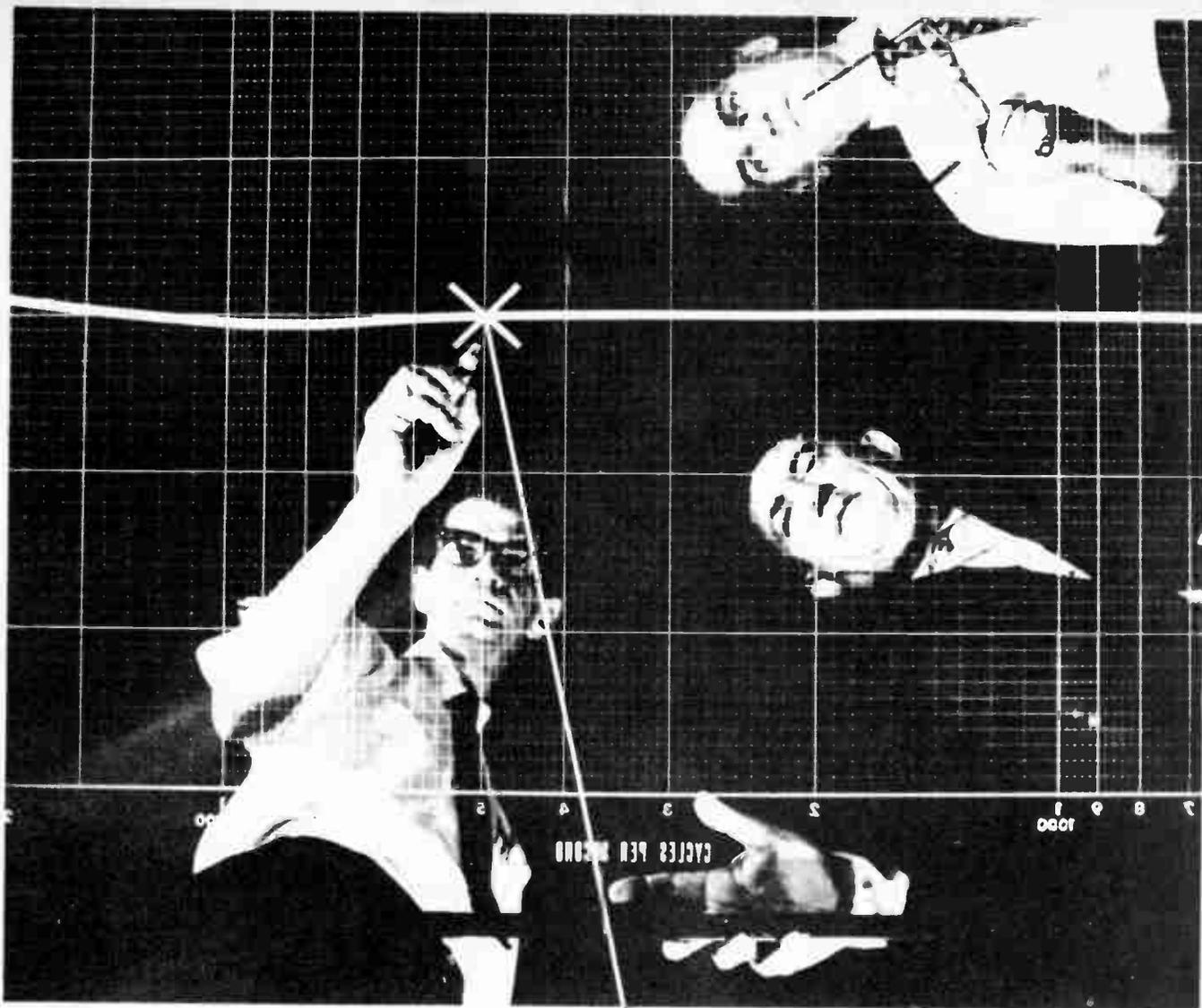
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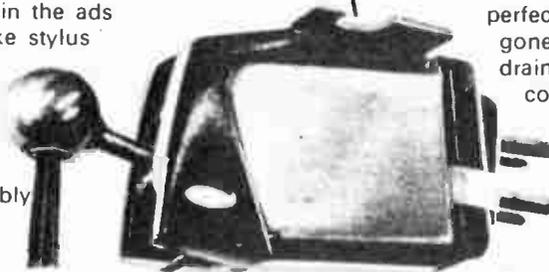


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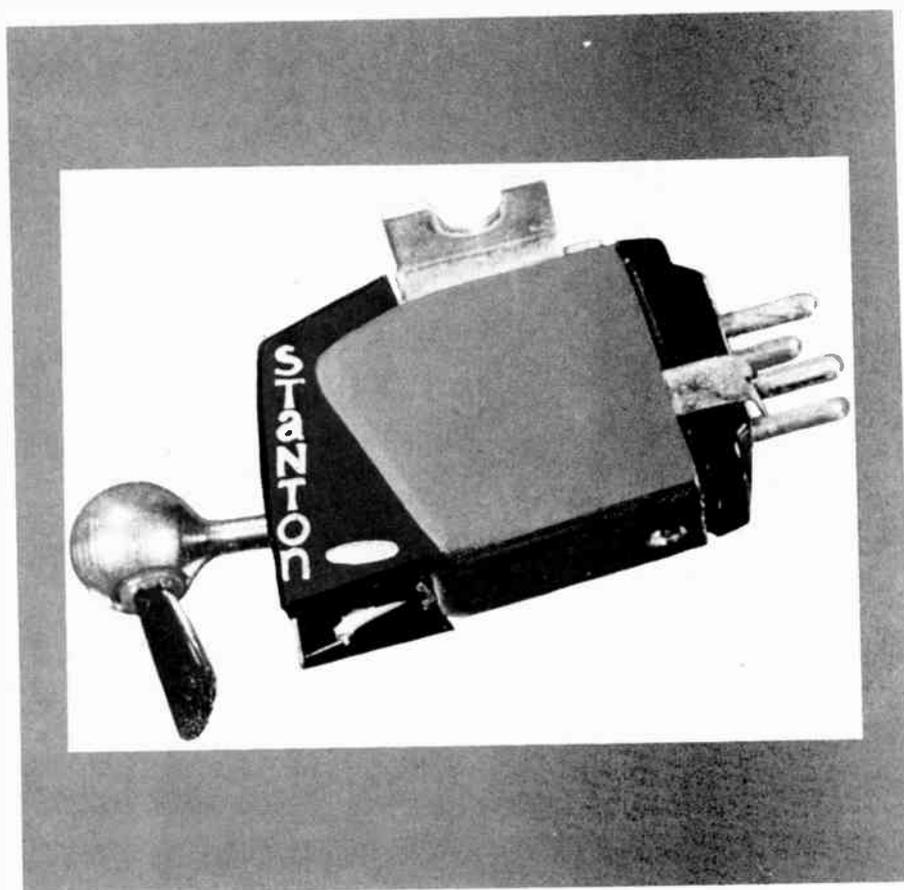
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LERO26

# STANTON 681T PHONO- CARTRIDGE

Calibration-series cartridge has exceptionally linear response.



**S**INCE Stanton Magnetics Inc. started manufacturing cartridges in 1965, their products have been primarily designed for the professional market and in particular for recording and broadcast studios.

The company has placed especial emphasis on linearity of frequency response. This is particularly so with the 681 range, in fact Stanton classify

them as their Calibration Standard Series.

Stanton also produce a 500 series which is intended for use in broadcasting studios.

This latter series is particularly interesting because of its unusual stylus bar shape which allows the cartridge to be backcued without damage or jumping of tracks.

The 681T reviewed in this article is a 681 series cartridge and has been tested with both a 681 EE and a 681 A stylus. The 681 EE is an elliptical stylus, and the 681 A is a spherical stylus.

The cartridge is supplied with a calibration chart (as are all Stanton cartridges) which gives the following performance data:—

- A. Frequency response.
- B. Sensitivity.
- C. Channel separation at 1,000 Hz.
- D. Dc resistance
- E. Inductance.

The external appearance of the Stanton 681 T is similar to many other moving magnet type cartridges — with the exception of the small hair brush fitted to the stylus assembly. This brush tracks some two grooves ahead of the stylus.

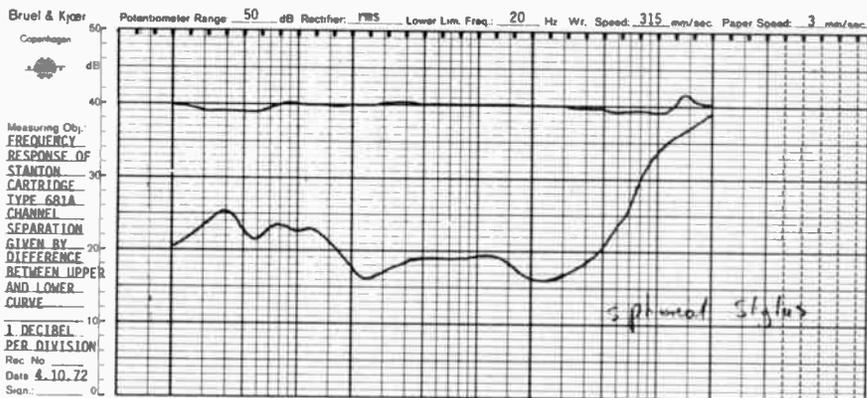
Because of the pivoting arrangement of this brush a 1 gram force is necessary to compensate for the upward lift produced by it. This has a number of advantages and disadvantages.

The advantages are that: It very effectively removes lint and dust from the record grooves. (This is particularly evident by the amount of built up on the end of the bristles).

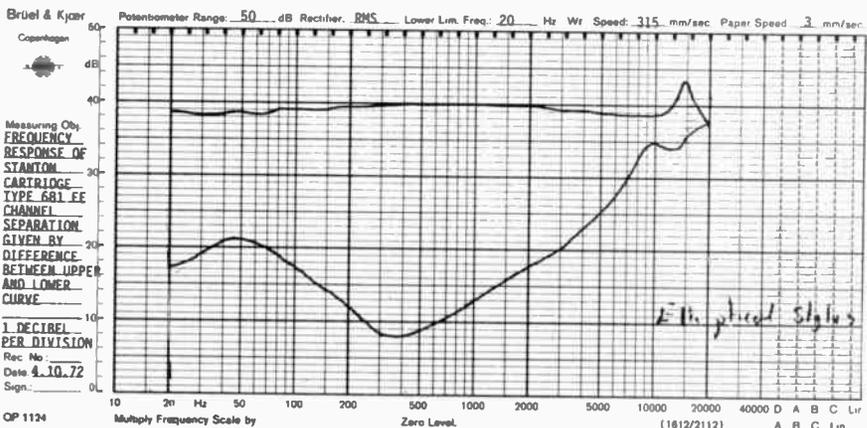
Apart from this it appears (subjectively) to very marginally improve the trackability of the cartridge on truly flat records. This is partly due to the anti-skating forces produced by the bristles.

Against this, the brush causes mistracking on slightly warped records due to the brush lifting the stylus out of the groove. Clearly it is unfair to fault a cartridge for a record manufacturer's problems, but regrettably, warped records are becoming ever more common.

Another minor problem is that on automatic record players with slow lift



Top graph shows Stanton 6817 cartridge with a 681A spherical stylus, lower graph shows the same cartridge, but this time with a 681 EE elliptical stylus.



and rise movements, the brush causes the stylus to traverse across the record possibly causing damage. However this is also a rather unfair criticism since the 681T is designed for a tracking force of 3/4 grams to 1½ grams and most automatic changers are only suitable for cartridges with tracking forces in excess of 1½ grams.

### LISTENING TESTS

The subjective assessment of a cartridge is necessary to determine its overall performance. Laboratory measurements of its frequency response, channel separation, etc. do not indicate its performance on 'real' record material, neither do measurements of static and dynamic compliance and stylus mass give an accurate indication of trackability. (However measurements of trackability reveal a lot more information than do distortion measurements at selected frequencies and fixed velocities).

For the trackability test we used the

second side of the first record in "The Tchaikovsky Ballet Album number 32BR 220302. Some slight mistracking occurred at the highest tracking velocities with bells, cymbals, triangles and piccolo, and resulted in a slight loss of the sharp attack characteristic of these instruments. This was particularly noticeable in the climax in the Dance of the Mirlitons. The xylophone in the Dance of the

Sugar Plum Fairy was extremely good — in fact it was possible to hear a squeak in the pedal mechanism! The bass drum, particularly at the end of the Dance of the Sugar Plum Fairy, and during the Final Waltz and Apotheosis from Act II, sounded rather blurred indicating some slight mistracking. On the other hand the kettle drums which are particularly predominant towards the end of the "Pas de Deux" were extremely good.

As expected the mistrackings observed with the elliptical stylus, were slightly more pronounced with the spherical stylus, particularly on the inner track.

The measured performance of the Stanton cartridge was very good. The frequency response is the flattest we have ever measured and agreed exactly with the calibrated performance.

Channel separation was the only parameter which did not agree with the calibration data supplied. It was 8dB less than the figure quoted.

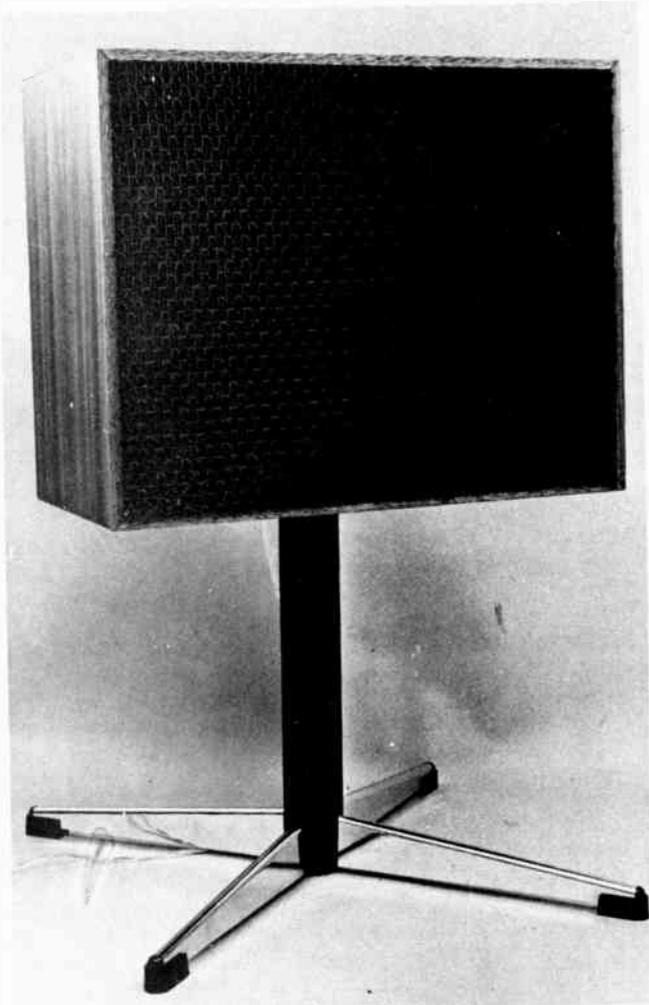
The Stanton 681T cartridge is one of the best cartridges we have ever tested. Although a number of isolated mistrackings were heard they were of quite minor importance, and for the major part of the listening period was exemplary.

### MEASURED PERFORMANCE OF STANTON CARTRIDGE

681T SERIAL NO: 0399X

Frequency Response	Elliptical Stylus 20Hz to 20kHz ±2dB Spherical Stylus 20Hz to 20kHz ±1dB
Sensitivity re 1kHz at 5cm/sec	3.3mV
Channel Separation at 1kHz	Elliptical Stylus 27dB Spherical Stylus 21dB
Cartridge Weight	6.37 Grams
Recommended Selling Price	681T \$90.00 681EE \$72.00

# PHILIPS QUADREFLECT LOUDSPEAKER



Full constructional details of this exciting new speaker (reviewed in *Electronics Today International* last month).

At present, the Philips Quadreflect loudspeaker system (described in the previous article) can only be obtained in kit form. But unlike the majority of speaker kits — these are supplied with the woodwork almost completely assembled.

This is perhaps just as well, for the complex enclosure would cause major problems for all but the most experienced woodsmiths. However in

the form in which the kit is supplied, construction is a fairly simple business and only hand tools are required.

## CONSTRUCTION

Paint both front and rear panels and leave to dry. The front panel has a recess around its front edge and this is the side that faces the listener.

Whilst these panels are drying, assemble the cross-over network.

As supplied by Philips' Elcoma division the kit includes:

Partly assembled veneered "PYNEBOARD" for the enclosure and grill cloth frame.

4 x AD7065/W8 7" woofers.

3 x AD0160/T8 1" dome tweeters.

5 x 6.8 $\mu$ F capacitors type 2222 344 21685  
or type 2222 344 25685

3 x 0.5mH inductors type 4304 078 21100

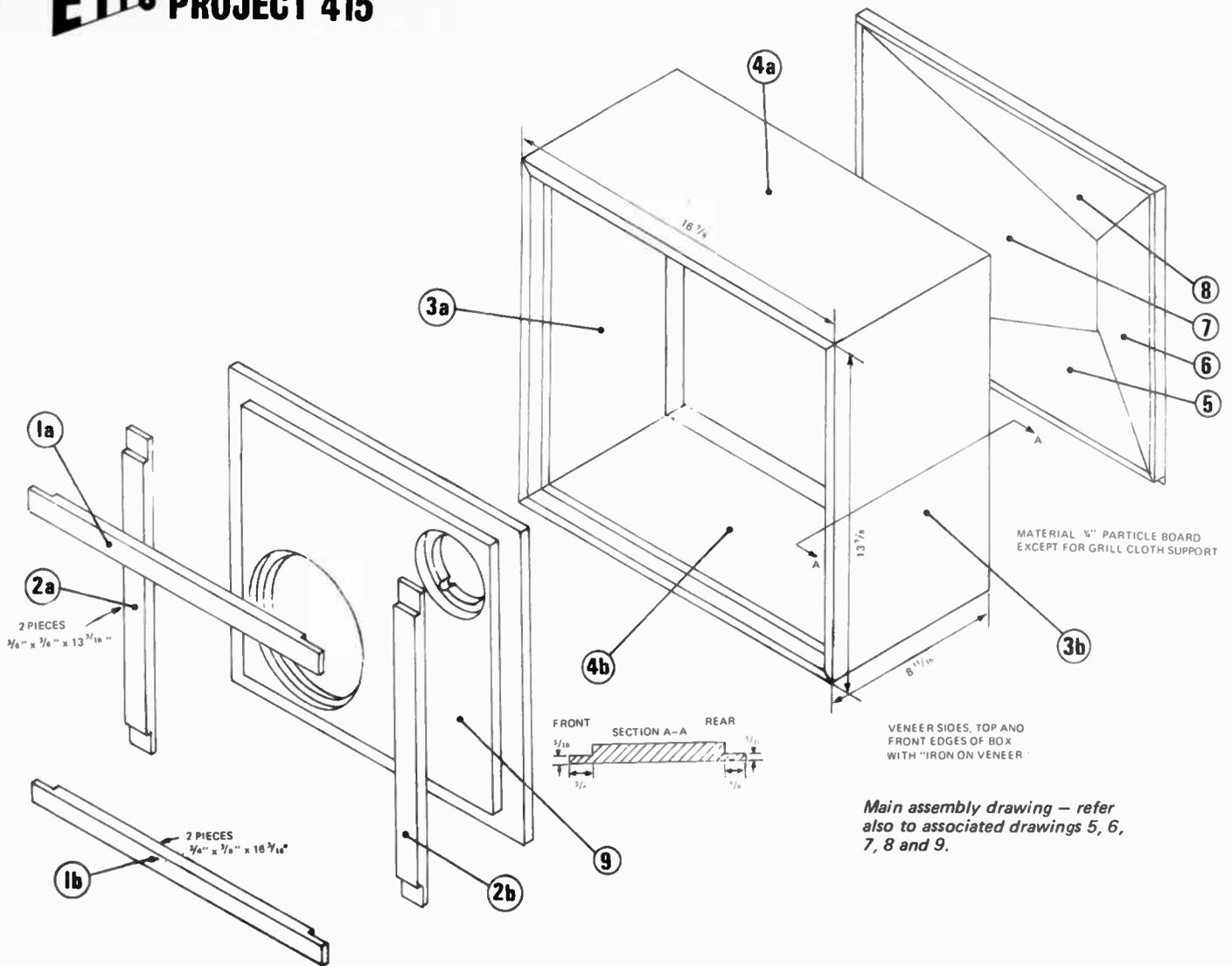
1 x 8.2 $\Omega$ , 4.2w resistors  
type 2322 330 21828

1 x Quadreflect system printed board.

10 yards of twin flex for internal and external loudspeaker connections.  
acoustic damping material.

The following items are required for completion of each enclosure

- 1 tube of PVC woodglue
- 1 tube of Quik-Grip
- 1 tin of matt black paint
- 1 tin (1lb) of woodgrain filler (teak of walnut as applicable)
- 2 sheets of No. 400 "wet or dry" sandpaper
- 1 can of Estapol.
- 1 can of Scandinavian finishing oil.
- 1 role of adhesive tape.
- Grill cloth, front 15" x 18", rear 18" x 23" (optional)
- Some fine steel wool.
- Small plane
- 56 "PYNEBOARD" screws 5/8" x 4 gauge
- 56 washers, 1/8" bolt size, 1/8" dia., 20 gauge
- 2 loudspeaker plugs to suit amplifier.
- 1/16" and 3/16" drill
- 1 timber off-cut 3/16" or 1/2" thick x 7" square
- 1 packet of Selleys strip calk.



Main assembly drawing — refer also to associated drawings 5, 6, 7, 8 and 9.

Capacitors, inductors and the resistor are mounted on the laminate side of the board to coincide with their respective positions as indicated on the copper side.

Glue the inductors to the top of the board to prevent them vibrating. They should be positioned so that L1 is flat on the board and L2 and L3 are vertical. The resistor should be spaced about 1/8" above the board to allow for heat dissipation. Cut all leads to the lengths shown below and solder them to the board. Code these leads — copper wire to positive terminals, tinned wire to negative terminals.

### LEAD LENGTHS REQUIRED

SPEAKER	POSITION	LEAD LENGTH
Hf1	Left Rear	30"
HF2	Right Rear	33"
HF3	Front	17"
LF1	Front	25"
LF2	Top Rear	35"
LF3	Left Rear	23"
LF4	Right Rear	24"

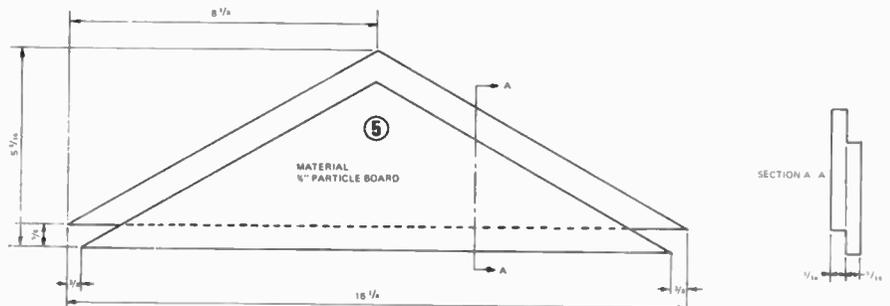
The remaining wire may be used to connect the speakers to the amplifier — longer wires should be used if the remaining wire is inadequate. It should be soldered to the board through the holes marked "input".

The crossover network can now be fixed to the back of the front baffle above the mounting hole for the front woofer, about 2" from the top and side edges. The short side with the internal wire connections should be parallel with the top of

the baffle. It should be securely screwed to the baffle using either 1/8" spacers or a few layers of adhesive felt to prevent vibration between the board and the baffle.

### ASSEMBLING THE ENCLOSURE

Firstly, fit the flat front baffle into the 'box' with the speaker rebates facing *outwards*. Note that the tweeter must be positioned *above* the woofer. (As top and bottom of the box are identical, select whichever has the



# The rave reviews keep coming...

"The Bose 901 is, indeed, one of the finest speaker systems it has ever been my pleasure to hear. I have lived with it now for several months, so that I am quite sure of what I say . . . it is the sound itself that remains paramount. The 901 is characteristically smooth. Everything is simply there . . . I urge that you listen for yourself. I think you will have to agree that Bose has, in a single giant step, produced one of the finest speaker systems ever made."

Larry Zide—American Record Guide—December 1969.



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VIC: Douglas Trading  
191 Bourke Street  
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TAS: P. & M. Distributors  
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## 3. Bert Whyte—Audio

"the illusion of an orchestra spread across the wall is uncanny . . . To hear a thunderous low 'C' organ pedal . . . or a clean weighty impact of a large bass drum is truly impressive . . . There is no doubt that the much-abused term, 'breakthrough', applies to the BOSE 901 and its bold new concepts."

## 4. Hi-Fi Buyers Guide

" . . . its over-all sound quality so clean that the listener is almost unaware of the electronics between him and the instruments . . . The sound? The 901 is very possibly the only speaker to date to pour forth in true concert hall fashion."

## 5. Stereo & Hi-Fi Times

"but the proof of the pudding inevitably is sound. And it is here that the BOSE 901 stands clearly away from the crowd . . . What a lovely sound those speakers produce! . . . Listen to Columbia's 'Carmina Burana' on this speaker and hear what a chorus should sound like! . . . these speakers provide a quality that is not to be matched."

## 6. Elementary Electronics

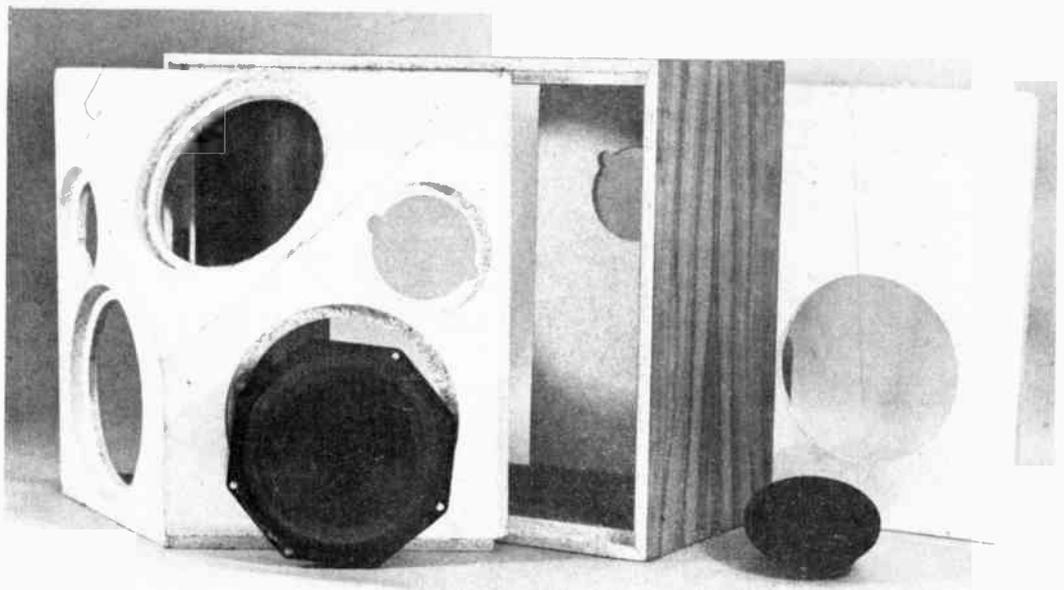
"conclusion. The BOSE 901 speaker system delivers the most natural stereo sound, creating the illusion of being in a concert hall, with a uniformity of frequency response and freedom from distortion that is unbelievable, particularly if the listener takes into account the physical size. It is our opinion that this is the speaker system to own, regardless of price, if one wants the ultimate in listening pleasure."

Your inquiry will bring you complete reprints of these unprecedented reviews and a list of franchised BOSE dealers in your area. Ask your dealer for an A-B comparison of the BOSE 901 with the best conventional speakers—regardless of their size or price. Then, go back to your present speakers—if you can.

You can hear the difference now.

**BOSE**

# PHILIPS QUADREFLECT LOUDSPEAKER



Main components of Philips-supplied kit.

better appearance for the top). The front baffle should be flush with the edge of the box. The back of the box has a deeper recess than the front, so ensure that the front baffle is glued into the *shallower* recess.

After glueing the front baffle into position, place the box facedown and run glue along the inside edge of the baffle to ensure an airtight seal.

The next step involves glueing the rear baffle section into the enclosure. Note that the 'flat face' forms part of the bottom of the enclosure; the

angled side with the single speaker mounting hole faces upward. Complete the sealing as with the front-baffle. An airtight seal of all seams is absolutely essential. Leave to dry for 12 hours.

When the enclosure is dry, glue the narrow timber strips along the front edges of the enclosure. These strips can be held in place by strips of adhesive tape. When the strips have dried it may be necessary to slightly plane and sandpaper the side edges so that they are perfectly flush with the sides of the cabinet.

Remove all excess glue, and smooth down all surfaces with fine sandpaper by rubbing *along* the grain of the timber. Apply the appropriate woodgrain filler and remove any excess with a cloth after approximately 8 minutes. Leave to dry 24 hours and apply a coat of Estapol. A second coat of Estapol may be applied after a further 12 hours. Leave to dry for 48 hours before finishing with Scandinavian oil. The oil should be rubbed in along the grain with fine steel wool.

During the finishing stage of the enclosure the grill cloth frame can be assembled. The four pieces are glued together. A small nail on each joint provides additional strength. Paint the front and edges of the frame, black. (Check that this frame and grill cloth fits into position — if not, sandpaper the edges.) The grill cloth can be fitted as soon as the frame has dried. The cloth can be glued to the frame with "QUIK-GRIP".

(Continued on page 41)

All drawings in this article have been prepared by Electronics Today International — all copyright is reserved.

## IMPORTANT

The main text of this article explains how the Philips-supplied kit is assembled. And in this form, assembly is a relatively simple affair.

Nevertheless a number of readers will wish to make their own enclosures. The drawings accompanying this article are for the benefit of these readers. It is only fair however to point out that this is a difficult enclosure to construct — it should not be attempted unless one has the necessary equipment, and skill. Unless the reader is quite confident that he has the necessary ability, he is recommended to purchase a part-assembled kit.

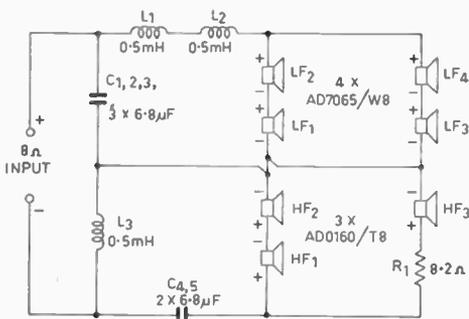
The speaker enclosure shown in the drawings differs slightly from the original Philips enclosure in one respect. This is that the 3/8" square strips around the front of the enclosure have been deleted and the main box extended by 3/8" to compensate. (This simplifies construction — and we feel results in a more pleasing appearance.)

## Hints on assembly

(to be read in conjunction with the main text)

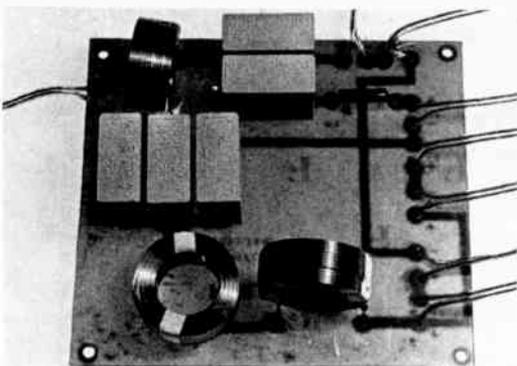
The two sides, top, bottom and the front panel should be glued together first. When dry, the back can be assembled and glued together in the following order — firstly the small triangular section (remembering that the tweeter is uppermost on the front panel), followed by the two side pieces and finally the top. Due to the complexity of construction some final fitting must be expected, but if the dimensions are closely adhered to, this should be minimal.

The two sides, top, and the small strip around the front should be veneered following final sanding.



ABOVE: Circuit diagram of cross-over network.

BELOW: How the cross-over network is assembled — (all components including pc board are included in the kit).



# TEAC's AN-60, AN-80 and AN-180 Noise-Reduction Units.



TEAC AN-60



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Our Dolby circuit removes machine and tape noise with such thoroughness that there is a signal-to-noise ratio improvement of 3 dB at 600Hz, rising to 5 dB at 1000Hz and 10 dB at 4K Hz and above.

Because we manufacture the ICs used in our Dolby circuit to extremely tight tolerances, ours operates at distortion levels of less than .3% — lower than many competitive units. So you see there is no question that you should have a TEAC Dolby Noise Reduction Unit.

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It's actually a simultaneous record-playback control center with its own record and playback amps. It has built-in mike and line preamps that maintain mixing capability, or add this capability to recorders not so endowed.

TEAC AN-80



TEAC AN-180

It has large professional-type VU meters for Dolby level setting as well as record/playback level indicators. AN-180 also incorporates such features as an internal 400 Hz, 100 Mv oscillator level controls, source/tape monitoring and a multiplex interference filter.

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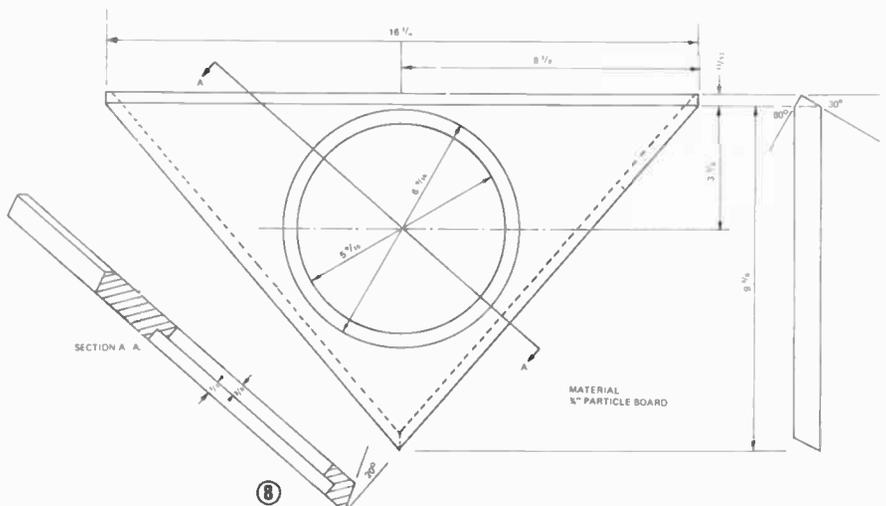
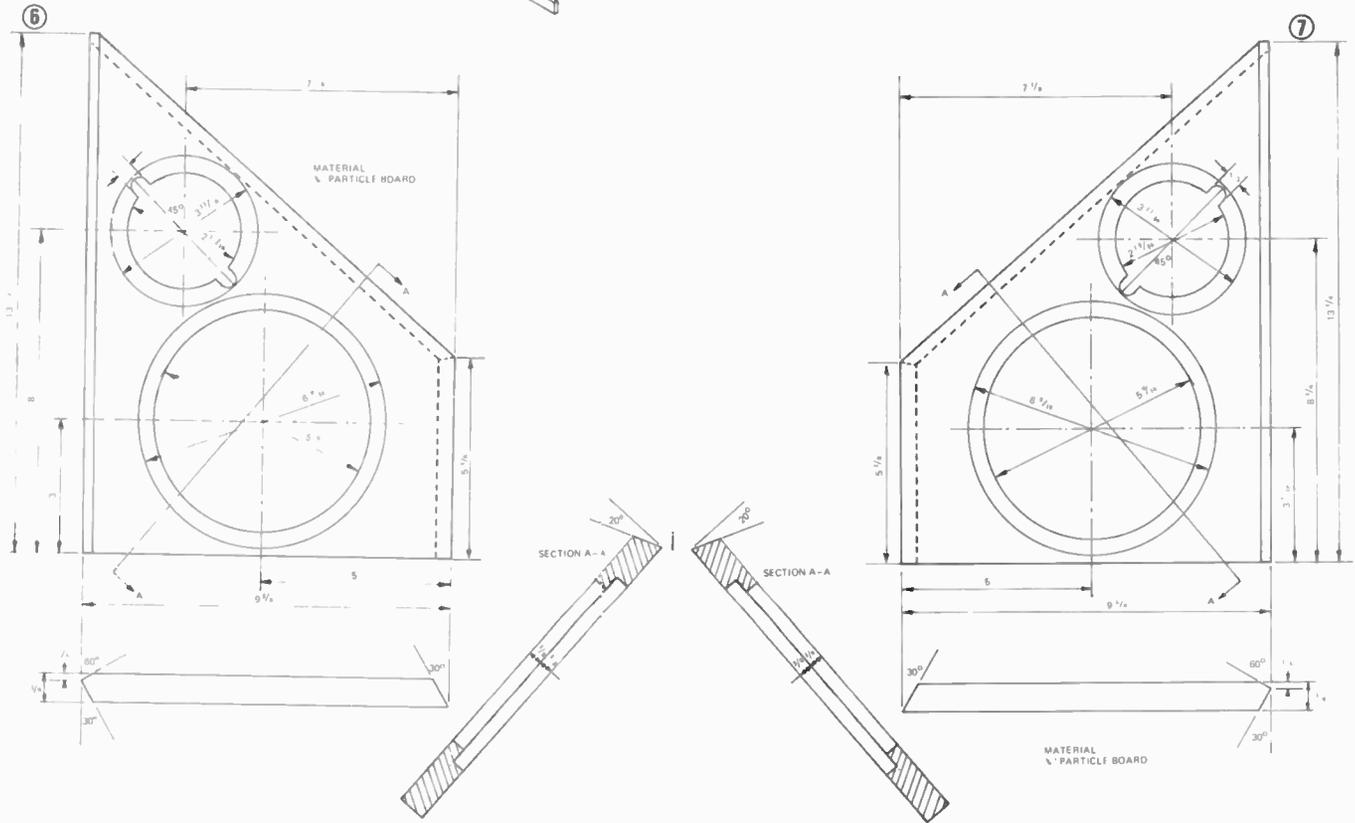
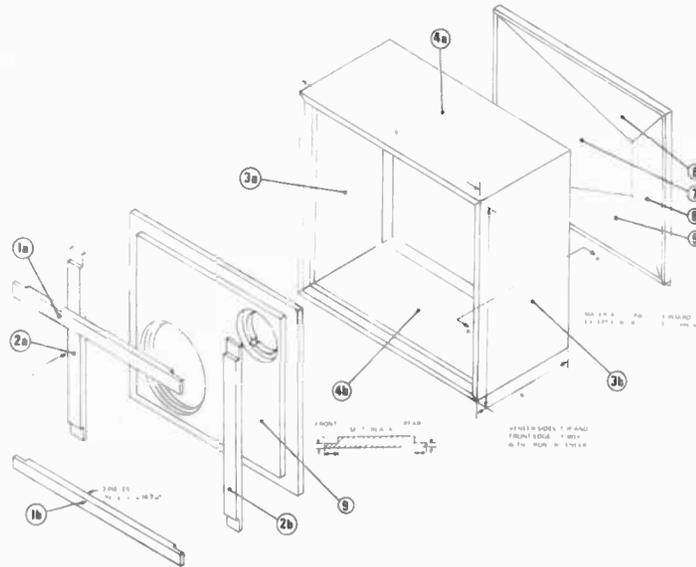
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# PHILIPS QUADREFLECT LOUDSPEAKER



If the cloth is cut flush with the back of the frame, the frame will be completely flush with the front edges of the enclosure. If the cloth is wrapped around the frame it will slightly protrude from the front.

At this stage a  $3/16$ " hole should be drilled for the external speaker lead. The best position for this is through the bottom, about 2" from the V-shaped back. Now bring all leads out through the appropriate speaker openings. Also allow the leads to follow the contour of the box. Fasten the leads to the panels of the enclosure with adhesive tape. This will make it easier to insert the acoustic damping

(Continued on page 43)

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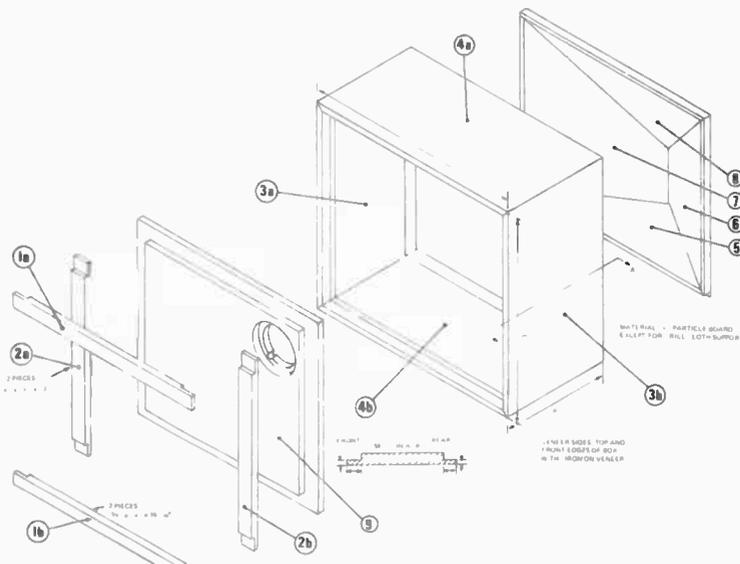
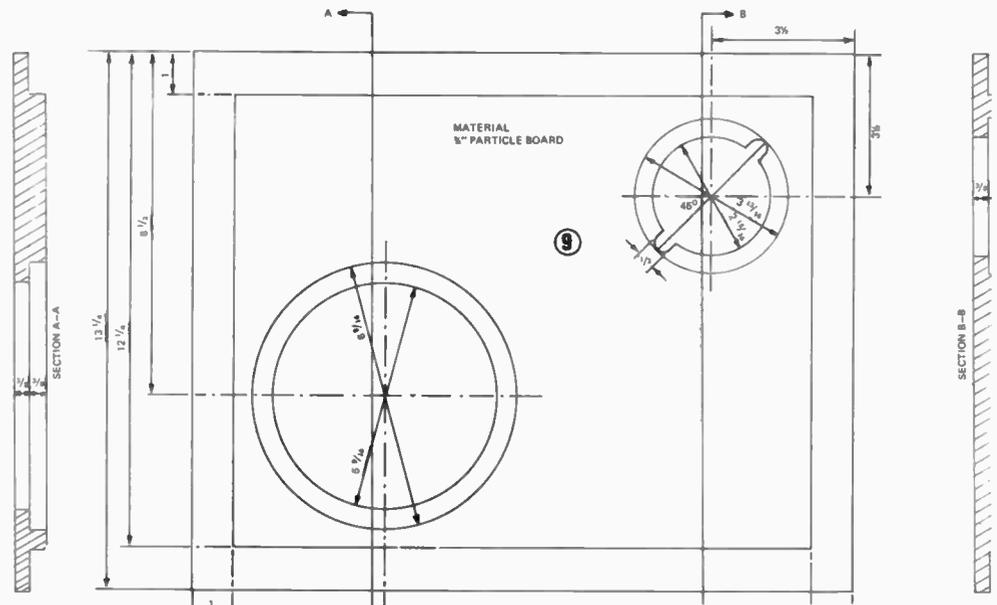


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# PHILIPS QUADREFLECT LOUDSPEAKER



material later. Now solder the previously cut leads to the front loudspeakers.

After this follows the mounting of these speakers. An airtight seal is essential and this can be achieved by placing a ring of cork strip between the speaker and the baffle flange. Mark the positions of all speaker mounting holes and drill a 1/16" hole in the baffle flange to facilitate the fitting of the screws. To ensure that the screwdriver will not slip off the screws and through the cone material use a small 3/16" thick piece of timber with a hole drilled through it, large enough to push the screwdriver through. By placing the hole directly over the screw which is to be tightened, the timber acts as a guide for the screwdriver.

Now place the enclosure front down

on to a table and connect the leads to the rear speakers. Having done this, inspect the enclosure for airleaks through the last remaining opening in the top centre. Any light spots which are showing should be sealed. This includes the hole through which the speaker lead passes. After ensuring that there are no airleaks the acoustic damping materials can be inserted. Cut it into four equal squares and make a roll of each square. Place each roll vertically into the enclosure from left to right. The rolls will unfurl and thus fill the enclosure. There is no need to glue the material into position.

Finally, fit the remaining woofer in position.

The front grille cloth can now be pushed into place.

The rear grill cloths are cut to size by making a paper pattern for each of the

three sections. Place the pattern on the grill cloth, allowing at least a 1/2" overhang. (The overhang is to be folded under before placing the cloth in its position on the baffle.) Cut the cloth along the outline of the overhang. The three sections may be stitched together or glued individually on the baffle. The former is to be preferred as this will only require the cloth to be fixed along the edges of the enclosure.

The cloth may be held in position by staples, tacks, or glue. Bear in mind that easy access to the speakers may be required and for this reason staples may be the preferred means of fixing.

Finally the enclosure should be mounted on a suitable furniture stand. For optimum effect the enclosure should be raised at least 18" above floor level.

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Battery : H-7D/A9.1V

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Impedance : 1K  
Freq. response : 100-10K HZ  
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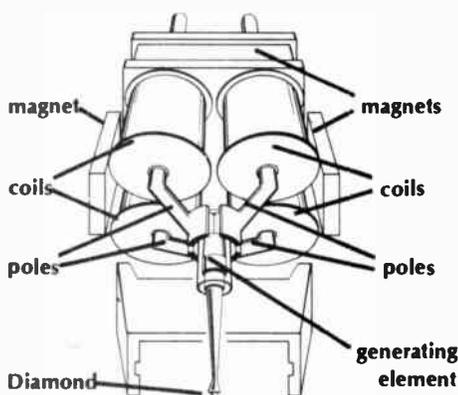
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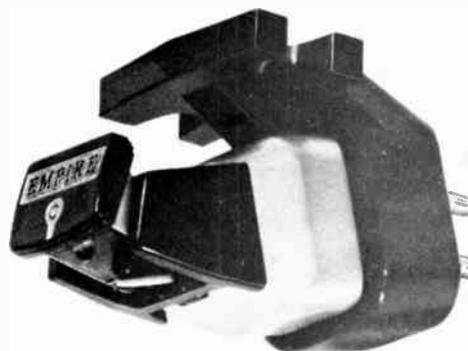
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All you have to do to enter is to fill in the entry coupon, place the speaker characteristics listed in order of priority and tell us in a few words why you placed them in this order.

The speakers being given by Leroya Industries as the first prize are two bookshelf models finished in American walnut veneer. The vented enclosures of each unit includes a three-way speaker system consisting of a ten inch woofer, a five inch twin cone mid-range speaker and a three inch tweeter.

Apart from the main prizewinner, the runner-up will receive \$50 worth of Memorex recording tape, the third prizewinner will receive \$25 worth of Memorex tape and every other entrant in the competition will receive a copy of the 36 page Bib "Hi-Fi Stereo Hints and Tips". This booklet is a splendid guide to the use of audio equipment, explaining in lucid terms the functions of each component, various technical terms, installation of equipment, tape subbing, etc. It is written by John Borwick, B.Sc., an internationally acclaimed audio expert. Being a British publication, there are several points irrelevant to Australian audiophile's needs, such as wiring of plugs and lists of English periodicals. But this in no way detracts from the usefulness of the booklet.

## YOUR ENTRY

Choosing a loudspeaker is never an easy task as so many considerations have to be taken into account. It is to some extent a matter of individual taste as to what is required from a loudspeaker and what is believed to be the salient points of any one speaker system.

There are certain characteristics which every speaker system must possess. But the decision as to whether the point of prime importance is the appearance, the size or the frequency response is often a matter of the individual buyer's personal requirements.

The purpose of this competition is to find a sequence of priorities to act as a guide when buying a speaker system. We would like you to mark down the features we have listed in order of preference and then to write in thirty words or less why you have placed them in that order.

Send your entry as soon as possible to: Speaker Competition, Electronics Today International, 21-23 Bathurst Street, Sydney, N.S.W. 2000, together with the entry coupon. Any entry not accompanied by a coupon will be considered invalid.

The competition closes on January 31st, 1973, with the winner being announced in a later issue.

A panel of judges appointed by the magazine will decide the winning entry.

## Contest

All entries must be accompanied by the coupon from Electronics Today International. There is no entrance fee, but any entry not accompanied by a coupon will be deemed invalid by the judges.

The winner will be decided by a panel of judges appointed by the Editor of Electronics Today International. The judges' decision will be final and no correspondence will be entered into concerning the outcome of the contest.



# COMPETITION

## Conditions

All entries should be addressed to: Speaker Competition, Electronics Today International, 21-23 Bathurst St, Sydney, N.S.W. 2000.

Ensure that your name and address is printed clearly on your entry coupon.

Closing date for the competition will be January 31st, 1973.



Mark your order of preference in the boxes, i.e. 1 for first choice, 2 for second choice, etc.

- High efficiency
- Low distortion
- Wide frequency response
- Smooth frequency response
- Wide polar response
- Attractive appearance
- Reasonable size
- High power handling capacity
- Parts and labour warranty
- Moderate price
- Superior transient response

Explain in thirty words or less the reasons for your order of preference.

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### ENTRY COUPON

**ELECTRONICS TODAY INTERNATIONAL SPEAKER COMPETITION**

21 Bathurst Street, Sydney, N.S.W. 2000

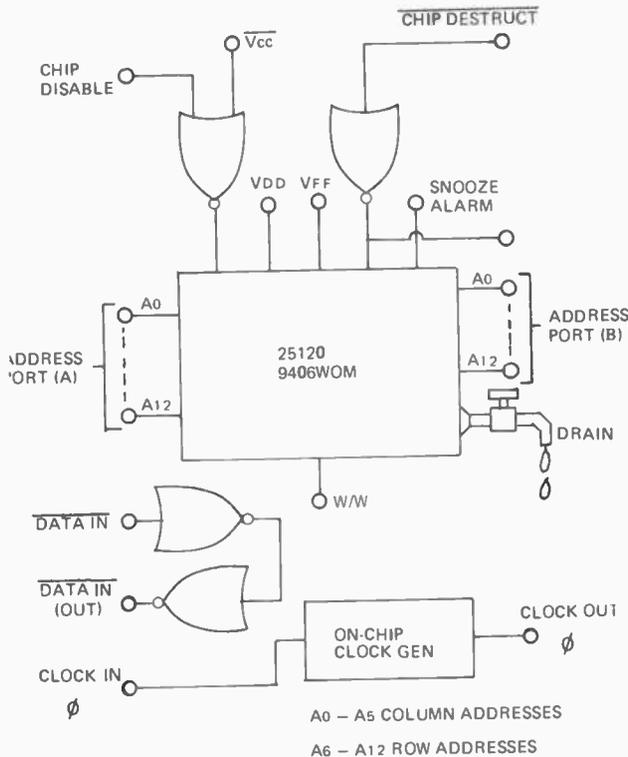
Herewith, please find my entry for your Speaker Competition. I have read the rules of the contest and agree to abide by the judges' decision.

SIGNED ..... DATE .....

NAME (block letters) .....

ADDRESS .....

A separate coupon must accompany each entry.  
Closing date for the Speaker Competition is January 31st, 1973.



# WRITE-ONLY MEMORY

Christmas special from Signetics incorporates First-in/Never-out (FINO) asynchronous buffers.

**A** new WOM from Signetics is described in a recent data sheet for the 25120, a fully encoded 9046 X N, random-access, write-only memory. Signetics points out that this is a final specification — and adds the footnote, "until we get a look at some actual parts".

The product is sufficiently unusual to merit substantial abstracting from the data sheet with only slight modification. It follows:

## DESCRIPTION

The Signetics 25000 Series 9046 X N Random-Access Write-Only Memory employs both enhancement and depletion mode, p-channel, n-channel and neu<sup>1</sup> channel MOS devices. Although a static device a single TTL-level clock phase is required to drive the onboard multiport clock generator. Data refresh is accomplished during the CB<sup>2</sup> and LH<sup>2</sup>

periods. Quadristate outputs (when applicable) allow expansion in many directions, depending on organization.

The static memory cells are operated dynamically to yield extremely low power dissipation. All inputs and outputs are directly TTL compatible when proper interfacing circuitry is employed. Device construction is more or less SOS<sup>3</sup>.

## FEATURES

- Fully encoded multiport addressing.
- Write cycle time 80 ns (max. typ.)
- Write access time<sup>4</sup>.
- Cell refresh time 2 ms (min. typ.)
- TTL/DTL compatible inputs<sup>5</sup>
- Available outputs, n
- Clock capacitance 2 pF max.<sup>6</sup>
- VCC = + 10V
- VDD = 0 V ± 2%
- VFF = 6.3 V ac

## APPLICATIONS

- Don't care buffer stores
- Least-significant control memories.
- Post-mortem memories (Weapons systems).
- Artificial-memory systems.
- Non-intelligent micro controllers.
- First-In Never-Out (FINO) asynchronous buffers.
- Overflow register (bit bucket).

## PROCESS TECHNOLOGY

The use of the unique SEX<sup>7</sup> process yields V<sub>th</sub> (var.) and allows the design and production<sup>8</sup> of higher performance than can be obtained with competitors' techniques.

## BIPOLAR COMPATIBILITY

All data and clock inputs plus applicable outputs will interface directly or nearly directly with bipolar circuits of suitable characteristics. In any event, use 1-amp fuses in all power-supply and data lines.

## INPUT PROTECTION

All terminals are provided with slip-on latex protectors for the prevention of Voltage Destruction. (Pill packaged devices do not require protection.)

## SILICONE PACKAGING

Low-cost silicone DIP packaging assures reliability by the use of non-hermetic sealing which prevents entrapment of harmful ions while allowing the free exchange of friendly ions.

## SPECIAL FEATURE

Because of the employment of the Signetics proprietary Sanderson-Rabbit Channel, the 25120 will provide 50% higher speed than you will obtain.

## COOLING

The 25120 is easily cooled by employment of a six-foot fan, 1/2 inch from the package. If the device fails, you have exceeded the ratings. In such cases, more air is recommended.

1. New channel devices enhance or deplete regardless of gate polarity.
2. Coffee Breaks and Lunch Hours.
3. Copyright U.S. Army Commissary, 1940.
4. Not applicable.
5. These inputs can somehow be driven from TTL. The method is obvious.
6. Measured in 1 MHz, 26 mV ac, 1.9 pF in series.
7. Signetics EXtra secret.
8. See "Modern Production Techniques" by T. Arrieta (not yet written).

# You can create the finest stereo sound source available . . .

with a little help from some dedicated Swiss craftsmen, a few Danish precision engineers and a fussy British technician or two.

And you don't need to be a millionaire. You do need to be discriminating, and realise where greater value lies in terms of precision engineering and performance. Here's a few hints . . .

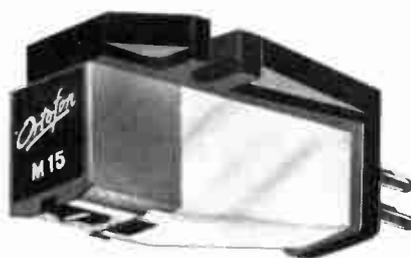


## Invest in the Swiss made Thorens turntable.

There are two models . . . the TD-125 and the TD-150 Mk. II. Why Thorens? Read these opinions from leading overseas reviewers: "the best three-speed manual we've ever tested" — High Fidelity. "wow and flutter were as low as we've ever tested" — Stereo Review. "a favourite contender in the best turntable category" — Audio. "it would be hard to imagine a unit that performs better" — Electronics World. Now look at these brief Thorens specifications:

- TD-125.** • Transistor governed 16 pole synchronous motor • Three speeds  
•  $\pm 2\%$  speed control on all speeds  
• Belt drive • 7½ lb. 12" diameter turntable • Wow and flutter  $\pm 0.08\%$   
• Rumble -68dB.
- TD-150 Mk. II.** • Same precision manufacture as the TD-125 but at a lower price • 16 pole synchronous motor  
• Belt drive • 7 lb. 12" diameter turntable  
• Two speeds — 33½ and 45 r.p.m.  
• Wow and flutter  $\pm 0.09\%$  • Rumble -65dB.

**So your Thorens turntable represents your help from the fastidious Swiss . . .**



## Now we turn to Denmark . . . to the famous Ortofon organization. This is the source of your new stereo cartridge!

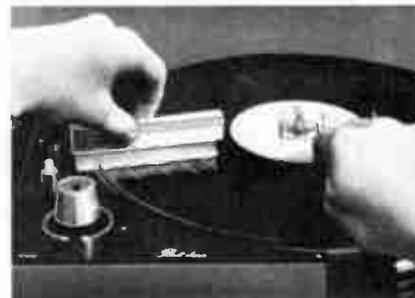
### THE ORTOFON M15.

Featuring entirely new principles, the Ortofon M15 stereo cartridge maintains the professional reputation of the makers in every way . . . for over 80% of recording studios as well as radio and television stations specify Ortofon . . . on a world wide basis!

When you see your Bleakley Gray franchised dealer, you can choose from the Ortofon M15 Super, the M15 or the MF15 cartridges. These are all attractively priced . . .

Typical specifications are:

- M15.** Weight of cartridge 5 grams.  
Frequency response 20 Hz. to 10 kHz.  $\pm 1$  dB.  
20 Hz. to 20 kHz.  $\pm 2$  dB.  
Recommended load 47 k ohms.  
Channel separation at 1 kHz. Greater than 30 dB.



## Finally, to the United Kingdom . . .

### KEEP YOUR RECORDS CLEAN WITH WATTS EQUIPMENT

Few music lovers realise that airborne dust and dirt are the greatest enemies of your records, and cause untold amounts of noise and interference. And the more sensitive your equipment is, the greater the problem! However, you can prevent most of the trouble with . . .

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Model Mk. IIA. A dual purpose record cleaner designed to maintain new records as new and to restore fidelity to older discs.

### WATTS "DISC PREENER"

Designed expressly for records which have not had previous anti-static treatment. The "Disc Preener" keeps new records like new.

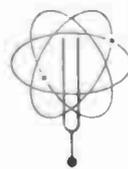
### WATTS FAMOUS "DUST-BUG"

This novel device cleans the record, removing dust and static charges as the record actually plays! Surface noise can be reduced considerably with the "Dust-Bug".

Call and see your nearest Bleakley Gray dealer. He'll help you create the world's finest stereo sound source!

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Adelaide Office: 301 South Terrace, Adelaide S.A. Tel. 23 6219  
Brisbane Office: 3 Prospect St., Bowen Hills, Qld. Tel. 52 7333  
Perth Office: 27 Oxford St., Leederville, W.A. Tel. 81 4988

N.T.: Piltzner's Music House, Smith Street, Darwin, T.F. 3801.  
Tas.: K. W. McCulloch Pty Ltd., 57 George Street, Launceston, 2 5322.

Bleakley Gray Corporation Pty. Limited,  
28 Elizabeth Street, Melbourne, 3000.  
Please send me all the facts about the Thorens TD-125/  
Thorens TD-150 Mk. II/Ortofon cartridges/Watts equip-  
ment. (Delete items not required.)

NAME \_\_\_\_\_ (BLOCK LETTERS PLEASE.)

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# we give you the auto features the rest try to sell

fully automatic  
stereo turntable  
BFU-121



## apan MUSIC MAKER

The BFU-121 boasts perfect record tracing; quiet, constant speed, 4-pole synchronous motor; feather-touch cue-control lever; 12 months warranty and after sales service.

And all for around \$125 . . . ready to operate, with no hidden extras. All the auto features that you normally associate with a much higher priced unit. All the quality that a discerning hi-fi enthusiast demands.

**AUTO PLAY:** Flip the lever to auto and the turntable begins to rotate. Upon reaching the required rpm, the arm leaves its rest and gently lowers the stylus to the disc.  
**AUTO RETURN:** On completion of the record an oil-dampened precision lifter is actuated to automatically return the arm to the rest, switching off the power.  
**AUTO REPEAT:** When the repeat button is depressed slightly, the arm will repeat automatic operation. By pressing the reject button, the auto-repeat function is released, thus stopping the record wherever required.  
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Manual and semi-auto models also available.

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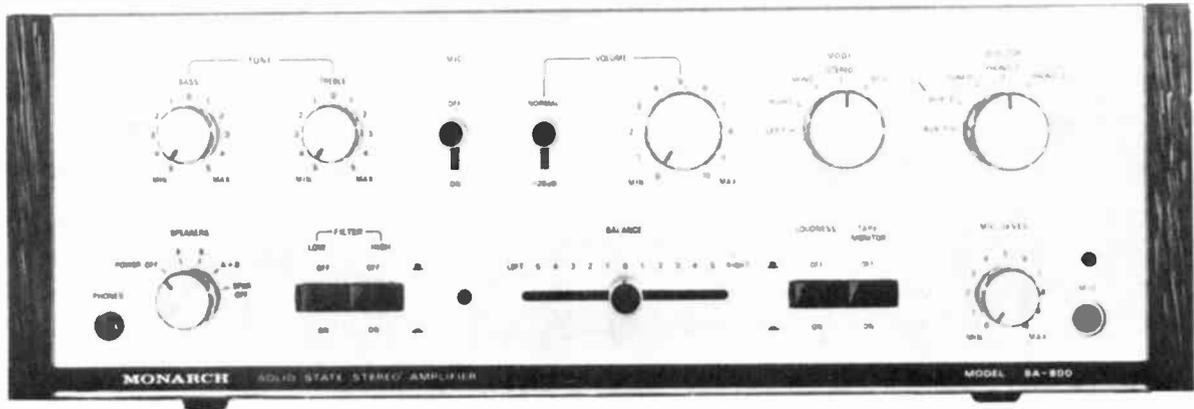
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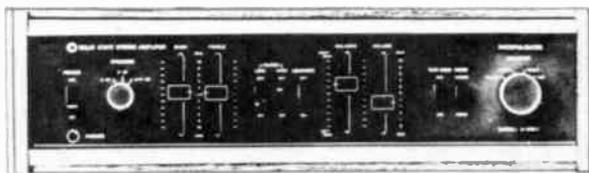
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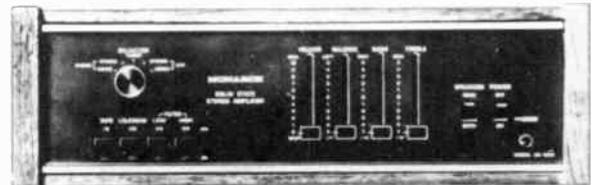
# Three Kings



**MONARCH SA 800** (80 watts RMS)  
Recommended retail price \$240



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Three amplifiers that stand head and shoulders above the rest. Because in the ratio of Power-to-Performance-to-Cash each Monarch amplifier gives more power, more performance for less money than any other amp in its class. No wonder Monarch is king as Australia's largest selling amplifier.

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# MAGNETIC FIELD MEASUREMENT

Latest developments in the precise measurement of magnetic fields — by John M. Stanley, Dept of Geophysics, University of New England Armidale, NSW.

have been used for recording magnetic fluctuations of frequency ranging between about 1 and 50 Hz. Here the threshold of sensitivity may be typically 5 micro Gauss. Induction coils have also been used to measure time-varying "magneto-telluric" currents within the Earth's crust (Solar induced electric currents deep in the Earth's crust and upper mantle), and to measure the magnetic field of the Earth from space satellites. In the latter case, the spin of the satellite provided the time variation of the field necessary for the instrument to operate. Integration provided a direct value of the field.

The "fluxgate" magnetometer is a modification of the induction principle and enabled static magnetic fields to be measured. The method was used for the detection of submarines during World War II, and since then has been fully developed as a most useful tool in geophysics exploration. Again, only a relative measure of the field is obtained. The device is directional, and measures only the component of the field resolved along the orientation of the sensor. Resolution is typically of the order of 50 micro Gauss.

Various less well known principles were also investigated, but it was not until the discovery of nuclear magnetic resonance, in 1946, that a new era was opened in the domain of accurate magnetic field measurement. This phenomenon linked accurately and linearly the value of the magnetic field to a circular precession frequency which was a characteristic of an atomic nucleus. Moreover, the absolute value of the field could now be determined.



**W**idely differing magnetic properties of materials produce a varied degree of variation of the Earth's natural magnetic field. Measurement of this variation provides a means of remotely sensing the presence of a foreign body having magnetic properties different from its environment. There are many applications for this technique, ranging from the mapping of mineral orebodies to the location of buried archaeological artifacts; from detecting the inclusion of foreign matter in food containers during processing, to the tracking of enemy weapon carriers. In addition, much of our knowledge of the Earth itself and the Sun and Solar System is based on magnetic field measurements both from the Earth's surface and from satellites in space.

Considerable effort has been directed

towards the improvement of magnetic field measuring devices. The magnetic fields of concern are usually less than one Gauss in intensity — and are thus termed "weak" by comparison with fields produced in the laboratory, or contained within atomic nuclei. The Earth's magnetic field for example, is typically 0.5 Gauss.

One of the first magnetometers to be developed for geophysical work was the "Schmidt Balance". It consisted of a delicately suspended magnetic needle. Measurements of the torque tending to align this needle with the Earth's magnetic field gave an indication of the magnetic intensity. It had a sensitivity of 10 micro Gauss, was prone to drift, and could only provide relative field values.

Induction coils consisting of many thousands of windings on a ferrite core

# MAGNETIC FIELD MEASUREMENT

## THE PROTON MAGNETOMETER

The "proton precession" magnetometer was the first successful adaptation of this principle. It was initially developed at Cambridge University to locate relatively magnetic archaeological treasures buried under the sands of the Nile basin. The magnetic moment of the protons contained in a fluid (water or benzene) were aligned approximately east-west by the application of a strong magnetic field in that direction. On the removal of this polarising field, the aligned magnetic dipoles precessed in unison about the Earth's field and could be used to induce a voltage at the precession frequency in a coil wound around the container of the fluid. The frequency was directly proportional to the field intensity — linked by a physical constant known as the "gyromagnetic ratio" of the proton.

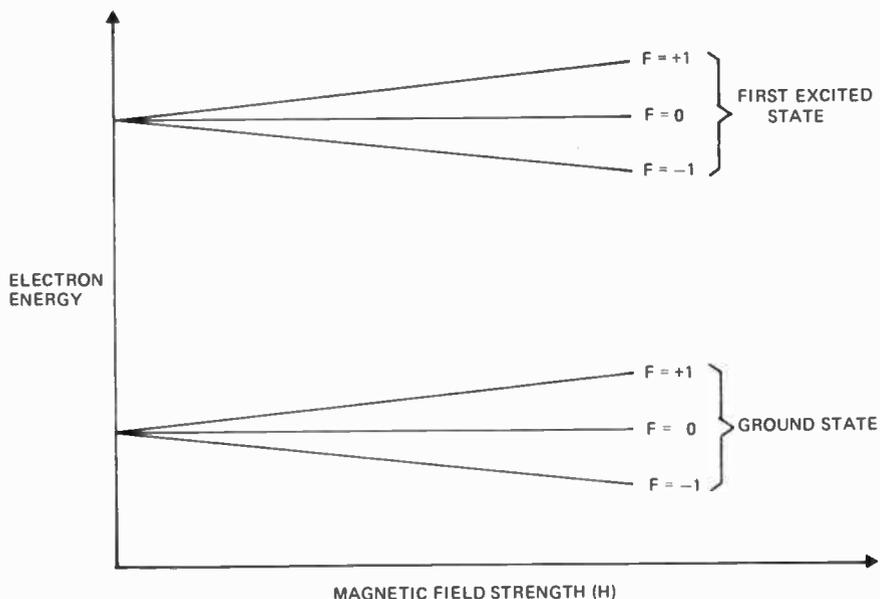


Fig. 1. The separation of ground and first excited state electron energy levels in the presence of an external magnetic field.

For many years this instrument was the standard reference for magnetic measurements in both the field and the laboratory. It measured the absolute value of the total field vector

to an accuracy of the order of 5 micro Gauss. Its principle limitation was that before each measurement could be made, the protons had to be realigned, a process taking two or three seconds. Thus time variations of period less than about five seconds could not be recorded, a factor greatly limiting the instrument's versatility, particularly in the domain of aerial magnetic surveying.

In 1957 a means was suggested of optically detecting "electron nuclear resonance" in an alkali metal vapour.

The method incorporated a phenomenon known as "optical pumping". Since then, considerable development of the "alkali vapour magnetometer" has taken place in America, France and the United Kingdom. At the Geophysics Department of the University of New England, a caesium instrument has been built and is being further developed for special high resolution archaeological and geophysical applications. This instrument has a sensitivity of 0.1 micro Gauss over a dynamic range of a few micro Gauss to one Gauss, and will respond to magnetic field fluctuations as rapid as 200 Hz.

Because it is the most versatile and sensitive of the now commercially available magnetometers, the alkali vapour type has been described in more detail. However, magnetometer development is not yet static. In 1964, the first practical SQUID (Super Conducting Quantum Interference Device) was operational. The prototype had a short term sensitivity of 0.1 micro Gauss over a dynamic range of 0.01 Gauss to 1 milli-Gauss,

## APPLICATIONS

New applications for precise magnetic field measurements have become a common event since the development of a.v. magnetometers.

One of the most striking successes of the a.v. magnetometer has been in the field of archaeological mapping. Where the a.v. instrument has excelled, is in the detection of items of pottery, stone walls, middens and humus deposits — often buried under many feet of sediment.

Probably the most common application of magnetometers has been in geological prospecting. By using these instruments, total field and vertical field gradient measurements made from the air or from the ground can be interpreted in terms of size, shape, orientation, depth and magnetic susceptibility of mineral bearing formations. The high quality of surface magnetic data obtainable with a.v. magnetometers has been particularly suited to digital analysis with computers and many advances have recently been made in this direction.

In Zoological field research, small mammals, with restricted home ranges, have had magnets attached to them and have been relocated with magnetometers.

The mapping of remanent magnetism, occurring in stripes across the ocean floors, has provided

positive evidence of "sea floor spreading" and continental drift.

Solar produced micropulsations in the Earth's magnetosphere are monitored from ground station geomagnetic observatories around the world.

This same solar activity is responsible for inducing large "magnetotelluric" currents within the Earth's crust. Measurement of these provides a means of calculating a resistivity profile of the crust — to a depth of several hundred kilometers.

Planetary magnetic fields is a topic about which little is known. Magnetometers have been orbiting the Earth for several years now and one has been sent in the Mariner spacecraft to Mars, to investigate this phenomenon.

The scope for industrial use of magnetometers as metal detectors is varied.

Magnetometers also have military uses like locating submarines or detecting munition dumps either hidden underground or in dense jungle.

In yet another application the author recently recorded the build-up of a charge for five hours before an electrical storm broke out. Where blasting in dangerous situations must be carried out, it is essential to be aware of the likelihood of lightning, as this discharge has been known to predetonate explosives.

but it was hoped that eventually a sensitivity of  $10^{-9}$  Gauss might be reached. Miniature helium refrigerators have been developed for use in satellites and it seems that the SQUID might find its greatest application in space research.

## THE PRINCIPLE OF OPTICAL PUMPING

The expression "optical pumping" was first used in 1951 to describe the assembling of atomic spin axes into a non-equilibrium distribution in which the majority of spins were aligned in a particular direction. To achieve this, the outermost (valence) electron of each atom was optically "pumped" into a higher energy level.

The alkali metal atoms have a single valence electron. The transition of this electron between its ground state orbit and its first excited state involves energies in the region of near infrared. In a magnetic field, both the ground and the excited states subdivide into a number of discrete energy levels characterized by a quantum number  $F$  representing the angular momentum associated with the spin of the atom. Of particular significance to us is the fact that the difference between these energy sublevels is linearly proportional to the intensity of the magnetic field. This phenomenon is called the Zeeman effect, and is valid for fields of up to one Gauss in intensity. Figure 1. shows the subdivision of electron orbit energies of the ground, and first excited state of a typical alkali atom, in an external magnetic field.

When an electron in a ground state sublevel is radiated with light of wavelength corresponding to the energy of transition between the ground and first excited state, it may accept that energy and be excited to the higher orbit. There is one restriction however. That is that the angular momentum quantum number may only change by  $+1$ ,  $-1$  or  $0$  depending upon the polarization of the energising radiation. For example, right circular polarized light may only allow a change of  $+1$  in  $F$  on transition to the higher state. Some short time after excitation (a few nanoseconds!) the excited electron will "relax" to its ground state, obeying the general selection rule  $\Delta F = \pm 1, 0$ . Spontaneous relaxation between sublevels of a given state can be considered not to exist.

Consider now an electron initially in the ground state with  $F = -1$ . On radiation with right circular polarized light, it is excited to the higher state having  $F = 0$ . (i.e.  $\Delta F = +1$ ). It then relaxes into one of the  $F = \pm 1, 0$  states with equal probability. Thus there is a  $2/3$  chance that the electron will return to a higher sublevel than its

origin. Thus as the excitation/relaxation is repeated there is a net migration towards the highest energy sublevel in the ground state, (i.e.  $F = +1$ ) hence the term "pumping". As there is no  $F = +2$  sublevel in the excited state, it follows that electrons located in the  $F = +1$  ground state cannot be excited by right circular polarized light. Hence these electrons are trapped. If we were to shine a light of the correct wavelength through a cell containing the alkali vapour, onto a photocell, the pumped state of the vapour would be recognized by maximum transmission of light through the cell. This is because none of the "pumping" photons could be absorbed from the light beam by electrons being excited.

It is a fact that the energy difference between two electron sublevels is proportional to a frequency known as the "Larmor" precession frequency of the valence electron. This precession frequency is also proportional to the magnetic field strength because of the linearity of the Zeeman effect responsible for the energy difference. Thus to measure the Larmor frequency implies measuring the magnetic field.

To achieve this measurement, we employ another characteristic of quantum mechanics. If a weak alternating magnetic field of the precise Larmor frequency is applied to the optically pumped alkali vapour cell, we may shake the trapped valence electrons out of the sublevel having  $F = +1$  and return them to the depumped situation. The cell may then reabsorb photons from the pumping light beam and in so doing become relatively opaque.

In Figure 2(a) we have a diagram of an alkali vapour magnetometer sensor arrangement and Figure 2(b) is a plot of photocell current as the signal generator is swept through the Larmor frequency.

The relationship between the Larmor frequency and the magnetic field in the case of caesium vapour is:—

Larmor Frequency = 349,869 Hz per Gauss.

Hence in the Earth's natural field, the frequency is about 170 kHz, and varies by 0.35 Hz per micro Gauss.

(Continued page 59)

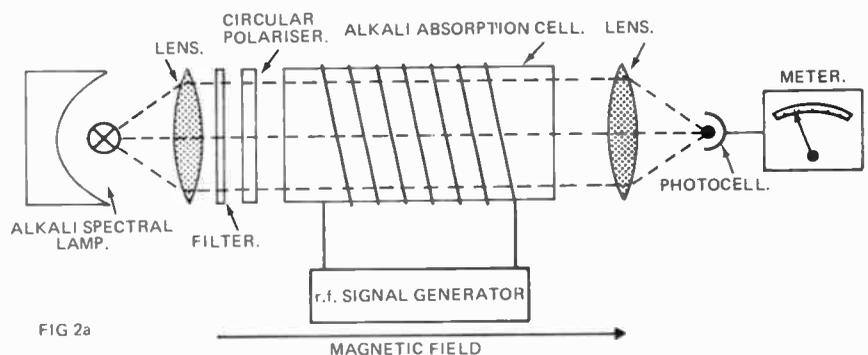


FIG 2a

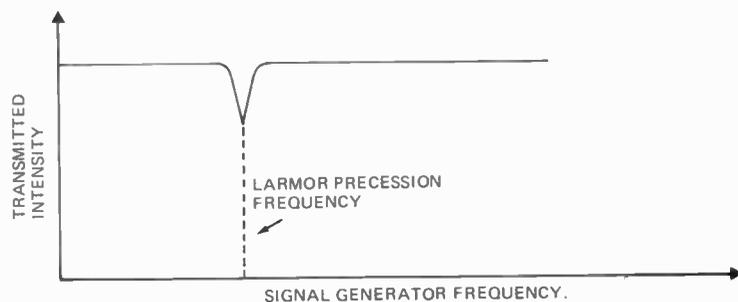


FIG. 2b

Fig. 2(a) A schematic diagram of the alkali vapour magnetometer sensor. (b) The absorption of photons from the light beam when the cell is being depumped by the electromagnetic field at the Larmor frequency. The transmitted intensity may vary by up to 20%.

# INSTROL

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## ADC STEREO CARTRIDGES — AMERICA'S QUALITY CARTRIDGE

### ADC 220X . . . \$17.00

ADC 220X. Type: Induced Magnet; Output: 6 mV at 5.5 cms / sec. recorded velocity; Tracking Force: 1 to 2½ grams; Frequency Response: 10 Hz to 18 kHz ± 3dB; Channel Separation: 20dB from 50 Hz to 10 kHz; Compliance: 20 x 10<sup>-6</sup> cms / dyne; Spherical Stylus Tip Radius: .0007" Vertical Tracking Angle: 15°.



### ADC 10E mk4 . . . \$51.00

Type: Induced Magnet\*  
Output: 4 mV at 5.5 cms / sec. recorded velocity  
Tracking Force: .7 gram  
Frequency Response: 10 Hz to 20 kHz ± 2 dB  
Channel Separation: 30 dB from 50 Hz to 12kHz  
Compliance: 35 x 10<sup>-6</sup> cms / dyne  
Elliptical Stylus Tip: Contact radius: .0003"; lateral radius: .0007"  
IM Distortion: Less than ½% — 400 & 4000 Hz at 14.3 cms / sec. recorded velocity  
Vertical Tracking Angle: 15 degrees  
Recommended Load Impedance: 47000 ohms nominal



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ADC 220XE. Type: Induced Magnet; Output: 6 mV at 5.5 cms / sec. recorded velocity; Tracking Force: 1 to 2½ grams; Frequency Response: 10 Hz to 18 kHz ± 3 dB; Channel Separation: 20 dB from 50 Hz to 10kHz; Compliance: 20 x 10<sup>-6</sup> cms / dyne; Elliptical Stylus Tip Radii: Contact radius .0003". Lateral radius .0007"; Vertical Tracking Angle: 15°

### ADC 550XE . . . \$30.00

ADC 550XE. Type: Induced Magnet; Output: 5 mV at 5.5 cms / sec. recorded velocity; Tracking Force: ¾ to 2 grams; Frequency Response: 10 Hz to 20 kHz ± 2 dB; Channel Separation: 20 dB from 50 Hz to 12 kHz; Compliance: 35 x 10<sup>-6</sup> cms / dyne; Elliptical Stylus Tip Radii: Contact radius .0003". Lateral radius .0007"; Vertical Tracking Angle: 15°.



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Built and Tested \$55.00 (1 cu ft), \$65.00 (1.6 cu ft)

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Enclosure kit (1.6 cu ft) \$26.00 (maple), \$28.00 (teak)  
Built Enclosure (1 cu ft) \$29.00 (walnut), \$30.00 (teak)  
Built Enclosure (1.6 cu ft) \$38.00 (Walnut), \$40.00 (teak)  
speakers & crossover only \$26.00 (one side only)

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A revised version of the popular Magnavox system was featured in July 1972 edition of Electronics Today. It featured a Philips tweeter and improved crossover

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The Dovedale III kit employs a 12" bass, 5" mid-range and 1" tweeter. Cabinet 28" x 15 1/2" x 10", 35 watts RMS.

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Melton kit (Unit 4) \$93.00  
Dovedale III kit (Unit 5) \$127.00

### SEPARATE COMPONENTS

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### COMPLETE SYSTEM

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### SEPARATE COMPONENTS

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# MAGNETIC FIELD MEASUREMENT

(Continued from page 55)

## THE SELF-OSCILLATING TYPE CAESIUM VAPOUR MAGNETOMETER

A number of approaches may be taken in the utilisation of optical pumping for a magnetometer system. Described below is the simplest. Figure 3 represents the components of this completed instrument.

### Principle of Self Oscillation

When an alternating electromagnetic field of the Larmor precession frequency is applied to an optically pumped vapour cell (as in Figure 2), the absorption characteristics of the vapour behave very much like a partial shutter, blinking open and shut at the Larmor frequency, in phase with the periodic pumping and depumping of the vapour. It then follows that if this modulation of the transmitted light beam is detected with a photocell, and the signal sufficiently amplified and suitably phase-shifted before being fed back to the depumping coil, then a closed loop self oscillating circuit will result. The resonance must necessarily be at the Larmor frequency if there is to be optical coupling to close the loop.

### The Sensor

Figure 3 illustrates a single cell sensor assembly. The light emitted from a caesium spectral lamp is focused into a parallel beam before being passed through a narrow band dielectric interference filter at the D1 wavelength of 894.4 nm. The spectral line corresponding to the transition from the ground state to the first excited state is known as the D1 wavelength. The filter has been designed to pass this wavelength only, and effectively to block all other wavelengths emitted by the caesium lamp.

The D1 light is then circularly polarised before passing into a cylindrical temperature stabilised absorption cell containing partial pressures of caesium vapour at  $5 \times 10^{-6}$  torr (35°C), a krypton buffer at 12 torr and a nitrogen quenching agent at 8 torr. Transmitted light is focused onto a silicon photovoltaic diode operated as a current source. The r.f. coil providing the H1 (depumping) field is wound around the absorption cell.

A bifilar heating coil is wound onto an aluminium sleeve which sits over the H1 coil and absorption cell. The aluminium serves to eliminate capacitive coupling between the heater

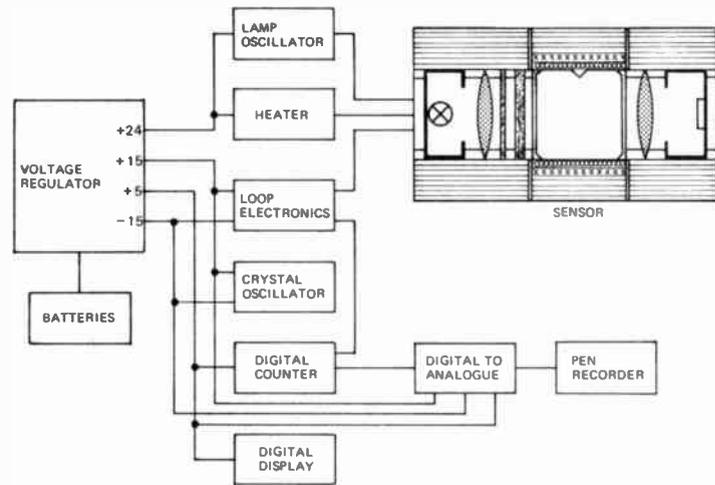


Fig. 3. Schematic illustration of the components of a single beam alkali vapour magnetometer.

and the windings of the H1 coil, and also uniformly to distribute the heating. A thermistor located on the cell surface controls a proportional ac heater circuit. The effects of thermal changes in the vapour cell principally arise from Doppler broadening of the spectral line. A thermal stability of 0.2°C is required to achieve an instrument sensitivity of 0.1 micro Gauss.

The components of the sensing unit are insulated with polystyrene foam, and encased in a resin bonded cylinder of three inch diameter and seven inch length.

### THE SPECTRAL LAMP

The spectral lamp is probably the most critical component in systems utilising optical pumping. It must be non-magnetic and extremely stable at the D1 radiation. The most satisfactory lamps at present in use consist of a small glass ampoule containing approximately 0.1 mg of natural caesium in a krypton buffer gas at 1 torr pressure. This lamp is energised into discharge by an r.f. excitation radiated from a small coil about the ampoule. The firing of the lamp is aided by strong electric fields, but the discharge is maintained more stably by high frequency magnetic excitation. An oscillator circuit capable of delivering approximately 3 watts at 130 MHz is in present use. The lamp output is servo stabilised.

### LOOP ELECTRONICS

The amplifier for a self oscillating system is required to have sufficiently high gain to compensate for the very low level of modulation of the optical beam.

A low input impedance band-pass amplifier was built consisting of four cascaded common emitter stages with feedback. The transfer impedance of

the circuit is nominally  $10^5$  volt/amp and constant phase is maintained over the working frequency range. A preset variable phase circuit follows enabling the rf field in the feedback coil to be set 90° out of phase with the optical modulation. Self oscillation will normally occur within 30° of optimum but a significant shift in the resonance frequency will result. During self-oscillation, a signal to noise ratio of 20:1 is typical with a 1 volt peak to peak signal.

### THE THERMAL CONTROL UNIT

The absorption cell in the sensor unit is thermally stabilised to  $35^\circ \pm 0.1^\circ\text{C}$  by a proportional heater. To eliminate

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# MAGNETIC FIELD MEASUREMENT

perturbing magnetic fields from the heater windings, a 50 foot bifilar element is heated with alternating current at 1000 Hz. The circuit consists of a twin Tee oscillator, with a thermistor controlling the current gain in a buffer stage. Output from the oscillator is fed into a conventional quasi-complementary, class B audio amplifier capable of delivering 10 watts into an 8 ohm load.

## THE COUNTING AND RECORDING CIRCUITS

The design of counting logic for the magnetometer is determined largely by the intended use of the instrument. For field use where a digital display in magnetic field units and a hold time of a few seconds was desirable, frequency counting is employed. But for maximum resolution with a rapid sample rate suitable for analogue recording only, a period counting circuit is simple.

## ABSOLUTE ACCURACY AND STABILITY

The absolute accuracy and stability of a single cell a.v. (alkali vapour) magnetometer is best considered separately. The absolute accuracy is dependant upon two principle factors. The first of these concerns an asymmetry of the resonance line related to the "Back-Goudsmit" effect which disturbs the linearity of the Zeeman energy levels with respect to the magnetic field. A rotation of the sensor about the magnetic field direction consequently produces a change of 6.7 Hz to the Larmor frequency in a 0.5 Gauss field. This corresponds to 19 micro Gauss. This

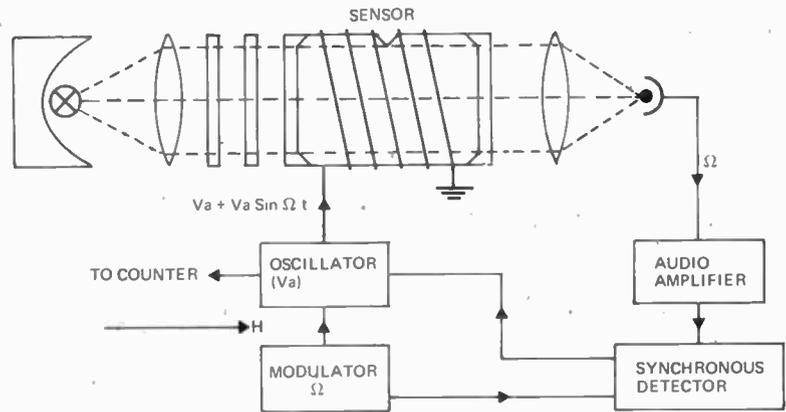


Fig. 4. The phase locked magnetometer system.

problem is in practice readily overcome by maintaining a fixed orientation of the sensor relative to the magnetic field being measured.

The second factor influencing the absolute accuracy of the self oscillating sensor is phase variation around the loop. Each sensor is calibrated when the loop phase is trimmed, and holds that calibration while the phase remains fixed. This problem has been overcome by the use of alternative sensor systems.

The maximum sensitivity of the instrument is limited by the short term stability of the sensor, which is dependant upon internal electronic noise. The expression for the rms fluctuation in terms of the Zeeman linewidth, the measuring bandwidth, the amplifier bandwidth and the signal to noise ratio of the electronics within the bandwidth yields a value of 0.01 micro Gauss. Experimental results agree with this figure.

The investigation of long period (<10sec) drifts of sensors has presented a more complex problem. After extensive comparisons, it has been assessed that an undisturbed sensor may drift through a range of 20 micro Gauss over an indefinite period, and

that a range of  $\pm 2$  micro Gauss can be expected over a one week period.

There are a number of reasons for long period drift of an a.v. magnetometer. They mostly reduce to the effects resulting from loop phase drift, lamp intensity variation or ageing of the caesium cell. While endeavour has been made to control these factors, the measured drift may be attributed to their presently remaining summed effect

## ALTERNATIVE ALKALI VAPOUR MAGNETOMETER SYSTEMS

### The Phase Locked Magnetometer

Figure 4 represents the components of the phase-locked magnetometer system. An rf oscillator is frequency modulated at an audio frequency  $\Omega$  so as to scan about the Larmor frequency. The transmitted light beam through the absorption cell is consequently modulated at  $\Omega$ . After amplification, the phase of the detected signal is compared with the initial modulating signal to determine the position of the mean generator frequency  $V_g$  with respect to the middle of the resonance line. The synchronous detector generates an error signal which is used in a control

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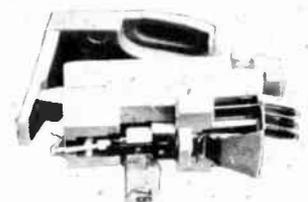
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## MAGNETIC FIELD MEASUREMENT

loop to maintain the generator frequency  $V_g$  in coincidence with the Larmor frequency. This system overcomes the phase problems encountered with the self-oscillating loop.

### THE MULTIBEAM SENSOR

It has previously been shown that asymmetry of the Zeeman splitting is responsible for the orientation dependence of the sensor. A twin cell arrangement as in Figure 5 may be used to substantially overcome this problem.

The dual cell arrangement has other very important advantages. When the single cell sensor is rotated about

180°, the phase of the feedback field has to be shifted through 90° to allow for the light beam reversing direction. The phase change becomes unnecessary with the dual cell arrangement and hence the solid angle of orientation through which the sensor can operate without adjustment is doubled. Experimentally, this is nearly  $3\pi$  steradians.

A further merit of the dual cell configuration is its noise cancelling characteristics. Fluctuations in lamp intensity, sensor temperature and related instabilities, have equal and opposite effects on either component and thus do not alter the peak resonance frequency.

A French team have combined three orthogonal dual cell magnetometers in a magnificently engineered system for airborne use. Their instrument operates in any orientation with

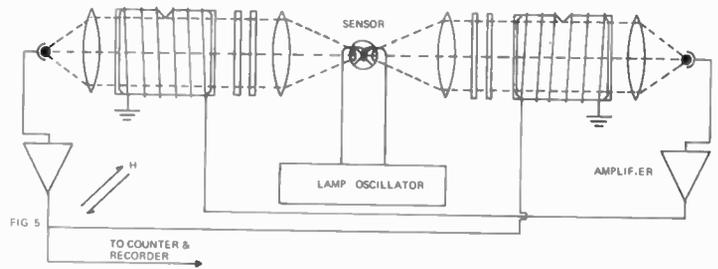
alignment error of less than 0.04 micro Gauss per degree. Each twin beam component derived pumping light from the one lamp, and depolarizing was achieved using the phase locked method. With the experimental performance figures of Table 1, this instrument must represent the ultimate in engineering of this type of magnetometer.

### The Magnetic Gradiometer

For exploration type applications a resolution of  $0.1\mu\text{G}$  is frequently a disadvantage, being too susceptible to "noise" anomalies. The excess sensitivity can, however, be put to great advantage by measuring the field difference between two sensors may 1m apart. The mathematical implications of obtaining gradient data instead of, or as well as, total field information are extensive and varied.

Fig. 5. The dual cell self oscillating system.

TABLE I	
SENSITIVITY:	0.1 micro Gauss
DYNAMIC RANGE:	0.2 - 0.7 Gauss
ORIENTATION EFFECT:	<0.04 micro Gauss/degree
TEMPERATURE RANGE:	-40°C to +50°C
THERMAL DRIFT:	<0.1 micro Gauss/degree C
POWER CONSUMPTION:	<80 watts
WEIGHT:	"Bird" - 15 lb.



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# LUXMAN SQ507X AMPLIFIER

Latest version of Lux SQ507 amplifier has some excellent additional features.

Some years ago we tested the Lux SQ507 amplifier and were impressed by its performance. We were therefore most interested to see what changes had been made in the latest version of this unit, the Luxman SQ507X.

The new model is in fact very similar to the earlier SQ507, both in appearance and general performance. Most of the features that made the SQ507 so good are retained, although the electronic protection circuit has been removed. A number of additional features have however been included.

## FACILITIES PROVIDED

The front panel of the SQ507X is a brushed aluminium extrusion with two rows of controls. It is framed by an oiled rosewood veneer timber enclosure into which the complete amplifier chassis is housed.

The top row of controls, from left to right, have the following functions:—

a) Dual concentric indexed bass

boost and cut potentiometers, with five boost and five cut positions.

b) A bass turnover frequency select switch with four positions for 600Hz, 300Hz, 150Hz and "defeat", the latter designating "not operational."

c) Dual concentric indexed treble boost and cut potentiometer with five boost and five cut positions.

d) A treble turnover frequency select switch with four positions for 1.5 kHz, 3kHz, and a "defeat" position.

e) A rotary source select switch with five positions for phone 1, phone 2, auxiliary 1, auxiliary 2 and auxiliary 3.

f) A large volume control knob with concentric ring for balance adjustment

The lower row of controls — from left to right are:—

a) Push on, push off mains switch.

b) Ring tip and sleeve socket for

headphones.

c) Toggle switch for main speakers selection.

d) Toggle switch for remote speakers selection.

e) Toggle switch for low frequency boost (6dB at 100Hz).

f) A large volume control knob with concentric ring for balance adjustment.

The lower row of controls — from left to right are:—

a) Push on, push off mains switch.

b) Ring tip and sleeve socket for headphones.

c) Toggle switch for main speakers selection.

d) Toggle switch for remote speakers selection.

e) Toggle switch for low frequency boost (6dB at 100Hz).

f) Toggle switch for low frequency cut (6dB at 70Hz).

g) Toggle switch for high frequency cut (6dB at 6kHz).

h) Rotary mode select knob with five

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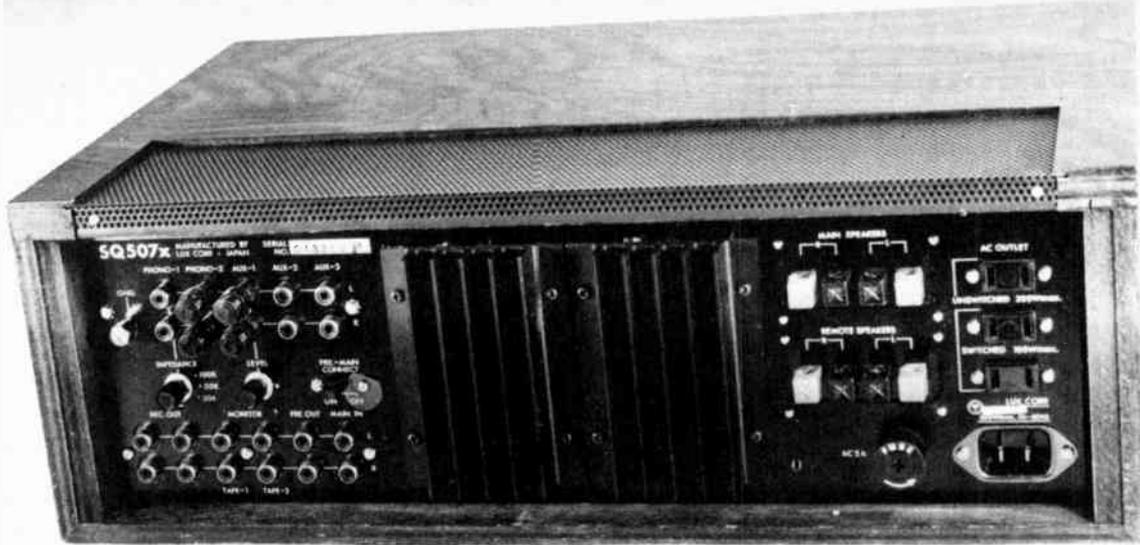
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Attenu

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## MEASURED PERFORMANCE OF LUXMAN SQ 507X AMPLIFIER SERIAL NO. 018250P

Frequency Response at Rated Output	20Hz to 20 kHz $\pm$ 1/2dB		
Power Output at Rated Input (8 Channels Driven)	54 watts		
Channel Separation at Rated Output	Auxiliary Input	100Hz 1kHz	54dB 43dB
Signal-to-Noise Ratio (Weighted with Respect to Rated Output)	Auxiliary Input		68dB
	Phono Input		52dB
Sensitivity for Rated Output	Input	mV	Impedance
	Phono 1 & 2	1.8mV	Phono 1 (variable) Phono 2 (47k $\Omega$ )
	Auxiliary 1	85mV variable	50k $\Omega$
	Auxiliary 2 & 3	85mV	200k $\Omega$
Harmonic Distortion (at Rated Output)	100Hz	1kHz	6.3 kHz
	0.3%	0.3%	0.5%
Controls Boost and Cut at 50Hz	Frequency Setting	Boost	Cut
	150Hz	9dB	9dB
	300Hz	12dB	12dB
	600Hz	13dB	13dB
Boost and Cut at 10kHz	Frequency Setting	Boost	Cut
	1.5kHz	11dB	11dB
	3kHz	8dB	9dB
	6kHz	4dB	4dB
Controls Boost and Cut at 50Hz	6dB at 50Hz		
	6dB at 10kHz		
	19dB cut at 1kHz		
Dimensions	450 mm wide x 160 mm high x 268 mm deep		
Weight	11 kg		
Recommended Selling Price	\$458.00		



- positions; mono, left channel, left plus right channel, normal stereo, and reverse stereo.
- j) Toggle switch for tape 1 and tape 2 monitor.
- k) On-off toggle switch for tape monitor.
- l) Muting toggle switch providing approximately 20dB.
- m) Combination record – playback DIN socket for tape recorder No. 2.

All input and output sockets, with the exception of a DIN socket on the front panel for tape recorder patching, are located on the rear panel. These consist of pairs of RCA sockets for phone 1, phono 2, auxiliary 1, auxiliary 2, auxiliary 3, tape 1 monitor, tape 2 monitor and main amplifier inputs. Pairs of RCA sockets are also used for tape recorder outputs and preamplifier outputs.

The preamplifier output and main amplifier input sockets are internally bridged by a slide switch located on the back panel.

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# LUXMAN SQ507X AMPLIFIER

Impedance matching selection for the phono 1 input is achieved by a small rotary switch which on the unit tested, did not align with the corresponding markings on the panel.

Speaker terminals for connecting both the main and remote speakers are of the spring loaded type and very practical. They are colour coded to facilitate phasing.

Three 2-pin American-type mains sockets are also provided on the back panel for powering other equipment. Two of these sockets are switched through the mains switch on the front panel whilst the other is unswitched.

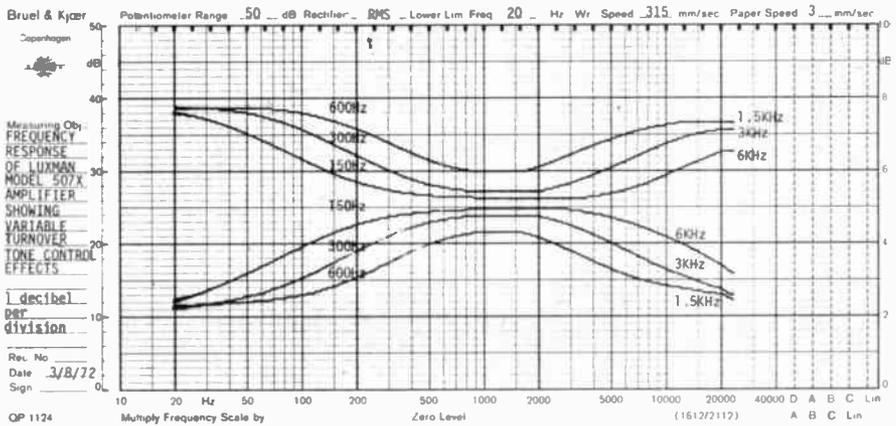
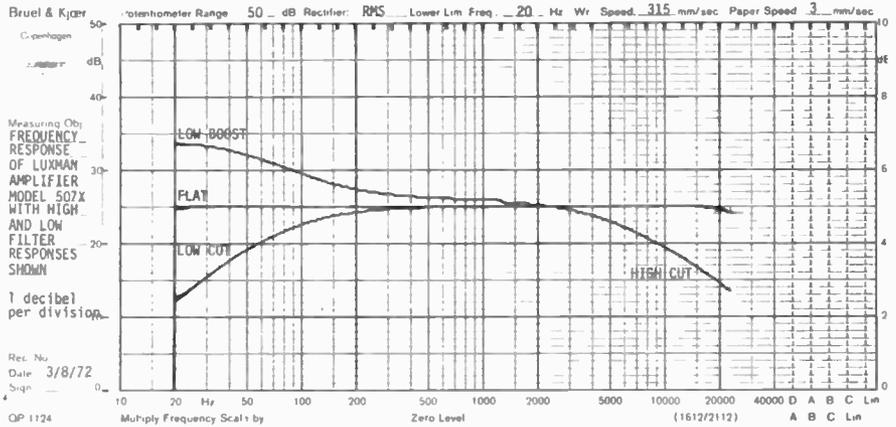
The handbook supplied was written in Japanese with a few odd figures and words in English interspersed throughout the publication. Surprisingly, the wiring diagram, details, component lists and ratings were all in English.

The internal layout of the new unit has been entirely revised and generally improved.

Firstly, each heat sink is a large multi-finned aluminium section projecting through the rear panel of the unit.

Secondly, the power transistors and the power amplifier boards are all mounted on internal sections of the heat sinks which are located over a small ventilation panel set in the base plate of the chassis. The rest of the circuitry is located on two large printed circuit boards mounted on the base of the chassis.

Fuses in each of the speaker outputs provide primary protection. These



fuses are located in the middle of the amplifier and require the removal of the chassis from the enclosure to provide access.

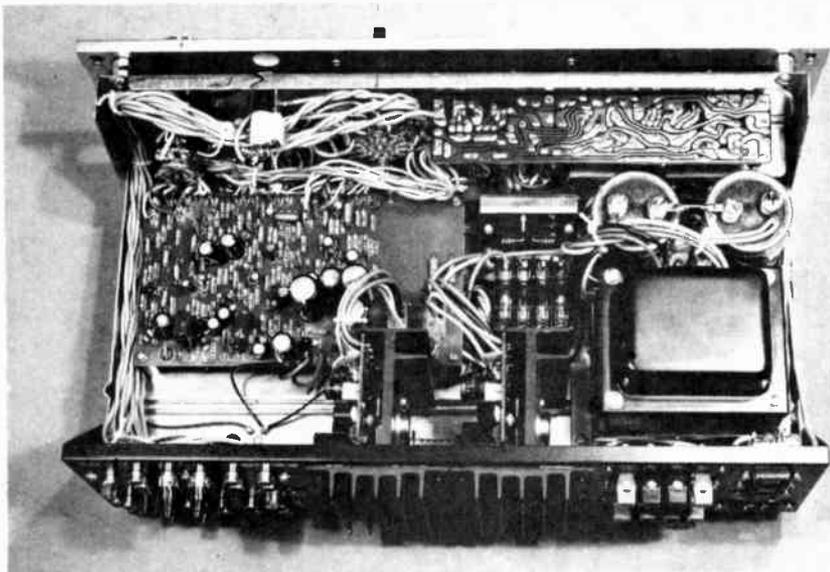
One feature which differs from the general layout used by most Japanese manufacturers is the location of the voltage selector plug inside the unit, instead of on the back panel. This

necessitates complete removal of the chassis from the cabinet to check that the voltage is correctly set, but thereafter ensures that the plug will not be accidentally altered with subsequent expensive results.

Measured performance of the amplifier was very good, with most parameters being equal to the manufacturer's stated figures as far as we could ascertain from the handbook. However the distortion at maximum output power was 0.3% which was higher than the 0.1% stated in the handbook.

At a recommended selling price of \$458, the Luxman SQ507 is clearly not for those who choose equipment on price alone. But it is to the ever increasing number of people who look at engineering features rather than just price tickets, that this amplifier will appeal.

It combines very good performance with a neat and well balanced external appearance. The inclusion of variable turnover tone controls has advantages for correcting roll-off of different speakers and room characteristics at both high and low frequencies. Also the addition of a second set of record and playback tape recorder sockets is in keeping with the latest trends. ●



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Supply current	0.65 amps	0.8 amps
Price plus 20c post	\$8.50	\$13.50

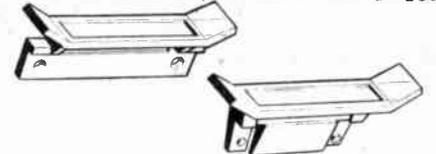
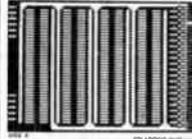
Data sheet supplied with each unit - only limited quantities available.

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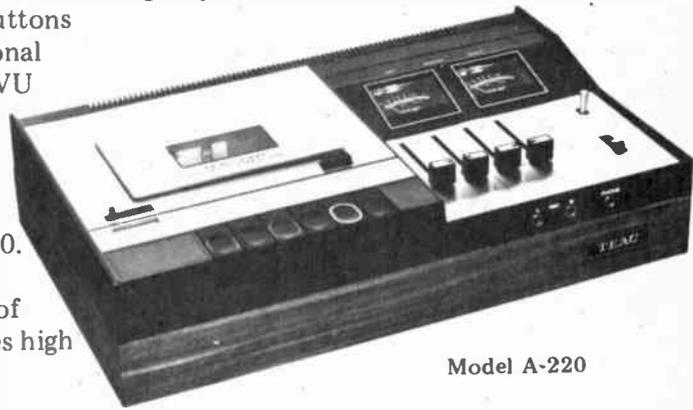


Model A-210

If all you need is a basic superior deck that can economically record and playback on conventional tape within a frequency response range of 30-12,500Hz, you'll want to look into the A-210. It's outer rotor drive motor holds wow and flutter down to a negligible 0.15%. Separate stop and eject buttons. Low-noise solid-state electronics. Contoured fingertip-control pushbuttons for all operational modes. Large VU

meters. Sliding scale record-playback level controls. Standard phone jacks for professional-style 600-ohm mikes and 8-ohm headsets. Strobe-type running light.

If you're looking for a deck that can handle the new chromium dioxide tapes, you should look into the TEAC A-220. It has the add-on feature of a tape selector switch in the CrO<sub>2</sub> position, provides recording and playback frequency response of 30-16,000Hz. As an added convenience, the A-220 incorporates high density ferrite heads and separate record and output level controls.



Model A-220

But if you're looking for the definitive Dolby deck with everything you need for near-professional operation, only the A-250 will do. It has TEAC's high-density ferrite heads. These "brown jewels" are so extraordinarily durable that we warranty them for the original owner's lifetime. Add to these a Type B Dolby System that improves the basic signal-to-noise ratio of the A-250 by an additional 10 dB.

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Model A-250

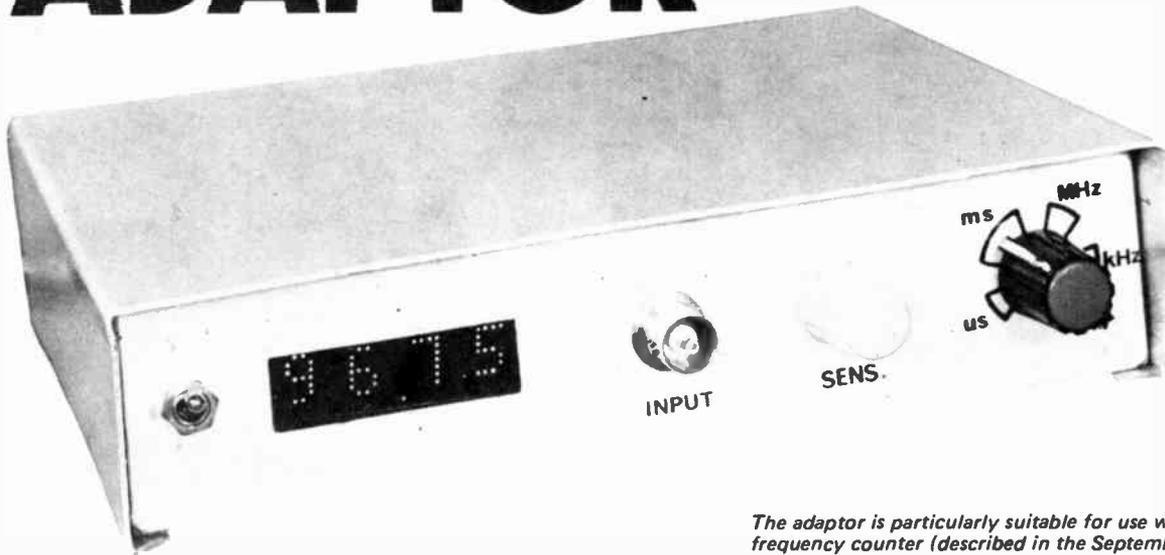
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AMI 144/R

# FREQUENCY COUNTER/DVM ADAPTOR

Simple adaptor enables digital frequency counter to be used as a DVM.



The adaptor is particularly suitable for use with the ET1 digital frequency counter (described in the September '72 issue of ETI).

**D**IGITAL voltmeters consist of a suitable scaling circuit and amplifier, plus circuitry for converting the analog level to a digital representation of that level.

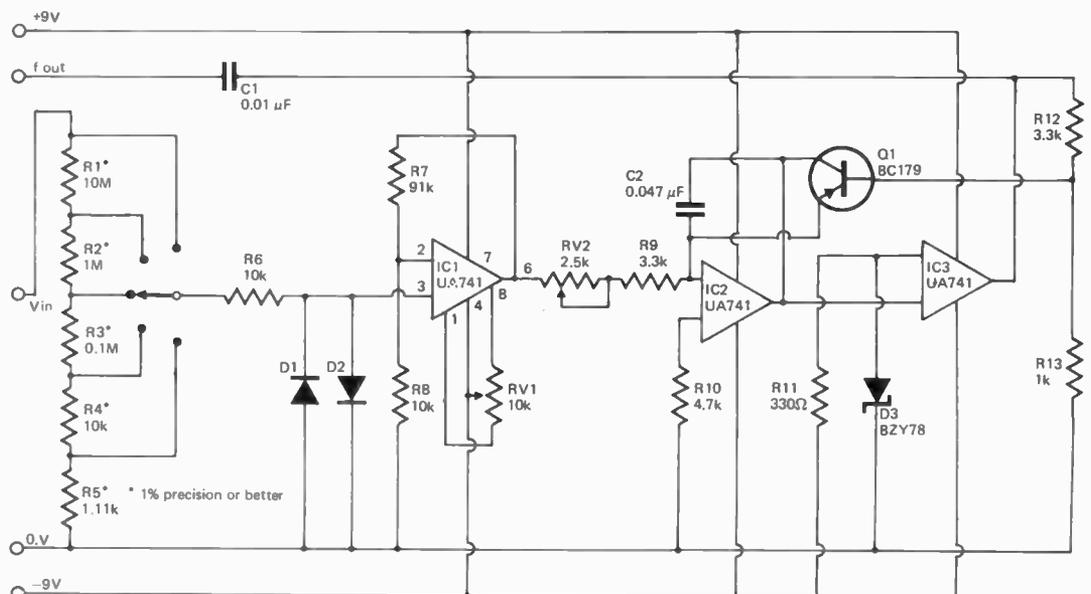
A substantial amount of the circuitry required is incorporated in digital frequency meters — such as that described in the September issue of Electronics Today International — and

if a suitable attachment is used, these units may be used as DVM's. This circuit — devised by one of our Canberra readers does just that.

The voltage to be measured is applied via a scaling circuit and high impedance input amplifier, to a linear integrator which produces a ramp voltage with slope proportional to the unknown voltage. The integrator

voltage is compared with a stable reference and when the two are equal, the integrator is reset. The resetting frequency is thus proportional to the unknown voltage and this can be measured with the digital frequency counter to give a digital voltage reading.

The input scaling network is a voltage divider comprised of precision



resistors R1 to R5. The division ratio is switch selectable from 1:1 to 1:1000 giving input voltage ranges of 0.1V, 1.0V, 10.0V, 100V, 1kV to produce a voltage of 0.1V at the input to IC1.

IC1 is connected as a non-inverting high impedance amplifier with a gain of approximately 10. Because of this high impedance (greater than  $10^9$  ohm) the impedance seen by the voltage being measured is constant at 10M regardless of the range selected. The input of IC1 is protected against accidental overvoltages by R6 and the silicon diodes D1 and D2.

The output of IC1 is passed to IC2 which is connected as an integrator to produce an output voltage ramp with slope proportional to applied voltage. The values of RV2, R9 and C2 have been chosen to give a slope of approximately  $-5V/ms$  with a nominal +1V input.

IC3 is connected as an open loop amplifier with the integrator output applied to the non inverting terminal and a  $-5.3V$  reference voltage to the inverting input. When the integrator output is more positive than the reference, the amplifier is saturated with an output of about +8V; when the integrator is more negative, the output changes to saturation at  $-8V$ . Due to the high gain of the IC, the change occurs over an integrator voltage change of less than 0.3mV.

As the integrator output triggers the comparator output to go negative, transistor Q1 is turned on, shorting the integrator capacitor and returning the integrator output to zero. The comparator output is therefore a series of narrow negative going pulses at a rate proportional to the voltage to be measured; this is provided as an output to drive a frequency counter.

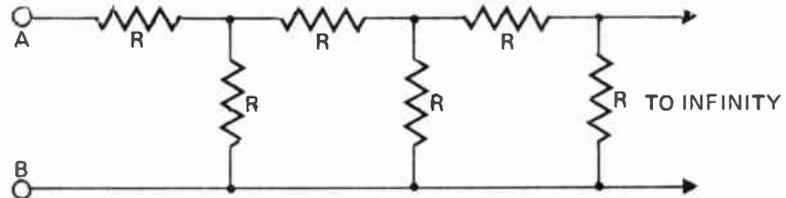
Potentiometer RV1 is connected across the offset null terminals of IC1, and is used for zero adjustment, counteracting the effects of the offset voltages of IC1 and IC2. It is adjusted to give a level integrator output voltage with the input shorted.

RV2 controls the integration rate and is the calibration control of the instrument. It counteracts the effects of variations in the values of C2 and R9 as well as IC3 offset voltage and D3 Zener voltage. It is adjusted after RV1 to give an output frequency of 1kHz for an IC1 input voltage of 0.1V.

Whilst 0.1V has been specified as the input for f.s.d., the circuit will accept over-range voltages without any adjustment, the limiting factor being the threshold voltage of the input protection diodes.

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# COMPUTERS IN BANKING

*Millions of cheques to be sorted each day – over 20 million accounts to be maintained. That is the situation in British Banks today. To cope, the major banks now use mammoth data-processing centres that soon will be direct on-line to all branches throughout the British Isles. To find out how their plans have advanced, Electronics Today International arranged special interviews with staff of two of the Big Four, National-Westminster and Lloyds Bank. In this report, Dr. Sydenham describes the vast undertakings being implemented to provide more efficient service.*



Fig. 1

*"I want to take three dollars out of my current account and put 90 cents into my deposit account. No, 50 cents into my current account and 27 cents into my savings account. Or maybe I should put the whole lot into the savings account and transfer a couple of dollars from my deposit account into my current account, because I've got these bills to pay and..."*

THE foundations of banking can be traced way back to times when people needed to barter product for product but found the method inappropriate when the goods were impracticable to transport. Trading goods direct gave way to the use of money systems in which an intrinsically valuable commodity was used to represent the value of the goods. Gold, silver, shells, even stones with holes have been used.

In Babylonian times, temple treasuries safeguarded money on behalf of its owners. In Roman times silver dealers carried out international money trading. Gold always has been sufficiently scarce to remain valuable, and in the Middle Ages goldsmiths acted as bankers, issuing paper receipts for entries of gold paid to them. It was logical that trading just in the receipts followed, for this avoided the need to transfer gold. It was confidence in the knowledge that there was wealth to back the receipts which enabled banking to grow.

These goldsmiths receipts were, in fact, an early form of banknote and these people gradually became bankers. Goldsmiths from Lombardy in Italy, where this development originated, settled in London, and today Lombard Street is still the centre of banking. Other forms of viable transfers were created along with bankers receipts and today the majority of monies transfer via the cheque.

In Roman times, comparatively few of the then small population of Britain would have needed to bother about trading at a sophisticated level. By contrast, today in the British Isles there are an estimated 21 million active accounts operating. National-Westminster (one of the larger of the Big Four in British

Banking — the others are Barclays, Lloyds and Midland) have, for instance, seven million operating accounts. Entries into Lloyds five million odd accounts run into 400 million a year. Yet everyone expects absolute accuracy (Fig. 1) in the account keeping down to the smallest legal currency unit and with immediate recall.

A cheque received by a creditor is paid into his or her bank for crediting against the appropriate account and then for debiting against the person using it. Two banks are, therefore, involved with each cheque issued. With so many active accounts, it is easy to see that an enormous number of cheques are in transaction each day. The task of clearing the cheques and adjusting the accounts both ways is performed by certain clearing banks which are set up with special facilities for this type of work. Lloyds handle one million cheques a day, National-Westminster 1.25 million. At times four million are cleared.

Conventional banking consists of passing cheques from one bank branch to the other for debit purposes. This is very inefficient from the labour point of view due to the large number of cheques concerned and the high growth rate (6% per annum) of accounts. However as much of this work is of clearly defined routine nature, it is suited to automatic data processing methods using digital computers.

In the mid 1960's, the major British banks started organization programmes designed eventually to provide central data-processing systems connected on-line (that is able to be connected immediately when desired) to all branches of the bank. British banking was able to make efficient use of the technique for banks have branches which are comparatively close to each other and in which large volume business is experienced.

Although banking is regarded as a conservative enterprise, the change to computer operation was adopted

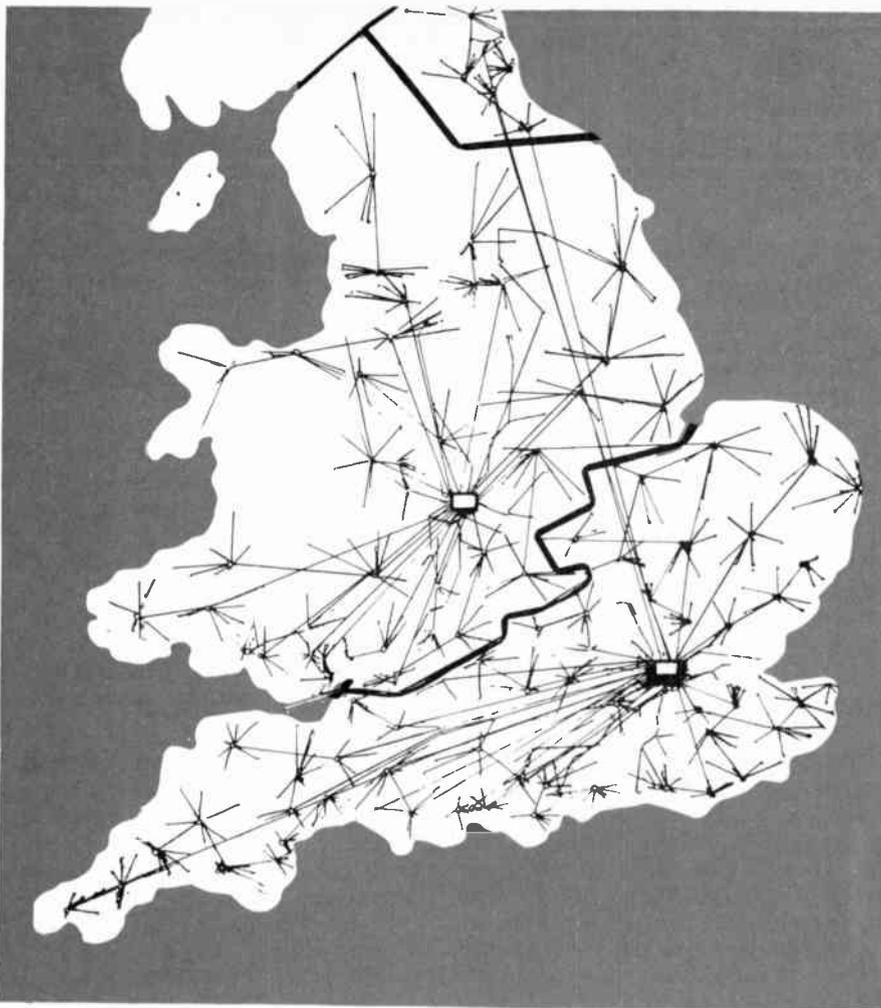


Fig. 3 Information is transmitted between branch offices and the London or Birmingham Computer Centres. This schematic map shows how branch terminals and centres are linked by telephone line.

without serious opposition, for the task of performing routine monetary operations was taxing human resources and capability for few employees find that aspect of banking rewarding. The Big Four have each installed sophisticated and powerful data processing centres.

The aim of these huge investment programmes (about \$150 million has been involved so far) is ultimately to provide direct, remote access to records from any branch of a bank no matter where it is located. These plans are nearing fulfilment now. For example, of National-Westminster's 3000 plus branches, 1100 are now on-line and the remainder should be connected by 1974. But bank business involves more than cheque clearing and sorting, and other services including registration of companies, trusteeship and investment portfolios have been computerized. To provide these functions has required the

creation, and continuing expansion, of some of the largest data-processing centres in the world.

### CLEARING AND SORTING CHEQUES

The reconciliation of cheques involves intercommunication between the two banks involved and hence there are practically innumerable cross-combinations between the many banks in existence. To handle these cross-combinations an institution, recently renamed B.A.C.S. (Banking Automated Clearing System), has been set up in which some of the larger banks provide clearing facilities on behalf of them all.

Cheques arrive at the clearing banks in random order and require sorting.

This process is largely automated using, in the main, IBM 1419 cheque reader/sorter machines (as shown in Fig. 2.) In these a pile of cheques is placed in the input chutes. They slide off one by one from the bottom of the pile at 1600 per minute and are transported horizontally for reading



Fig. 2 — Cheque clearing in the City Computer Centre

# COMPUTERS IN BANKING

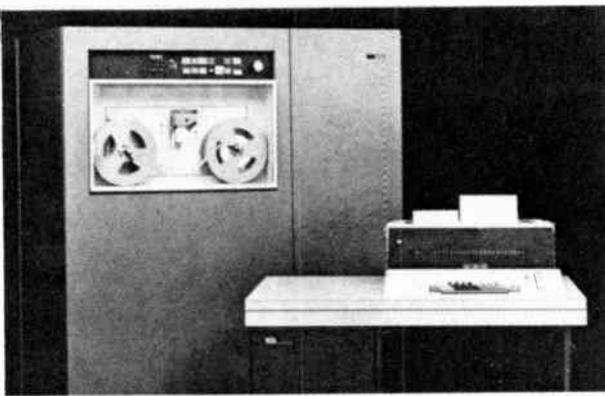


Fig. 4 - The 3981 computing concentrator cabinet and 3982 keyboard terminal at a typical on-line branch.

and sorting. Before processing, each bank encodes the amount of the cheque in a manner similar to the account number so that the magnetic sensors can read the number and cheque value. As the cheque moves across, the ink is magnetized, then the value and account number are read and stored for account adjustment. Finally, the cheque is fed into the appropriate out bin.

Many machines like this are needed to handle the vast quantities of cheques. National Westminster use a row of 17 of which 13 are coupled on-line to the computing power of the centre. Visual display units (V.D.U's) are placed at strategic locations to assist the machine operators. A small army of personnel cope with the machine-unacceptable cheques in a manual reconciliation area.

## ON-LINE NETWORKS

It was one thing to decide that all branches should be put on-line and another to do it, for it was not entirely a bank decision. Communication by radio or telephone between centres and other geographical locations is, by law, General Post Office controlled (G.P.O.).

Various methods were investigated. Lloyds, the first to have all of their accounts centrally processed, used a mixture of on-line terminals and special messenger-transported paper tape communications. It took them four years to achieve this and it was completed in October, 1970. It is, however, not entirely on-line but by 1974 they hope to be without any tape links.

The organisation of the networks are basically similar for each of the banks involved. Figure 3 shows a schematic map of the double shell-burst configuration. Two main centres (two have been chosen as optimum) house the data processing equipment and the many computers involved. From the centres run lines, rented from the G.P.O., over which data can be sent and received in a compatible form from outlying concentrator branches. These, as the title implies, pack up the data into high time-density form from the surrounding branches.

At a typical on-line branch will be found an IBM 3980 bank teleprocessing system. This system, seen in Figure 4, was developed by IBM specifically to cope with future demand in banks. It consists of two

units, a 3981 computing concentrator and a 3982 keyboard terminal. Each concentrator unit can accept up to ten keyboard terminal links and contains computing circuitry and storage facilities for data used to control the terminals and the flow of data between them. Each has magnetic-core memory capable of storing 8196, 16 bit words (a bit is the smallest piece of computer logic and can be in only one of two states: a word is a set of bits, usually sixteen in length but some times longer). The memory facility enables the concentrator to have its own permanent programme built in, and this can be altered to suit the changing needs at a particular location. More recent concentrators can accept up to 16 terminals.

Telephone lines are used to connect the keyboards to the concentrators and concentrators to the central processing unit (C.P.U.). This way smaller branches operate into larger ones using low speed lines. For example, each keyboard terminal needs 147 baud lines (the baud is a unit of transmission speed and is near enough the number of bits of binary data received in a second). A concentrator to C.P.U. (Central Processor Unit) line is graded at 1200 baud.

Not all banks use IBM equipment. National-Westminster have Burroughs terminals connected into IBM concentrators. Their network has at present 180 concentrators needing 90 main line G.P.O. links.

## COMPUTING AND DATA PROCESSING CENTRES

London is a natural choice for the first centre, the other somewhere central: Birmingham for Lloyds and soon Kegworth for National-Westminster. At present National-Westminster uses four centres in London

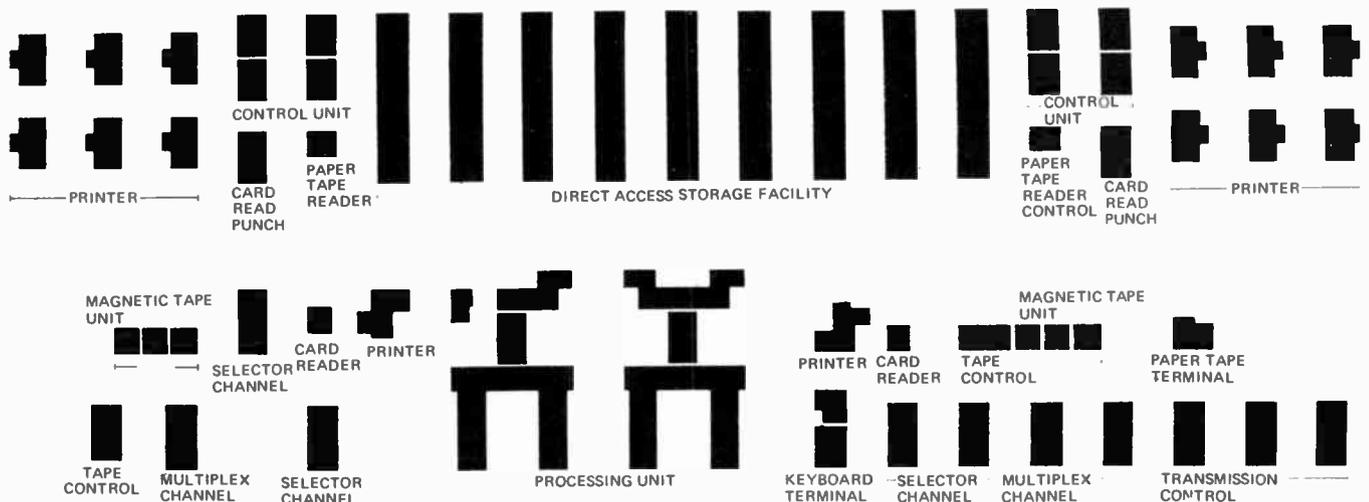
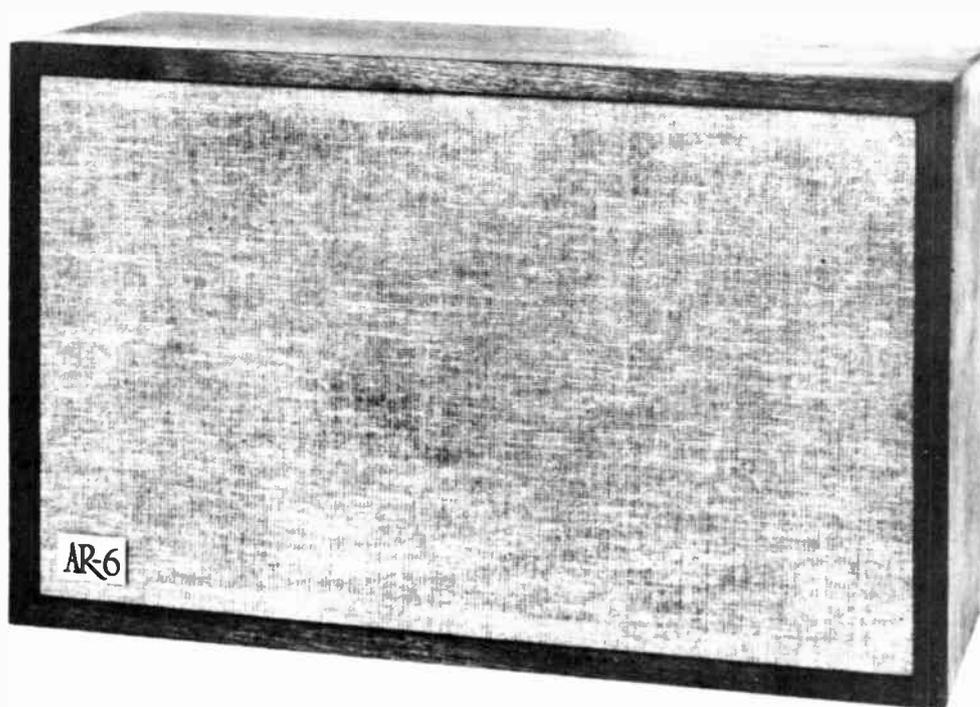


Fig. 5 - Layout of Lloyds DP centre in London (which has now been expanded still further).

# The AR-6 speaker system from Acoustic Research.



The least expensive speaker sold by AR (the AR-4x at \$132) is also the most widely sold of all high-fidelity speakers, because it has provided maximum performance per dollar of cost. The new AR-6 offers significantly better performance for \$180. It adds one-third octave of low distortion bass, and also provides superior dispersion and more uniform energy output at high frequencies. The seven inch depth of the AR-6 adapts it ideally to shelf placement, or it may be mounted directly on a wall with the fittings supplied with each speaker system.

#### **Stereo Review says . . .**

"All in all, the AR-6 acquitted itself very well in our tests. It was not quite the equal of the much more expensive AR models, whose sound it nevertheless resembles to an amazing degree, but on the other hand it out-performed a number of considerably larger and far more expensive systems we have tested in the same way. Incidentally, the AR-6 shares the AR characteristic of not delivering any bass output unless the programme material calls for it. If at first hearing it seems to sound "thin" (because it lacks false bass resonances), play something with real bass content and convince yourself otherwise. We don't know of many speakers with as good a balance in overall response, and nothing in its size or price class has as good a bass end."

#### **High Fidelity says . . .**

"Another great bookshelf speaker from AR . . . a really terrific performer. The AR-6 has a clean, uncoloured, well-balanced response that delivers some of the most natural musical sound yet heard from anything in its size/price class, and which indeed rivals that heard from speakers costing significantly more . . .

The response curves taken at CBS Labs tell a good part of the story. Note that across the largest portion of the audio spectrum and especially through the midrange the AR-6 responds almost like an amplifier . . .

Directional effects through the treble region, as evidenced by the average of 2dB that separates the three response curves, are actually less pronounced than we've seen in some costlier systems. Tests made of the effect of the tweeter level control show that it can vary the response from completely minus the tweeter to a steady increase in tweeter output of about 2 dB across its range. The design in this particular area is just about perfect . . . Pulse tests indicate virtually no ringing; in fact the AR-6 seems better than average in this regard too.

. . . a pair of AR-6s would be an excellent choice."

The workmanship and performance in normal use of AR products are guaranteed from the date of purchase; 5 years for speaker systems, 3 years for turntables, 2 years for electronics. These guarantees cover parts, repair labour and freight costs to and from the factory or nearest authorised service station. New packaging, if needed, is also free.

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WD 21/PP

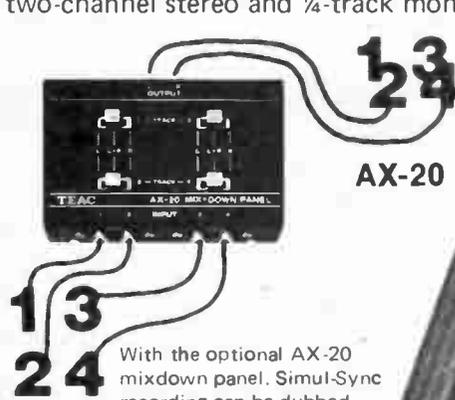
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# COMPUTERS IN BANKING

and four in the provinces. This inheritance from a bank merger in 1970 (National-Provincial, Westminster and District amalgamation) is rapidly being phased out to leave only Woolgate House and Kegworth plants.

Layout in the centres differs somewhat. National-Westminster's Woolgate House has equipment installed on a three-dimensional plan using five floors. Lloyds use a single floor two-dimensional layout in their London Computing Centre.

On the seventh floor of Woolgate House are 100 punched card machines where 125 people produce 200,000 cards a week. Below on the sixth floor are 35 tape units, switching units and the main tape library with its 3500 tapes.

The fifth floor is used to site the central process units and the core of the four IBM 360/65 computers. Here, also, are eleven printers, racks of modems (the G.P.O. device for connecting lines to digital equipment), a rather older but still useful IBM 1800 computer used for scheduling work loads, and seven IBM 2703 polling devices. The latter continuously scan the incoming lines, sampling them and connecting them so as to use the computers at maximum possible efficiency.

Down yet another floor is an IBM 360/50 computer system that 'stands-alone'. This work horse, as it has been called, is a self-contained computing unit working quite separately from the main C.P.U. On this floor are 23 IBM 2314, direct-access, disk storage facilities and 8 unusual data-cell storage units also made by IBM. Each disk unit has nine packs of which eight are normally useable. Each pack stores close to 30  $10^6$  bytes (a byte is a term for an 8 bit long character) so in disks alone there are over 10,000 million bits of storage. But even this is overshadowed somewhat by the capacity of the data cells, for each stores over 3000 million bits in just 18 inches by 15 inch diameter. These revolutionary design stores consist of short magnetic strips that normally hang from one end. When needed they are lifted out, wrapped on a read/write drum for use and are then thrown back into storage. The eight units are used to store historical data not put onto disk. Also, on the fourth floor are two Datagraphics machines which transfer data from magnetic tapes onto microfilm at a rate equivalent to 65,000 lines per minute. These films go to a micro-film library.

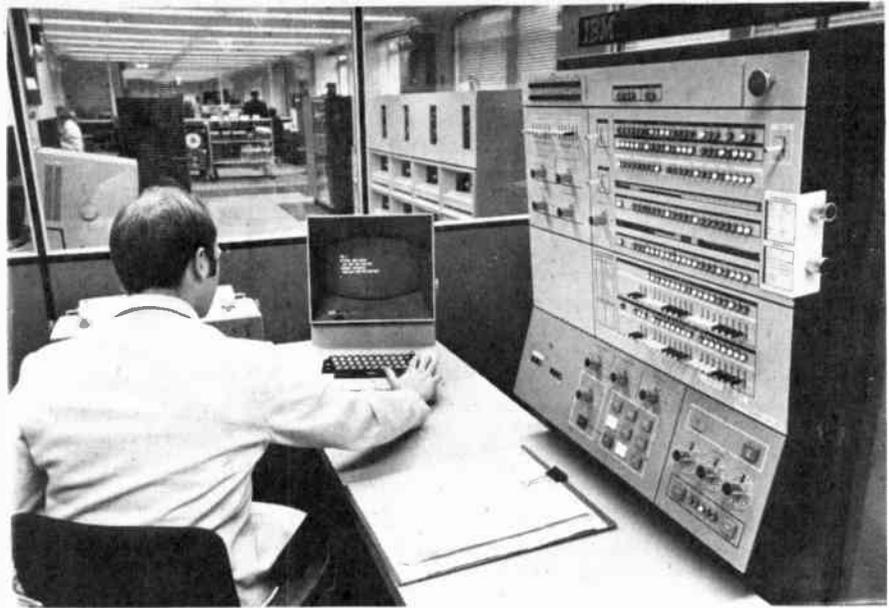


Fig. 6 — A view of Lloyds computing centre showing, in the foreground, one of the computers and an operator communicating with a VDU via a keyboard and, in the background, the disk stores and tape peripherals.

Finally, on the third floor are 17 cheque reader/sorters and the three IBM 360/40 computers that control them.

It is easy to see why this centre is regarded as the largest in Europe — it has twice the capability of that used to control a moon-shot!

A floor plan of Lloyds London centre is shown in Fig. 5. This equipment connects two IBM 360/65 units to the branches. Lloyds also have a separate cheque clearing operation.

## THE COMPUTERS

It is interesting to look at the computational power available in these banking centres. It is not entirely correct to compare computers by simple definitions for no really common criteria exist. The peripherals and the way they are used very much decides the actual capability. For simplicity, however, a starting point can be made by stating the time it takes to cycle a storage bit, that is to read in and read out at a position. The other quality of general relevance is the quantity of storage available in the computer itself. The disks, tapes, data cells and punched cards are supplementary storage. It is more common to use a character size element (a number of bits defining say a decimal number using binary storage) rather than bits direct so most figures are quoted in decimal characters or bytes. Another factor is that cores can be interleaved so that the time constants of a store core are overlapped to obtain an effectively faster core cycle-time.

At present the best commercial cycle time is around 100ns but experimental units exist to operate in less than 1ns. The 360/65 units, used as the main computer, (see Fig. 6,) in both Lloyds

and National-Westminster, have a cycle time of several hundred nanoseconds and some 2 million bytes capacity. A number are used together as a group to provide a work load as near as practicable to the theoretical machine capability. The 'stand-alone' 360/50 system, cycles in 500 ns and has half a million bytes storage.

Compare these figures with the early IBM 1620 machines with only 20k decimal (k here is the nearest binary equivalent to 1000 which is 1024) character storage and a cycle time of 20 $\mu$ s to carry out simple operations.

The 360 series has recently been superseded by a 370 series. The Kegworth centre of National-Westminster is currently being fitted with two 370/165 units which have the capability to do at least the task of four 360/65 machines.

## SECURITY

Centralisation of data creates the need to provide utmost security of the plant and records. All data is duplicated, even triplicated, and the sets stored separately at different locations. Branches also have their daily records always available.

Getting into the centre at Woolgate House is like entering a top secret military establishment. Each entry is policed and those entering must wear an identification tag. Only those issued with magnetic door lock pass cards can open the doors.

## WHAT ON-LINE BANKING MEANS TO THE CUSTOMER

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**WEST AUST. AGENT:** B.P. Electronics,  
192-196 Stirling Terrace, Albany. W.A.  
6330. Ph. 41-3427.

**VICTORIAN AGENT:** Geo. Hawthorn  
Electronics, 966-968 High St., Armadale.  
Vic. 3143. Ph. 509-0374.

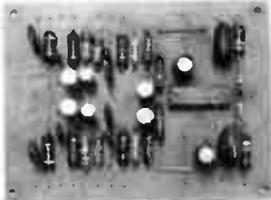
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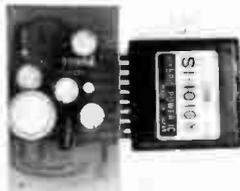
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A superior low-noise stereo pre-amp, available as Model MP-5, RIAA equalised for magnetic cartridge or MP-6, NAB equalised for tape head playback. Specification: Voltage gain 34db, Input overload point 100mV rms, Output voltage swing 5V rms, output noise level 70db below 10mV phono input. Voltage range 9-15V DC requires plus and minus power supplies or 18-30V DC single supply. Complete Stereo Kit price — \$6.50., post 25c.



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Specifications: Noise level — 92db below 1V on any channel, Distortion — 0.05% or less at 1V rms output, Gain of +6db on the two front channels, controllable from -7 to +6db on the two new channels, and frequency response of +0.5db from 20Hz to 20KHz at 1V RMS output. It may be connected to any 2 Stereo Amplifiers and many be fed from a Magnetic Cartridge or other similar source. Ideal for use with our MOD '73 series Stereo Amplifier Systems. Operates with a +15V and a -15V power supply. PRICE — \$31.50., post 50c.

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**IMPROVED MODEL** — Now with plug and sockets for changeover to standard ignition

### DECODER FOR FOUR CHANNEL SOUND

This simple Decoder Unit, which appeared in the November issue of "Electronics Australia", will allow you to go 4 Channel without going for broke. Simply connect the input terminals to your present stereo amplifier speaker terminals and the output to a second stereo amplifier or tape recorder amplifier and the decoder will then synthesize rear channel signals either from existing records or the new quadraphonic pressings. A simple kit and very easy to assemble, it is complete with P.C. Board and all components. Requires 20V supply. Price \$5.90 post 30c.

## COMPUTERS IN BANKING

data as it is collected to the centre where it is processed and stored. During the early hours of the morning each branch is sent the balance statements and other information for the guidance of the branch staff. So each day a detailed statement can be called up in no more than 30 seconds: a statement of account takes 3.5 seconds. The manager can request a detailed list of over 50 particulars about an account to aid his judgement. He also gets a list of overdrawn accounts as matter of course. Staff are, therefore, released from many of the monotonous tasks of traditional banking.

Other novel procedures can be introduced if on-line operation is generally available. Take, for instance, the automatic cash dispenser facility soon to be launched by Lloyds at branches which are on-line. At present most banks in Britain operate a cash card system whereby a special plastic card is used to obtain cash from a machine. The difficulty is that it is hard to ensure that the system is not cheated and equally important from the bankers' point of view that there is money in the account to cover the withdrawal. To prevent fraudulent use, the service is restricted to only small sums of money.

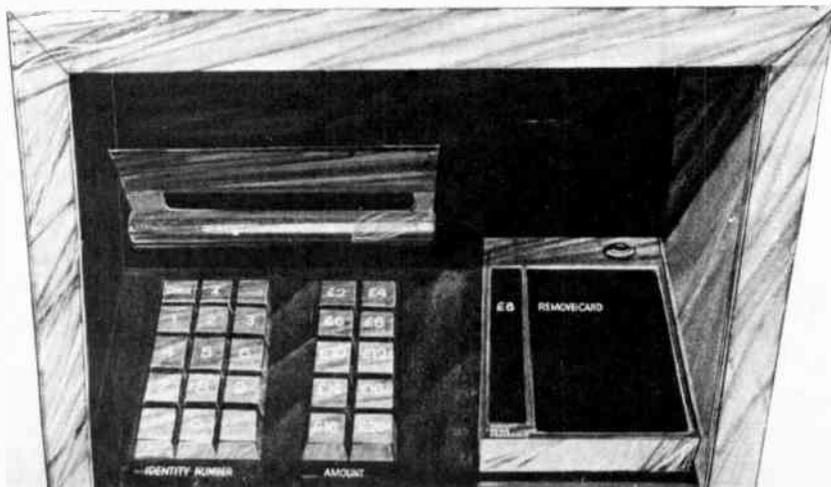
The new Lloyds dispensing units (shown in Fig. 7), overcomes most of the objections because it is on-line coupled to the central records. A customer inserts his personal card into the slot. If accepted, the keyboard on the left is uncovered ready for use. He then keys in his personal four-digit

number (known only to him and his bank) and the amount required. Within forty seconds of starting the process he has his money which appears in a tray. In that time the amount required has been checked against the account, the account updated and a signal sent to operate the cash tray. This facility will enable withdrawals at any time and at any branch, provided the balance is there. Initially, not all branches will have them, but by 1974 all banks could be offering this service. A later plan of Lloyds is to enable deposits to be made the same way.

The impact of data processing is very apparent in this application for already we see the routine work of banks being put onto machines without the need for bank officials on a counter. So far the computer has enabled us to keep up with expanding business in banks but there are those who feel that something superior to the cheque system is needed to further stream-line finance.

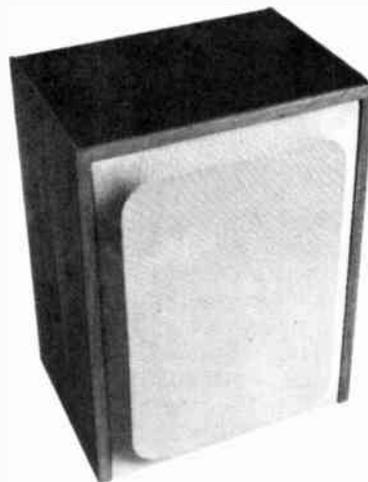
Hargreaves, the Director of Public Affairs at IBM in Britain, gave a talk in 1969 entitled "Computers in the world of change". In it he brought the fast changing nature of our existence into meaningful terms. One of his examples is a fitting end to this report. He said:— "We can represent the history of the last 50,000 years by the life-span of some 800 people. Of these, 650 would have lived in caves, only 70 would have had some proper means of communication, six would have been acquainted with the printed word and just four would have been able to measure time accurately. The majority of the discoveries which contribute to our material well-being have been made in the life-time of the 800th, and the 801st can expect to experience more changes in his life-time than in those of all preceding 800." (A similar comment is also made by Alvin Toffler in his book "Future Shock" — Ed).

Fig. 7 — A typical Lloyds automatic cash dispenser.



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# RADIO ASTRONOMY FOR AMATEURS

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## PART XI

Further practical advice on the design and construction of suitable antennae.

Small and medium scale and quad-Yagi antennae are described in many of the currently available antenna handbooks. But large scale arrays of this type are rarely mentioned.

'Amateur Radio', June 1967 carried an article on long quad-Yagis written by Ian Berwick, VK3ALZ. Practical construction details and dimensions were given. A subsequent article in the 'Victorian VHFer', May 1972 and '6UP' for September 1972 (Journals of Victorian Div. W.I.A. VHF Group and former journal of N.S.W. Div. W.I.A. VHF Group respectively) gave details of a very large array for 144 MHz developed by VK3ALZ. It had a measured gain of 19dB (from pattern measurements). We recommend that you read these articles as the information is excellent.

These antennae are well suited to radio astronomy as a large gain can be

achieved with a boom length almost half that for a conventional quad. Front-to-back ratio is excellent and sidelobes are well down. They are less critical of construction inaccuracies but cost somewhat more than an equivalent conventional Yagi. Dimensions can be readily scaled to other frequencies. The chances of getting a quad-Yagi to work correctly are probably better than for a conventional Yagi.

### THE RHOMBIC ANTENNA

This antenna is often mentioned in texts as suitable for HF use but dimensions for use in the middle regions (i.e. 140 MHz) of the VHF bands make it almost unusable for rotating — unless you have lots of space and mechanical ingenuity.

Gain is excellent and the antenna is nearly aperiodic (i.e. wide band) if terminated as shown in Fig. 1. The

terminating resistor should be a carbon type only. Wire wound resistors have too much self-capacity and inductance. A ½ watt type will serve the purpose nicely.

Not too much slack should be allowed in the legs — keep them taut but not strained. This type of antenna can be built and erected in an afternoon.

The feed impedance is quite high, 800 ohms, so that matching will be necessary followed by a balun if coaxial cable is used.

To avoid the matching problems and associated feedlines etc. an RF preamplifier could readily be designed to accept the high impedance balanced antenna feed.

Heavy gauge wire or heavy duty hookup wire is recommended for construction of the rhombic.

Even if this antenna is made quite small, such that only three wavelengths per leg is used, quite good performance can be achieved. But the rule 'the larger the better' generally applies.

Rhombics can be stacked and fed in phase just like most other antennae — but this limits performance to single frequency operation. A stacking distance of a half wave length is recommended.

Vee-beams can also be used but the rhombic is more useful as Vee-beams have terminating difficulties (see the texts mentioned).

Full design details for this antenna

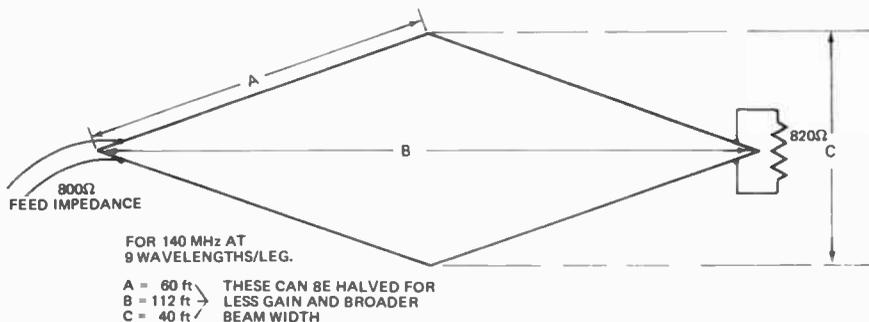


Fig. 1. Rhombic Antenna for 140 MHz.

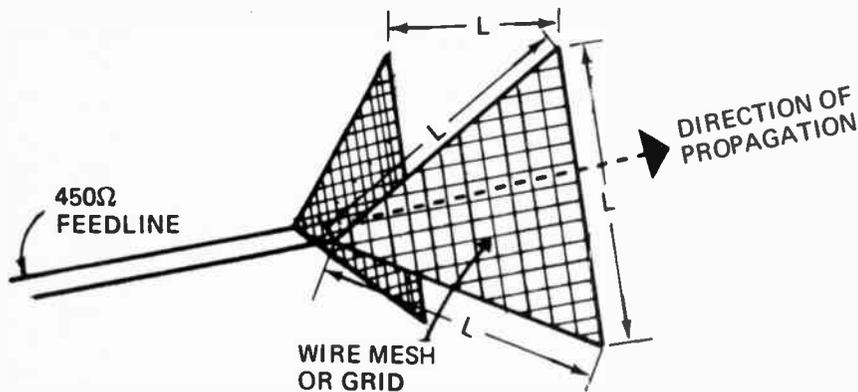


Fig. 2. The Skeleton Horn Antenna

can be found in "The ARRL Antenna Book", "The Radio Amateur's VHF Manual" (by the ARRL) and the British "Services Textbook of Radio, Vol.5, Transmission & Propagation".

### THE SKELETON HORN

This is a broadband antenna adapted from microwave practice where it is much used in conjunction with waveguides. An illustration is given in Fig. 2.

The skeleton horn is unidirectional with only one major lobe. It 'fires' out of the open end.

The sides of the antenna can be made from wire mesh or a grid stretched over a wooden or metal frame. If the support is sturdy enough, the sides can be made of sheet metal.

Gain increases with frequency. An extra 6 dB is added every time the frequency is doubled. Low frequency cutoff is governed by the side length, gain being very low when L equals a quarter wavelength.

The feed impedance varies with frequency, generally being between 400 to 500 ohms.

If L - 10ft, gain at 140 MHz will be about 12 dB. If L - 20ft gain at 140 MHz will be about 18 dB.

Again these antennas can be stacked, but this limits them to single frequency (or harmonically related frequency) operation.

### THE PARABOLIC REFLECTOR OR DISH

This is probably the most widely used antenna in radio astronomy. Grote Reber's pioneering work in radio astronomy was done with a home-made 30ft dish. The unwieldy beast he used was made from wood and galvanised iron sheets and now resides in an American science museum.

An excellent constructional article by Cyril Edmonds, VK3AEE was published in the June issue of

Impedance Multiplying Factor	Ratio S/D1	Ratio S/D1
2	40	3.0
	20	2.4
	12	2.0
	10	1.8
	5	1.5
3	2.2	1.5
	3.3	2.0
	4.0	2.3
	6.0	3.0
	10.0	4.4
	15.0	5.7
	20.0	7.0
4	40.0	12.0
	1.5	1.5
	2.1	2.0
	2.5	2.5
	3.5	3.4
	4.0	3.9
	6.0	5.8
8	10.0	10.0
	15.0	14.0
	20.0	20.0
	1.5	2.9
	2.0	5.0
10	2.5	8.5
	3.0	12.0
	4.0	22.0
	5.0	30.0
	6.0	44.0
12	10.0	100.0
	1.5	4.0
	2.0	7.8
	2.5	15.0
	3.0	25.0
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	1.5	5.0
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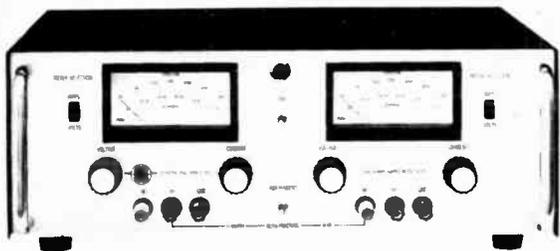
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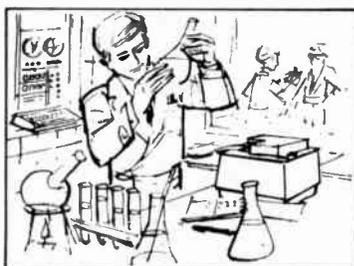
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# RADIO ASTRONOMY FOR AMATEURS

'Amateur Radio' 1967. This article concisely details theoretical and practical considerations as well as giving constructional details.

A more recent article in the "Victorian VHFer" of August 1972 reprinted a technical report of the Crawford Hill (USA) VHF Club which gives a lot of detail and some excellent background theory and practical suggestions. We recommend you read these articles before considering building.

## IMPEDANCE MATCHING AND TRANSFORMING

Any antenna must be connected to a feedline of the correct impedance for unless this is done maximum power transfer cannot take place.

The impedance of an antenna at its feedpoint is often not that of the transmission to which it is to be connected. The feed impedance must be transformed, (often changing it from balanced to unbalanced in the process), to that of the feedline in use.

Antennae using a dipole driven element often have feed impedances which are very low. Transforming this to another impedance is done in two main ways — the 'folded dipole'

technique and the gamma and/or omega match. These techniques are illustrated in Figs. 3 and 4.

A dipole is an inherently balanced element, and the folded dipole transforms the feed impedance, maintaining the balanced nature of the element.

The gamma and omega matching techniques also perform a balanced-to-unbalanced conversion as well as an impedance transformation. The capacitors remove resistance introduced by the gamma-match elements.

The omega technique gives a better match, particularly where dipole impedance is reactive and not purely resistive.

Design equations for the gamma and omega match devices are as follows:

$$A = \frac{180.5}{f \text{ (MHz)}} \quad B = \frac{114}{f \text{ (MHz)}}$$

where A is in feet and B is in inches.

This assumes that the matching element is the same diameter as the dipole driven element. In practical situations, the 'short' is made adjustable, and the above equations give starting point dimensions.

For folded dipoles, the impedance transformation depends on the spacing to diameter ratios. Table 1 gives values for these ratios (with reference to Fig. 3) for common impedance multiplying factors.

The next (penultimate) article in this series describes line matching transformers, and coaxial baluns, and includes a number of hints and tips on practical antenna constructions. ●

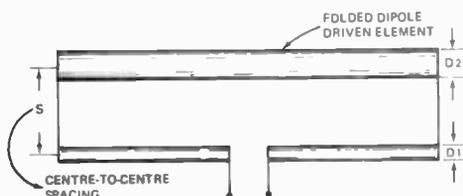


Fig. 3. Folded Dipole Impedance Match.

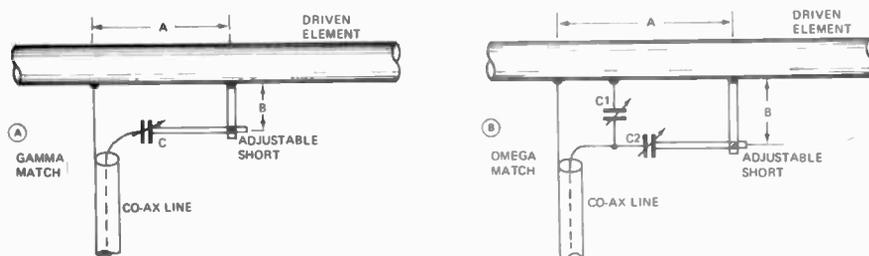


Fig. 4. The Gamma & Omega Matching techniques.

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# PART 9

# TRANSDUCERS IN MEASUREMENT AND CONTROL

Dr Sydenham describes the various methods used for measuring moisture.

**K**NOWING the water content of a substance is often of vital importance. In paper and board making, the moisture content of the pulp must be controlled; storage of valuable art objects and books demands humidity control of the environment; in the manufacture of synthetic textiles the air must be moist to prevent static electricity building up; personal comfort depends much upon the moisture present in the air.

In some areas of research it is necessary to monitor humidity in order that instruments are operated safely, for few are designed to work in saturated air. The laser interferometer method described in a previous article requires correction for the humidity of the radiation path if accurate length measurements are to be obtained. In wheat milling, moisture content is important for it largely controls the amount of insufficiently ground grain

that must be sold as reject material. The growth of plants depends upon the moisture content of the soil, plant and atmosphere.

In the study of radio propagation, it is necessary to determine rainfall and its droplet size distribution, for rain alters transmission significantly. Drops of rain impacting on a surface can cause erosion by impact and cavitation effects. In instances such as soil or structure erosion, the amount and size distribution of the drops is important. This article deals with the techniques used to transduce water content data such as these into more convenient signals which are usually but not exclusively of electric form.

## DEFINITIONS OF WATER CONTENT

Many definitions of water content exist, and it is necessary to have a basic understanding of these in order

to comprehend the techniques employed to monitor it.

Moisture can occur mixed with other carrier gases, as found in the atmosphere, or it may be of interest when combined with solids to form a substance such as paper pulp.

In 1801, John Dalton, a British chemist, formulated Daltons law which states that the total pressure of a mixture of gases (or vapours) is equal to the sum of the pressures of each constituent gas if it occupied the same volume by itself. These individual pressure values are called the partial pressures. He also speculated that all gases would liquify if the temperature were sufficiently low. Consequently from this, we can see that if a gas containing water vapour is cooled, there comes a point where water commences to liquify or condense out. This temperature is the **DEW POINT**: it occurs where the vapour is 100% saturated with water. The greater the water content, the sooner the water condenses as the temperature is lowered. Unless the temperature is raised, the gas will take in no more water in vapour form. The same concept can also be compared with the state change to ice (the solid phase of water) instead of liquid: this is known as the **FROST POINT**. These two points each define the partial pressure of the water vapour but not in a single manner. Various institutions such as the Smithsonian Institution in the United States (see reading list) publish tables enabling the water vapour content to be assessed if the dew or frost points are known.

If the partial pressure is known, then the numerical value of any other definition of humidity can be obtained.

Other definitions commonly encountered are —

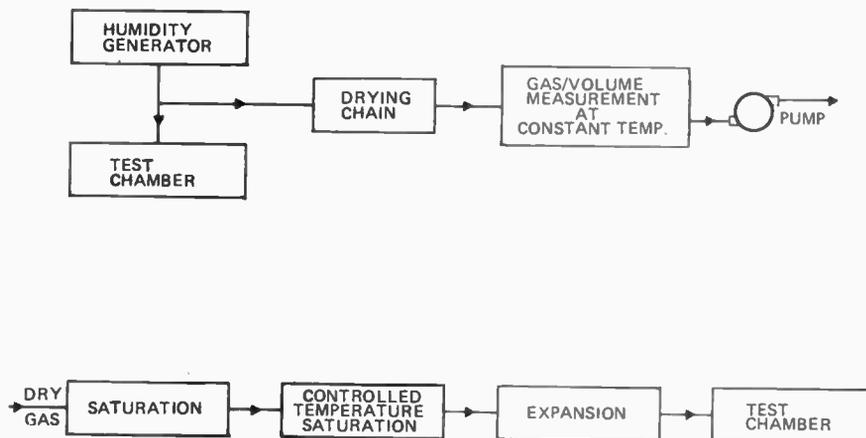
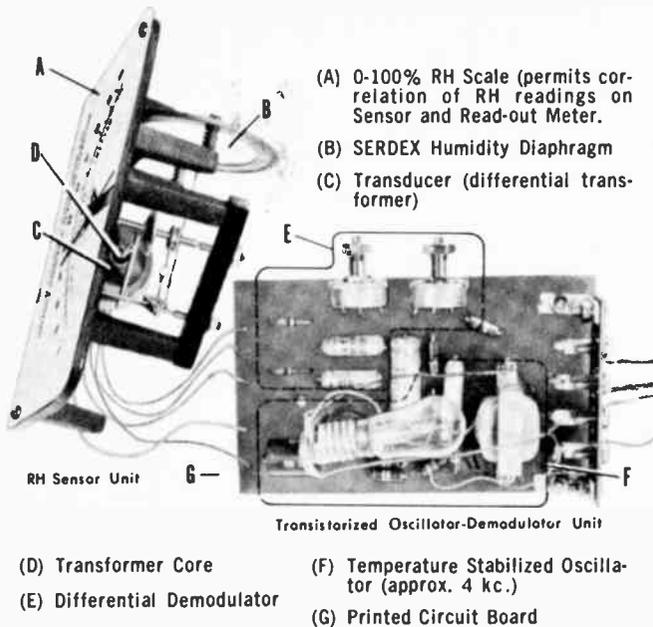


Fig. 1. Layout of the calibration standards for humidity.  
a) gravimetric determination of moisture content (the absolute standard).  
b) two pressure humidity generator (the transfer standard).

*Fig. 2. Operation of this SERDEX humidity sensor is based upon a hygroscopic animal membrane forming a diaphragm.*



**RELATIVE HUMIDITY, RH** for short — this expresses the amount of water vapour present, compared with the maximum that could be at the temperature of interest. (The quantity of water vapour present would only apply for a stated temperature). RH is expressed as a percentage. For example, a dry day in the summer could be as low as 20% whereas when it is actually raining, it rises to 100%. The need for this relative unit occurs because many processes do not depend upon the absolute water content, but on the amount that could be absorbed or liberated from the air. RH is probably the most commonly used unit outside of process control areas.

**PARTS PER MILLION, PPM** — this expresses the water content by virtue of the weight of water,  $PPM_w$  or its volume,  $PPM_v$ , so it is either the ratio of the partial pressure of the water vapour to the total pressure, or else the  $PPM_v$  value multiplied by the ratio of the molecular weights of water to the other gas to yield the first value. Care is needed to define which is intended, for both units are dimensionless, and appear the same unless qualified with a (by weight) or (by volume) statement.

**WET BULB TEMPERATURE** (no accepted abbreviation exists) — if a thermometer has its sensing area wetted with water (usually with a saturated wick) and air is passed rapidly over it, the thermometer reads a value less than that of an identical dry thermometer by an amount depending upon the relative humidity. If the air is 100% saturated, no more

moisture can be taken up so the bulb is not cooled at all. (The same reason is why evaporative air coolers do not give as much cooling in humid weather). This concept is used in the wet-and-dry bulb hygrometer.

**MIXING RATIO** — the ratio of weight of water vapour to dry carrier gas.

**POUNDS/KILOGRAMS PER HOUR** — this expresses the absolute amount of water vapour supplied per hour. For example, heat treatment of metals requires knowledge of the water content in the furnace as this controls the carburizing process reaction rate.

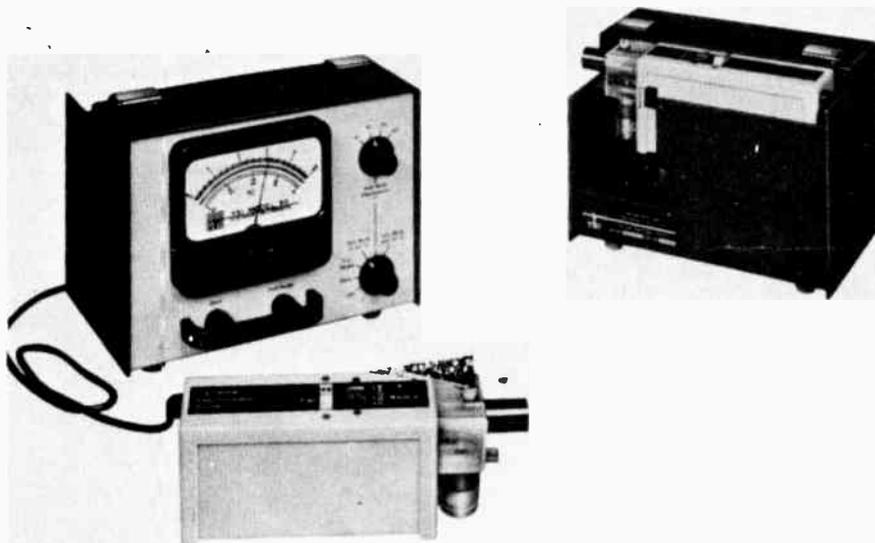
**RELATIVE EQUILIBRIUM MOISTURE** (rem or em) — in the paper industry, it is the ability of the fibres to lose or absorb water (the sorption process) that decides the shrinkage, tearability, etc. Equilibrium will eventually occur between the air humidity and the paper content. To make it clear that it is the paper moisture content that is stated, em is quoted. Hence a lower em than RH means the paper takes in moisture.

### LIMITATIONS OF DEW POINT MEASUREMENT

Not all moisture measurements make direct use of the dew point phenomena but it is instructive to consider the limitations of the process for the effects are present in most procedures.

**THE KELVIN EFFECT** — In 1870, Lord Kelvin arrived at the conclusion that the vapour pressure over a concave liquid surface is less than that over a plane surface of the same material. Water condensing on a surface forms droplets which produce a curved interface surface with the surrounding vapour. It has not been an easy matter to prove Kelvin's theory, for the effect is small, but convincing electron microscope studies of evaporating lead, carried out at Imperial College in London, have shown it to be true for lead and gold. The Cambridge Systems Company of Massachusetts have estimated the depression in dew point temperature due to 30  $\mu$ m dropsize condensation as 0.005K. Few people would find the Kelvin effect error a problem.

**THE RAOULT EFFECT** — In 1887 Raoult produced a law governing the



*Fig. 3. The Yellow Springs Instrument Co. aspirated psychrometer. The righthand view shows the unit packed for transportation. Thermistors are used as temperature sensors.*

# TRANSDUCERS IN MEASUREMENT AND CONTROL

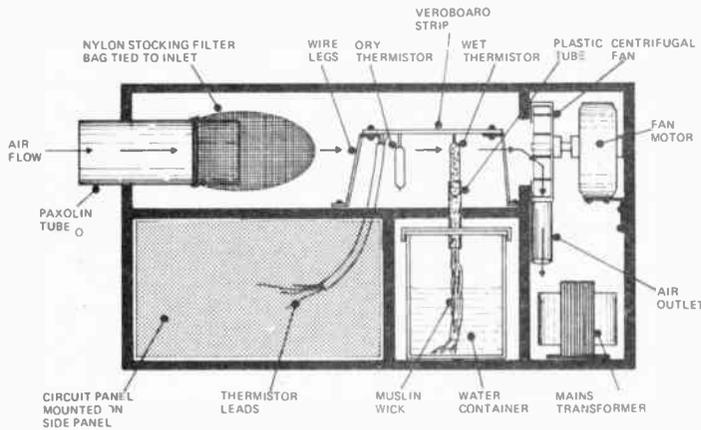


Fig. 4. Inside layout of an aspirated wet-and-dry bulb hygrometer which uses computing circuitry to produce a RH output.

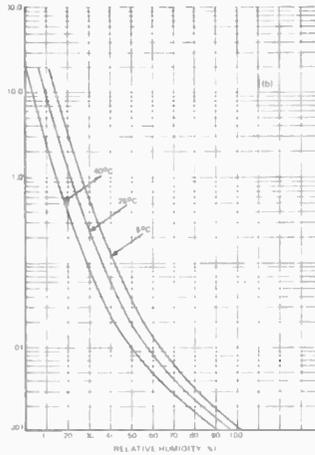
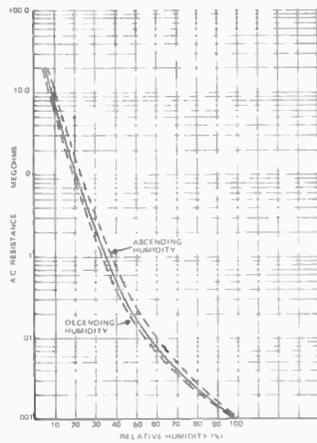


Fig. 5. Performance curves for the Warren Components Corporation humidity sensing element.

- a) these curves show the lag error depending on the direction of approach to a value.
- b) here are shown curves of resistance variation with humidity. Note the shift due to temperature and the slope away from a truly logarithmic response at high RH.

Fig. 6. System configuration of the Cambridge Systems dew point gas analyser. (The detector is in the centre of the system).

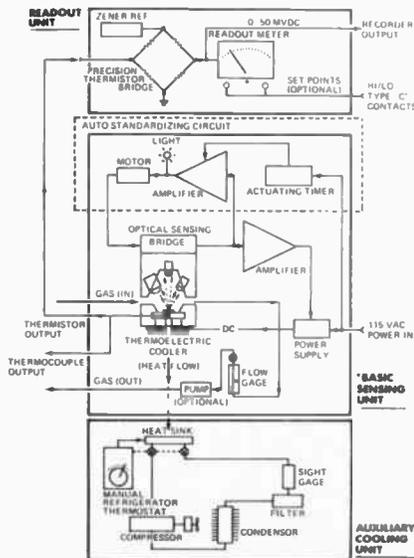
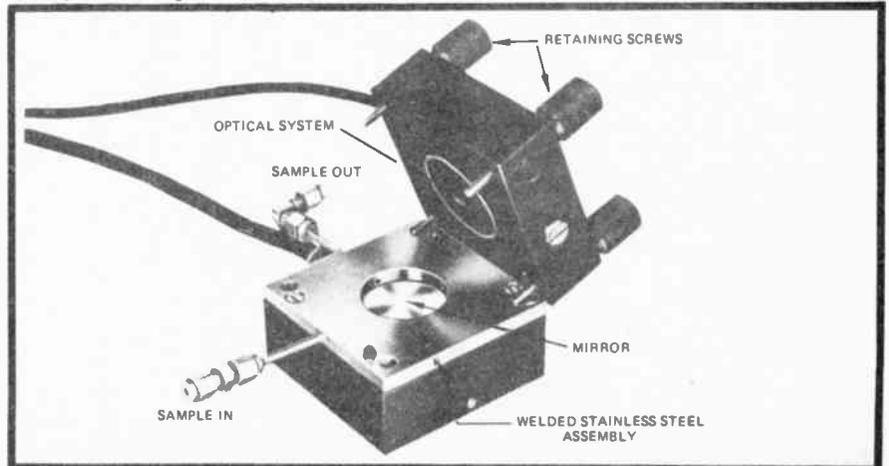


Fig. 7. Exposed view of the sensor used in the system of Figure 6.



effects of impurities on vapour pressures. If contaminants exist upon the dew forming surface, the vapour pressure is decreased. It has been estimated that this produces an error equal but opposite in sign to the Kelvin effect error if the same surface with its  $30\mu\text{m}$  drops is contaminated with a 10 molecule thick salt layer. These errors are random so they will not necessarily cancel. The Raoult error is reduced if there is more water on the surface diluting the impurity. As we shall see later, this heavy dew operation can be achieved by simple adjustment in dewpoint measuring methods so is preferred in exacting applications.

**THERMAL MEASUREMENT ERRORS** – the determination of dew point involves temperature measurement so this also needs to be of adequate accuracy. The two previous parts of this series dealt with temperature measurement so it is only necessary to reiterate that errors due to sensor calibration, heat loss and gain due to mounting thermal conductivities need consideration if accurate results are to be obtained. Generally, thermal measurements limit the precision of dew point devices.

## STANDARDS AND CALIBRATION

The standard used to calibrate moisture determining instruments is called a gravimetric hygrometer. This uses a procedure, shown in Fig. 1a, whereby the water vapour is absorbed in chemicals, leaving only the carrier gas – which is weighed with great precision. The process has greater accuracy than other methods (as it should have, being the standard) but is bulky and time consuming requiring many hours to make a determination.

A second, less accurate device, known as a two pressure humidity generator, (see Fig. 1b), is used as a transfer standard (its value is set in relation to the standard hygrometric method and can be used to test many instruments

before needing recalibration). In this method a dry gas is saturated and then passed into a superior controlled system where the saturation is ensured by using temperature control of the vapour. It is then passed into an expanding chamber where the device to be tested is housed. The degree of expansion decides the vapour pressure of the water. In field or factory use, neither of these is satisfactory due to size, cost and time factors. Instead a substandard, preferably a dew point device, is used which, (if warranted) is calibrated by a standards laboratory. The wet-dry bulb method is sub-standard (in order of standards hierarchy) to the dew point methods, the tables used with it having been derived from dew point data.

A simple method to produce a test environment is to inject a known amount of water into a known volume evacuated chamber. Dry inert gas is then introduced to provide the pressure needed. This idea has been used at the von Karman Gas Dynamics Facility in the United States to provide a calibration accurate to a dew point error of  $\pm 0.8K$ . This is not as accurate as the ultimate standard methods but does suffice to check and intercompare most daily-used techniques.

Gravimetric equipment is capable of dew point determinations to about 0.01K, the two pressure generator to 0.06K and the dew point method to 0.25K. Other methods are generally inferior, but each must be considered, for the specific application may render accurate methods inaccurate due to peculiar factors.

#### MEASUREMENT OF HUMIDITY

With this background, it is now possible to discuss actual techniques.

#### HYGROSCOPIC MEMBRANES AND HAIRS

The least scientific but easiest principle to employ makes use of the

fact that some organic materials alter dimension with changing moisture content. Human hair, for instance, is used in laboratory clockwork driven humidity recorders. It extends some 3% for the change from zero to maximum water content. Several commercial instruments use the movement produced to drive a microdisplacement transducer thereby providing an electrical signal — one unit, shown in Fig. 2, uses an inductive solenoidal transducer; another, a strain gauge placed on a driven mechanical member of the linkage operating the indicator pointer. Such devices could be expected to work to a few percent RH accuracy only and it is recommended that they be used only in the range 15–90% RH and in the temperature range 1–40°C. Their operation is prone to stiction effects and somewhat erratic response is experienced. They also need cross calibration to a more fundamental method.

#### WET-AND-DRY BULB PROCEDURES

The simplest wet-and-dry bulb hygrometer consists of two mercury thermometers in a frame, with the bulb of one covered by a wet muslin sleeve. The evaporative effect is at the mercy of draughts so this static procedure is not very accurate. Dew point temperatures are not achieved on the wet bulb. Rough estimates can be made of the dew point using Glaishers factor (which varies with the temperature) but for best work standard tables and charts are used.

A better arrangement is to cause the atmosphere to pass over the wick at high speed. As the surface velocity is increased, the cooling effect falls off as the air velocity is increased, and at around 30m/min there is little to be gained by it going faster. The obvious development step, therefore, was to whirl the two thermometers. Devices made this way are called whirling or sling psychrometers. (The grand name

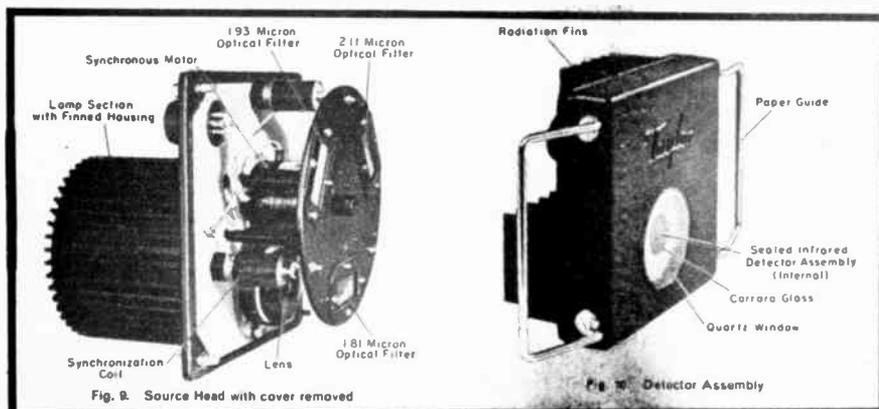
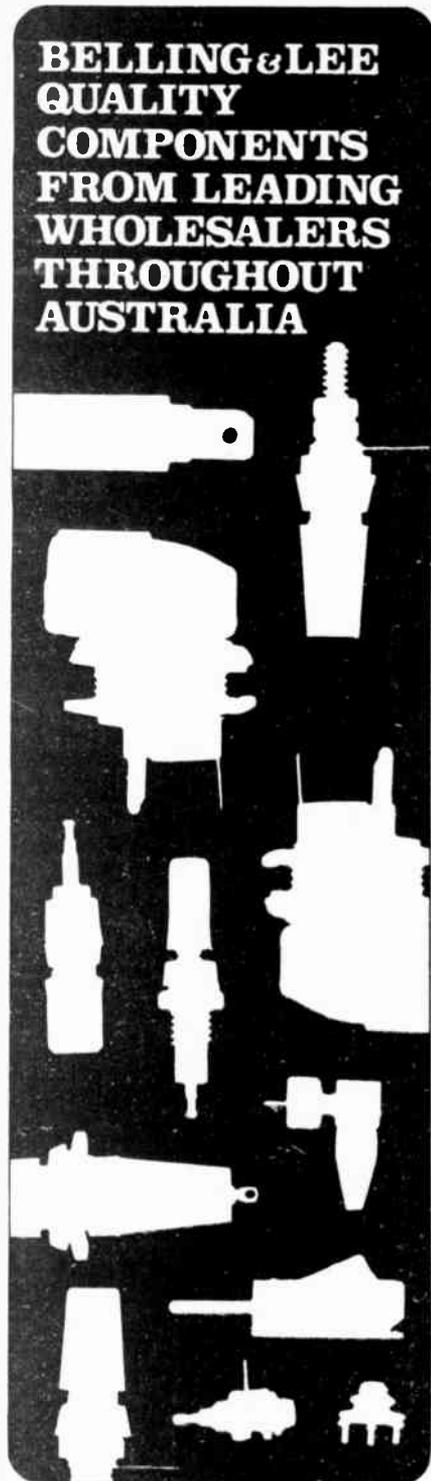


Fig. 8. Source head and detector assembly of the Taylor infra-red moisture gauge.



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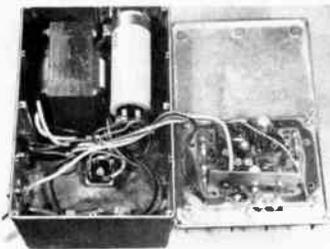


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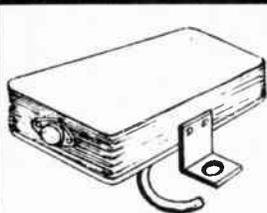
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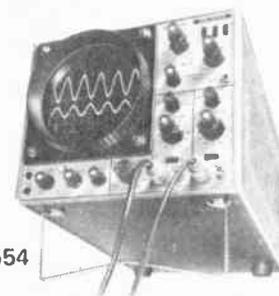
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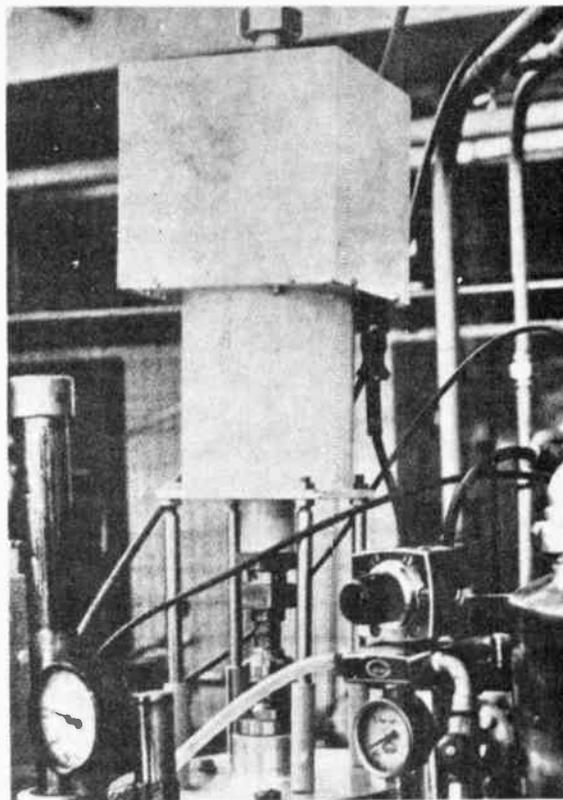


Fig. 9. Microwave moisture meter (Skandinaviska Processinstrument AB, Sweden) mounted in line for monitoring of moisture of materials flowing in tubes.

is applied without real distinction to the term hygrometer). One maker supplies a unit with a built-in slide rule scale that gives RH directly from the wet and dry readings taken after three minutes of rotation. In general, it is necessary to use the charts. Where electrical signals are needed or where the delicate glass thermometers need to be omitted, other methods are used.

As it is the relative wind speed that matters, it is easier in wet-and-dry instruments to aspirate the two thermometers by driving the air over them using a fan. The Assman psychrometer uses a clockwork or electrically driven fan to do this. This form of instrument is amenable to automation by replacing the mercury thermometers with proportional readout electrical sensors. Commercial units are available that aspirate thermistor sensors, (see Fig. 3), reading wet bulb depression directly.

It is still necessary, however, to resort to tables to obtain values of RH and other units with these. In 1969, 'Wireless World' reported a design that went one stage further. An inside view of the device is given in Fig. 4. The thermistor resistance variations were firstly linearized and then combined in an operational amplifier arrangement to yield a direct linear scale of RH to  $\pm 5\%$  accuracy. It has several short-comings, namely not being useful near freezing point temperatures (as is the case with all wick-type devices) and at low RH values. It does, however, show that a direct reading aspirated wet-and-dry

bulb method can yield RH values without the need to use tables making it useful in automatic control or recording applications.

### RESISTIVITY AND CAPACITIVE METHODS

The resistance between electrodes connected to a moist substance such as paper or soil is a measure of the moisture content. On paper making machines, wiping fingers have been used; in soil, electrodes embedded in a plaster block have been suggested. The variation of resistance with moisture content is roughly logarithmic but the actual value depends much upon contaminants and salts in solution that produce electrolyte. The use of ac measuring techniques is superior as this eliminates the electrolytic effect.

Evaporated grid sensors (gold fingers interleaved over an inert substrate) are made in which resistivity varies. Akin to this is the Warren sensor which consists of a special plastic backing having a humidity sensitive conducting plastic grid on the surface. Again the response is logarithmic and a small temperature coefficient and hysteresis effect exists — as Fig. 5 shows. The Dunmore sensor (originated in the 1930's) is made as two wire spirals forming electrodes on a former which is coated with lithium chloride.

Changes in capacitance also can be utilised. Simple sensors use plates separated by the medium of interest to form a capacitor. Differential arrangements assist in reducing errors. For air humidity sensing, a sensor has

been made from porous anodized aluminium strip, coated each side with gold layer electrodes. This acts as an aluminium oxide capacitor in which moisture diffuses into the pores.

Although a simple matter to measure the resistance changes and display them on a calibrated non-linear scale meter, it does not yield dew point nor give a linear scale. The overall accuracy of an instrument using these detectors can be improved if the humidity sensor is used only as an error detector of dew point.

### DEW POINT DETECTORS

The most obvious way to detect the appearance (or disappearance) of moisture is to optically monitor the reflectance of a mirror surface. Several devices do just this. Simple instruments are manually observed. A mercury thermometer is placed in a heat conducting block having a mirror surface. Cooling is applied uniformly with ice or ether to the block as the air is aspirated across the mirror. The temperature, when mist occurs, is the dew point. (In practice, a rough run is made first, with a second slower rate taken as the system heats up to loose the condensate.) Improved designs are still being reported in the scientific literature. They are inexpensive and accurate to 1K.

Automation has been achieved by viewing the reflected light with a photo resistor. One system using this is shown in Figs. 6 and 7. A stainless steel mirror is cooled by a thermoelectric Peltier cell until reflectance drops as the condensate forms. It is then temperature servoed to track a constant reflectance situation. The block temperature is held at the dew point of the gas passing over it. Temperature is transduced by thermistor or thermocouple in the unit shown. By altering the level of the reflectance signal, it is possible to operate with a heavy dew reducing the Roault errors. A precision instrument is actually more sophisticated in its peripherals, as can be seen in Fig. 6.

Resistance and capacitance sensors can also detect the presence or not of moisture, and many dew point meters use them instead of the optical method, for there is a sharp transition when the condensate is boiled off as the element is heated.

Where size is vital, the Spanner method (after D.C. Spanner in 1951) can be used. This uses two thermocouple junctions, one dry, the other in the active environment. The generated voltage is read for the dry unit. It is then used as a Peltier junction, cooling it for a timed interval. Water condenses upon it. The circuit is then switched back to measuring: the voltage measured is related to dew point. The principle has

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SP629 Flip flop	\$0.40
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SP670 Triple 3 input NAND gate	0.35
SP680 Quad 2 input NAND gate	0.35
SP690 Hex inverter	0.35

### Signetic "Utilogic"

This family of logic offers medium speed combined with a greater noise margin than is available from either DTL or TTL logic. Power requirements are the same as TTL/DTL (single 5 volt supply).

### "Utilogic" dual in line package

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LU356 Dual 4 input expandable driver	0.35
LU370 Triple 3 input NOR	0.35
LU377 Triple 3 input NAND	0.35
LU387 Quad 2 input NAND	0.35

### LINEAR INTEGRATED CIRCUITS

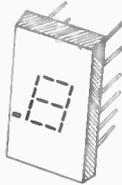
Fairchild and Signetic devices (no choice). Some of this line is not marked but it is fully tested and sold on a money-back guarantee. State first choice on package (TO-5, 8-pin dual in line, or 14-pin DIP—we will not ship flat packs).

NE526 High speed comparator	\$1.00
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709 Popular operational amplifier	0.40
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### LED DISPLAY

The MANI is a seven segment diffused planar GaAsP light emitting diode array. It is mounted on a dual in line 14-pin substrate and then encapsulated in clear epoxy for protection. It is capable of displaying all digits and nine distinct letters.

#### FEATURES:



High brightness, typically 350ft.-L @ 20ma.  
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Long operating life, solid state.  
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### LM309K—5 volt regulator



This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation.

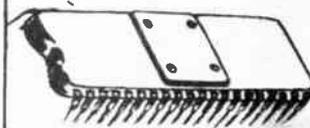
Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) at current of up to one ampere.

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FIVE for \$10.00**

### LSI—CALCULATOR ON A CHIP

This 40 pin DIP device contains a complete 12 (twelve) digit calculator. Add, Subtract, Multiply, and Divide. Outputs are multiplexed 7 segment MOS levels. Input is BCD MOS levels. External clock is required. Complete data is provided with chip (includes schematic for a complete calculator).

Complete with data, \$14.95



**Data only \$1.00**

### COUNTER DISPLAY KIT—CD-2

This kit provides a highly sophisticated display section module for clocks, counter or other numerical display needs.

The RCA DR-2010 Numitron display tube supplied with this kit is an incandescent seven segment display tube. The .6" high number can be read at a distance of thirty feet. RCA specs. provide a minimum life for this tube of 100,000 hours (about 11 years of normal use).

A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven segment decoder driver. The 7447 accomplishes blanking of leading edge zeroes, and has a lamp test input which causes all seven segments of the display tube to light.

Kit includes a two sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's.

Circuit board is .8" wide and 4 1/2" long. A single 5 volt power source powers both the IC's and the display tube.

CD-2 kit complete only \$10.95  
Assembled and tested ... \$13.00

**Board only \$2.50**



RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left-hand decimal point. Each \$5.00  
**SPECIAL 5 for \$20**

### UNIVERSAL COUNTER DISPLAY KIT CD-3

This kit is similar to the CD-2 except for the following:

- Does not include the 7475 quad latch storage feature.
- Board is the same width but is 1" shorter.
- Five additional passive components are provided, which permit the user to program the count to any number from two to ten. Two kits may be interconnected to count to any number 2-99, three kits 2-999, etc.
- Complete instructions are provided to pre-set the modulus for your application.

CD-3 board only \$2.25  
IC's 7490, 7447 2.75  
RCA DR2010 tube 5.00  
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### 256 BIT BI-POLAR FIELD PROGRAMMABLE READ ONLY MEMORY

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# TRANSDUCERS IN MEASUREMENT AND CONTROL

been used by many people since 1951. The procedure has been largely automated. The low cost of the sensors makes the method very applicable in field studies of soil-plant-water relationships where many tens of measurements are needed. A single cyclic switching and interrogating unit is used to operate the sensors in turn.

## HYDROLYSIS

A thin film of phosphorous pentoxide, held between noble metal electrodes, absorbs the moisture of the sampled gas as it flows through. A dc voltage across the electrodes breaks the water down into hydrogen and oxygen. The electrolysis current flowing is a measure of moisture content and will cover ranges from 0-100 to 0-10,000 parts per million with about 5% accuracy of the full scale setting chosen.

## ENERGY ABSORPTION METHODS

Gas molecules absorb electromagnetic radiation in a selective manner. Water vapour attenuates energy in the region of 3-6  $\mu\text{m}$  wavelength (infra red). Microwave frequencies in the region of 100 to 4000 MHz are also strongly attenuated by moisture vapour.

In both cases, the same idea is applied. A source of the radiation (a tungsten lamp for IR work or solid-state low-power microwave sources) is viewed by a sensor through the gas. Measuring the difference between the ideal signal and the absorption signal enables the loss to be determined, and hence the moisture content. In the IR instrument, the difference may be obtained by rotating a filter wheel so that the detector sees the source through the sampling cell - first with a bandpass optical filter and then with a selective absorption band filter. Another method, shown in Figure 8, sequentially applies three (two have been used also) IR sources (the same tungsten-halogen broadband lamp but with different narrow band-pass filters to select wavelengths needed) to radiate through the gas stream onto a lead sulphide detector. This provides three levels of signal which can be combined and processed to give the moisture content in the required units.

Most microwave devices operate by

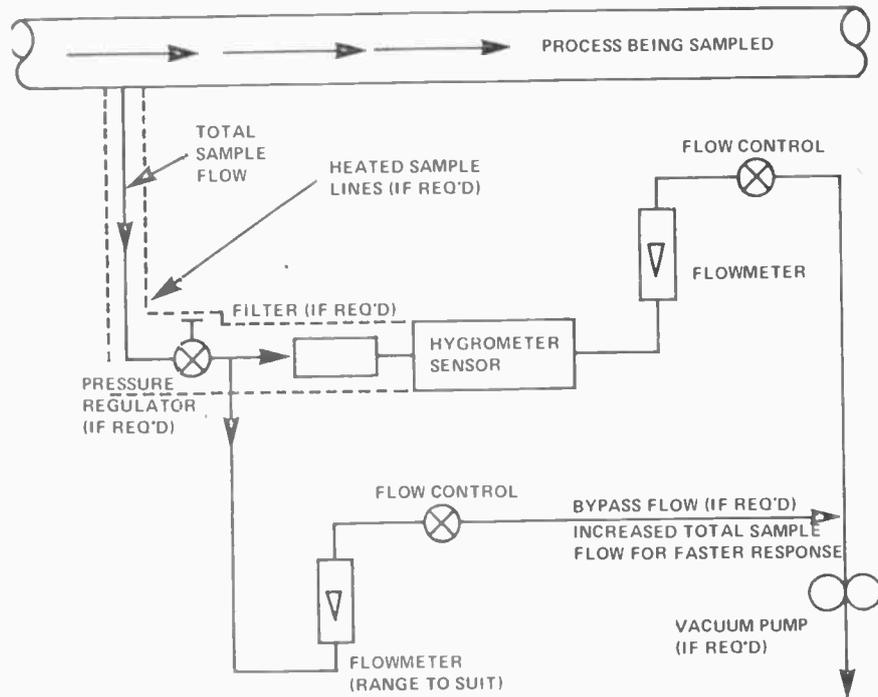


Fig. 10. Components and layout of a moisture sampling system.

monitoring the amplitude loss as it is easier to measure attenuation, and experience in such measurements is commonplace. The use of phase shift effects instead is relatively new, but at the Royal Institute of Technology in Stockholm whose unit is shown in Fig. 9, a number of these (which measure dielectric effects) have been built proving their feasibility.

## INSTALLATION OF MOISTURE MEASURING DEVICES

Many instruments are operated to continuously provide moisture measurement. Where the through volume is large a sampling line is bled off to feed the detector. This line may introduce errors by contaminating the input gas with leaks or chemical reaction or more likely by condensing moisture out of the gas. The line temperature must never drop below the dew point so heated lines may be needed. Fig. 10 is a schematic layout of a sampling system recommended by Cambridge Systems. Filters may be needed to remove solid contaminants but usually dew point meters include these. Flow meters are vital in order to know the amount of gas sampled. Teflon or stainless steel tubing are used for they are non-hygroscopic.

If the hygrometer is multiplexed between a number of lines, problems can occur due to the time taken for the materials of the lines to lose the

absorbed moisture. The lower the dew point value, the longer it takes to purge the lines so switching between widely differing samples will have a restricted response. For example, a poor line (nylon for instance) takes several hours to re-establish equilibrium. Lines are usually purged clean with dry air or nitrogen before use. Freon 114 is an excellent solvent gas to use.

## RAINFALL

It has become necessary to use higher frequencies (10-30GHz) in communication links to gain more bandwidth. Unfortunately, at these wavelengths, rain can seriously attenuate signals, so the major laboratories (Bell Telephone and the British Post Office, for example) have research programmes going to investigate this. One of their first problems was to produce continuously recording rain gauges, for the manually-read weather station rain gauge only gives values integrated over long time intervals.

The Bell system makes use of the fact that rainwater has a high dielectric constant. A collecting area gathers rain, funneling it into a narrow run-off channel. Inserted in the channel are electrodes which are normally separated by air. When rain spills down the chute, the dielectric constant between the plates change (in

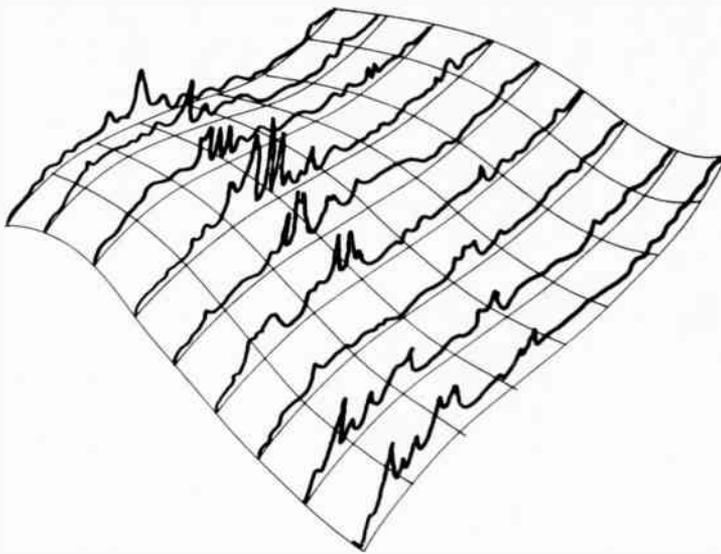


Fig. 11. Three dimension representation of rainfall distribution measured by Bell Telephone laboratories

proportion to the amount flowing) and this is used to alter the capacitance of an R-C oscillator. The output appears as a frequency deviating signal. The Bell company placed 96 of these units over a 50 square mile area and telemetered the data back to a central recording unit. The data was processed to produce isometric plots of the rainfall, as shown in Fig. 11. It was then correlated with the signal loss of microwave transmissions.

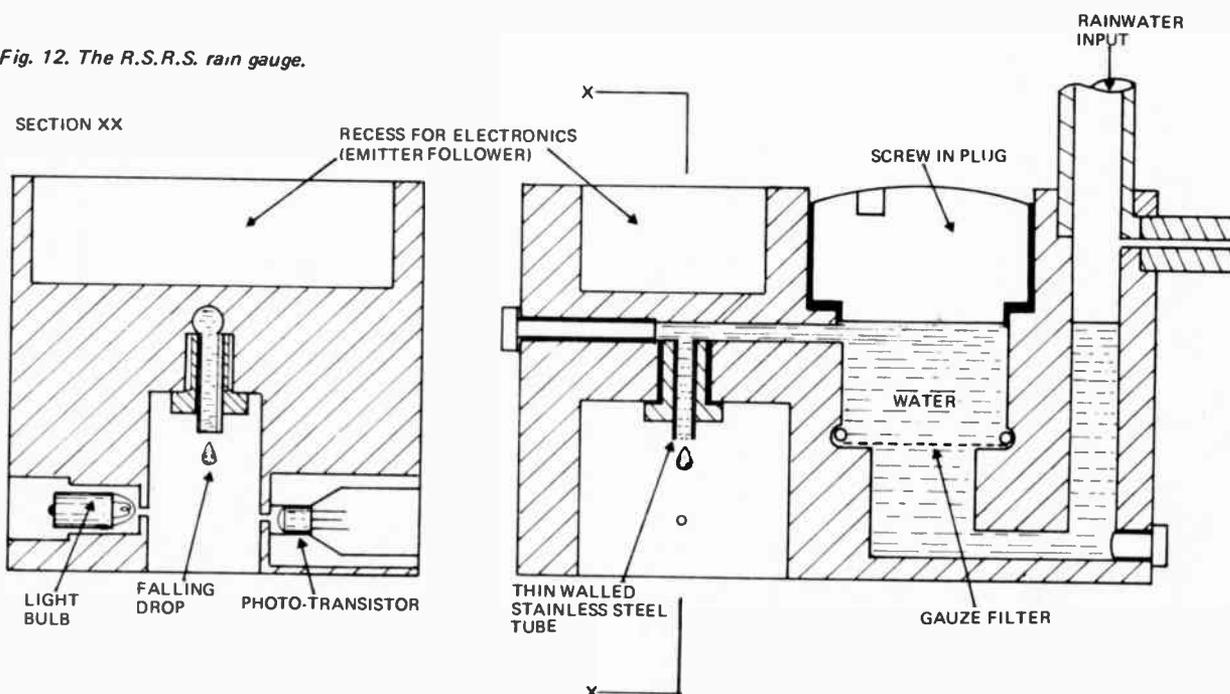
The British groups (Post Office Research Department and the Radio and Space Research Station) recently reported another technique. The collected rain-water is fed, (see Fig. 12), to a 3 mm internal-diameter tube where it drips through as constant size (but varying rate) drops. The falling drops are detected with a simple photo transistor light interruption sensor. A digital unit telemetry link is used to send an 8 bit binary code of the drop rate to the processing centre.

## RAIN DROP SIZE DISTRIBUTION

In many instances where rain fall is measured, it is necessary to know more than just the amount of water precipitated. For a number of reasons — (erosion being the most general need, for the droplets can damage a surface — soil for instance is eroded by impact and washing,) the research worker needs to obtain data on the nature of rainfall. Drop sizing and distribution (rain spectra) is a recurring measurement problem. As early as 1904 a simple method of flour balling was used (flour encases the drop as it falls into it). High speed photographic methods have been reported regularly. The advent of electronics enabled drops to be monitored faster and more accurately. The list of methods is extensive.

A recently reported development by staff of the I.I.T. Research Institute in Chicago, uses a television scanning arrangement to count and size the droplets as they pass a viewing area. The drops are virtually frozen by using a rapid flash of a xenon lamp to illuminate them in front of a vidicon tube. During this period, the scene is scanned and line data stored. The video signal is then processed to decide the quantity of drops and their size distribution and these data are printed out using a number of channels. To routinely test the instrument, slides which have drop cross-sections on them, can be inserted in the optical space.

Fig. 12. The R.S.R.S. rain gauge.



For best performance assessment, water sprays and falling glass beads were used whose distribution had been proven by independent methods. In one method a belt of sensitized paper was moved past a test slit. Drop imprints on the paper through the slit were made permanent by exposure to ammonia fumes. The method is similar to many sizing systems now in use (blood cell and leaf area came to mind) but here the image is dynamic and splashing drops on the terminal boxes of the equipment lead to errors.

Finally, a brief comment on ice measurement. On aircraft superstructure and North Sea trawlers, ice builds up impairing the performance, on the former it would lead to trouble so de-icing units, which heat or crack the ice away, are standard equipment. Generally, the pilot decides when to de-ice by subjective factors such as heaviness of control. Approval has recently been given to a small device that electrically indicates the amount of ice build-up. A probe about 25 mm across is fixed in the air-stream to simulate the worst point on the airframe. The probe is an oscillator in which its mechanical mass forms part of a tuned circuit. As ice builds up, the resonant frequency changes providing a continuously varying signal of build-up.

**FURTHER READING**

**HYGROMETRIC AND**

**PSYCHROMETRIC TABLES:**

"Smithsonian Meteorological Tables, 6th ed., R.J. List, Publication 4014 Smithsonian Institute, Washington, D.C., 1963.

"Hygrometric Tables", H.M. Stationery Office, 1964.

"Psychrometric Tables (Marvin)" Published in U.S. available C.F. Cassella, Regent House, Fitzroy Square, London.

**DEFINITIONS AND TERMINOLOGY:**

Numerous working data pamphlets by Cambridge Systems Inc., Newton, Massachusetts 02158, U.S.A.

"Humidity and Moisture: Measurement and Control in Science & Industry" Reinhold Publishing Corp, N.Y., 1965, Four volumes.

**CALIBRATION:**

"Humidity Calibration Techniques", K.M. Cole and J.A. Reger, Instrum. & Control Systems, January, 1970, 77-82.

**METHODS IN INDUSTRY:**

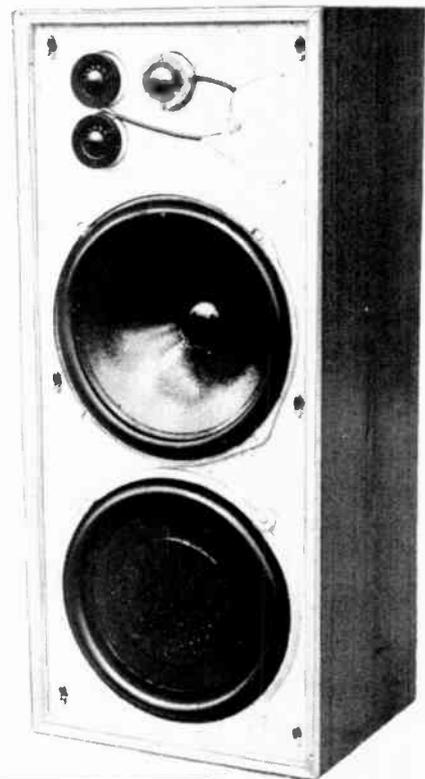
Many papers appear in issues of "Measurement and Control" journal. ●

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- S.A.: Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide 5000.
- TAS: Audio Services, 72 Wilson Street, Burnie, 7320.
- VIC: Encel Electronics Pty. Ltd., 431 Bridge Road, Richmond, 3121. Tel. 42-3762.
- W.A.: Albert's TV and Hi-Fi, 282 Hay St., Perth. 6000.

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**INTERDYN**

# AMATEUR RADIO

Roger Harrison VK2ZTB



# THE STATE OF THE ART

**S**INCE 1961, Radio Amateurs have taken part in space communications research by constructing artificial satellites for launch by NASA in the United States. (A survey of Amateur Satellites appeared in September 1971, Electronics Today.)

On October 9th 1972 the sixth satellite in the OSCAR series (Orbital Satellite Carrying Amateur Radio) was launched into an approximately 1000 mile high, polar orbit from the Western Test Range in California, USA as a secondary payload on the Ito-D weather satellite.

The principal experiment on board OSCAR-6 is a linear translator, designed by Carl Meinzer DJ4ZC. The translator receives ground station signals in the two metre amateur band over a 100 kHz passband centred on 145.95 MHz and re-transmits these signals in a 100 kHz passband centred on 29.50 in the 10 metre amateur band.

OSCAR-6 also carries a command and 35 channel telemetry system with

output to a 435.1 MHz beacon transmitter. This system allows all important functions on board the package to be monitored and allows the package to be turned on or off as desired. The command and telemetry system was designed and constructed in Australia by a group of Melbourne amateurs sponsored by the Wireless Institute of Australia.

The satellite is also noteworthy in that it is expected to function for a much longer period than previous OSCARS. It has a design lifetime of at least one year.

The first stations to work through the two-to-10 metre translator were New Zealand amateurs (during the first orbit), and the first Australian amateur to communicate via the translator was Bob Halligan, VK3AOT, during Orbit 3. To date, innumerable stations have successfully worked through the translator, with Australian activity extending from Antarctica to Cocos Island in the Indian Ocean. Contacts between New Zealand and West Australian stations are common.

Since launch, a magnetic stabilizer aboard the package has caused the satellite to align itself with the earth's magnetic field. This simple device obviates much of the flutter fading caused by the satellite tumbling through space.

Simple equipment may be used to work through the translator as only 80 to 100 watts ERP SSB or CW is required for the uplink on two metres, and any reasonable 29 MHz receiver with a simple antenna will suffice for the downlink. Readers who wish to listen to OSCAR should contact the WIA in the capital cities or listen to WIA Sunday morning broadcasts for Orbital data.

## TROPOSPHERIC PROPAGATION STUDIES

The Victorian VHF Group in Melbourne and the Christchurch VHF Group in New Zealand are setting up an experiment to investigate

Tropospheric-Duct VHF propagation across the Tasman Sea. A beacon transmitter on 145.3 MHz is operated continuously by the Christchurch group and a remote receiving station is under construction in Melbourne. It is planned to site the station near Melbourne with continuous recording facilities to monitor the Christchurch beacon over a long period. It is hoped to have the experiment under way in time to catch temperature inversions during the coming summer.

In Adelaide, Gary Herden, VK5ZK, has been holding regular schedules with Bob Elms, VK6BE, in Albany WA, on 144 MHz and 432 MHz for over 12 months. The path distance is over 1100 miles. Excellent results have been obtained on 144 MHz but a two-way exchange is yet to be accomplished on 432 MHz. Gary is now in a position to predict tropospheric openings by consulting the daily weather map!

In New South Wales, Sydney amateurs VK2ZQJ and VK2ZRH have been using high power SSB to work a 144 MHz tropospheric scatter circuit with VK2ZAY, VK2ZCV and VK2ASI in the New England region approximately 250 miles north of Sydney over mountainous terrain. An attempt will shortly be made on 432 MHz over the same path.

## DAPTO MOONBOUNCE PROGRESS

A new pre-amplifier using an MS175 transistor has been constructed which shows an improved noise figure over the BFR91 preamp described in this column the month before last. On September 10th, tests were carried out with Al Katz, K2UYH in New Jersey, USA but he was not heard at Dapto, although VK2AMW's echoes from the moon were received at normal strength. Information was later received that K2UYH could not be present for the test. Further schedules are being arranged. ●

## WOULD YOU LIKE TO BE A RADIO AMATEUR?

The Wireless Institute of Australia, established in 1910 to further the interest of Amateur Radio, can help you to attain the knowledge necessary for the P.M.G. Amateur Operators' Certificate of Proficiency examination. Correspondence Courses may be commenced at any time. Personal Classes commence in February each year.

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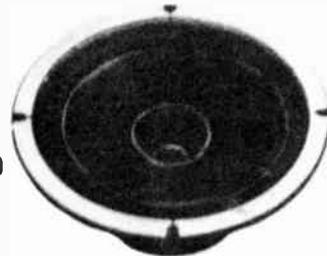
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rms.	4 watts	8 watts	10 watts
program:	15 watts	25 watts	35 watts
Flux density:	10,000 gauss	11,000 gauss	12,000 gauss
(minimum)			
Sensitivity:	95 db/W	96 db/W	97 db/W
Voice coil impedance:	8 Ohms.	8 Ohms.	8 Ohms.
Frequency range:	65	35	30
	16,000 hz	18,000 hz	20,000 hz
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Frequency Response .... 20-5,000 Hz  
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Flux density .... over 12,000 gauss.  
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### MX31 2-WAY CROSSOVER NETWORK



This network features an adjustable volume control for the tweeter. Crossover frequency is 3,000 cps.

\*\$5.48 TAX INC.

Also available MX5 Crossover without volume control.

\*\$1.91  
TAX  
INC.

### KALTRO SSK84 2-WAY SPEAKER SYSTEM ASSEMBLY KIT

\*\$26.87  
TAX  
INC.



This woofer, tweeter and network speaker system assembly kit has been designed for the sophisticated Hi Fi listener who wants to make their own enclosure. Complete instructions for building a cabinet come with each assembly kit.

#### WOOFER 8" Diameter

Frequency Response .... 30-5,000 Hz  
Resonance Frequency .... 30-45 Hz  
Voice Coil impedance .... 8 ohms  
Power Capacity .... 20 Watts (Music)  
Baffle Opening .... 6½" dia.  
Depth .... 3½"  
Mounting .... 4 holes, 3½" radius

#### TWEETER 2½" Diameter

Frequency Response ... 1,000-20,000 Hz  
Voice Coil impedance . 8 ohms  
Baffle Opening .... 3½" Diameter  
Mounting .... 4 holes, 1½" radius  
Depth .... 1½"

#### CROSSOVER NETWORK

Crossover Frequency .... 3,500 Hz  
Matching Impedance .... 8 ohms

#### DT3 DOME TWEETER

Designed to compliment the FR8A 8" Woofer with the use of an MX31 or MX5 Crossover network.



\*\$6.24  
TAX  
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Frequency Response 1,000 to 20,000 cps.  
Voice Coil impedance, 8 ohms.

#### HTM2 HORN TWEETER

Power handling capacity .... 10 Watts RMS  
Frequency Response .... 30-21,000 Hz

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This horn tweeter has been designed to achieve perfect high tones when mounted in the correct enclosure.

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3003

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GROUP

## BRITISH AUDIO SHOW REPORT

**B**ritain's recent 1972 Audio Show proved to be the biggest and most popular so far, reflecting the massive interest by audiophiles as well as the public.

Queues formed outside Olympia all day long on closing day, even though admission was not free.

One of the highlights was unquestionably Bang & Olufsen's Beogram 4000 straightline tracking turntable. Combined with the latest B & O SP15 cartridge, the unit can be truly described as a 'state of the art' system. An illustrated description of this unit appears elsewhere in this issue.

Several other firms demonstrated designs with servo-controlled dc motor direct-drive systems, for example, Sony, Pioneer and National. More conventional turntables were shown by BSR (model 701, a cheaper version of their successful 801) and Garrard, with its new AP96 unit. Thorens displayed the new TD160, based on their TD150 model. This is a two-speed transcription unit, incorporating the TP16 arm, with a unique 4-position magnetic anti-skating bias adjuster, which eliminates the functions normally associated with mechanical bias adjustment.

An arm of world-wide renown, the SME Series 9, is now released in an improved version, with various useful changes at the rear of, and beneath, the pivot. A smaller and lighter counterweight is now fitted, with the rider detached. Below deck level, horizontal entry plugs are now standard and the headshell is not detachable, although a removable shell can still be ordered.

Loudspeakers continue to attract electroacoustic designers, and Olympia offered a wide selection of models. If a trend was discernible, it is towards smaller physical size and lower efficiency, although the bigger enclosure models are coming back into fashion where deep bass radiation is desired.

One such system is the Goodmans 'Goodwood', a monitor type enclosure selling for less than £100.

Other total enclosure designs are produced by B & W Electronics, a small firm with a growing world market and reputation. Their improved DM70 has a big curved ELS unit for high frequencies, with matching transformer and level control. B & W introduced two new models, the DM5 two-way compact loudspeaker system, and the DM4, a three-unit monitor, using Bextrene coned bass/midrange unit produced in their own factory, a type HF1300 Mk II lower HF unit, and a plastic domed upper HF unit.

Lecson demonstrated a system employing a horn-loaded bass, mid- and HF units, of high efficiency, due to John Greenbank (described in our AUDIO NEWS pages last month). Another uncommon design was the Sinclair Q30 loudspeakers, which are doubled designs, with inverted cone units, handling up to 25 watts. The slender shape is only 2½in deep (by 23½ x 34½in).

Heathkit's new AS9520, and AS9515 loudspeakers (using KEF units in the first two models) offered exceptional sound quality in the demonstrations, and are competitively priced. As well as tuner-amplifiers, Heathkit is later introducing a quadraphonic decoder unit. Goodmans Module 90 is another outstanding example in this category.

Scan-Dyna showed an attractive new tuner-amplifier, the 2400, with many advanced design features, including touch-sensor controls for function selection.

Ferrograph introduced several new products, including the F608 stereo amplifier, developing 60 watts RMS per channel into 4 or 8 ohm loudspeakers.

Although open reel tape recorders still dominate the professional

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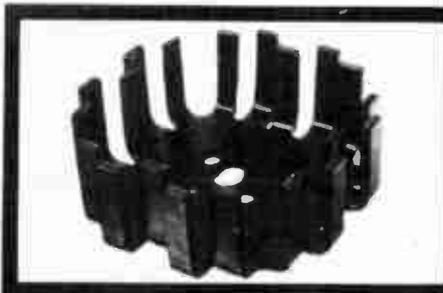
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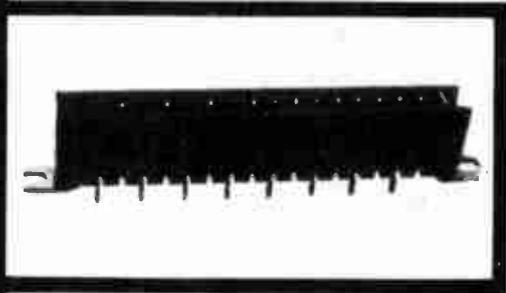
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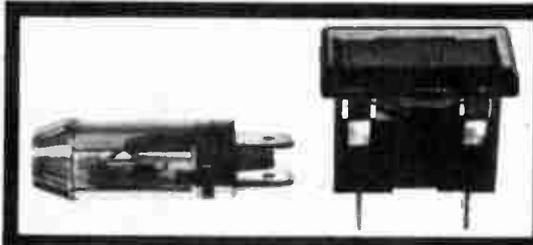
Typical of the British trend to 'unit/audio' is this 4-channel 'music centre' from Sanyo. Unit combines MW/FM stereo radio; 3-speed turntable, cartridge and stylus suitable for CBS SQ 4-channel discs; 8-track cartridge player capable of playing 4-channel discrete cartridges. Also included are two sets of speakers. (Model GXT 4731K).



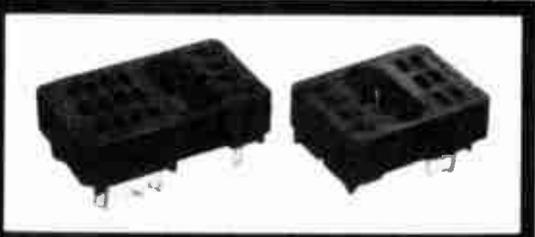
Heat sinks



Edge connectors



Neon indicators



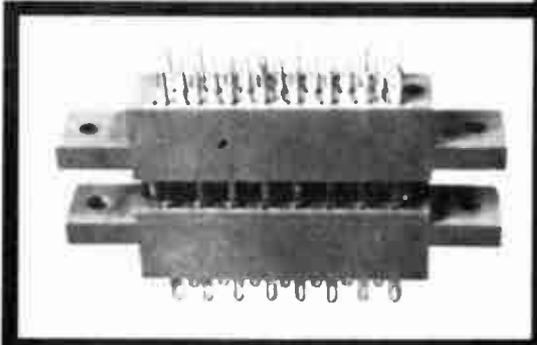
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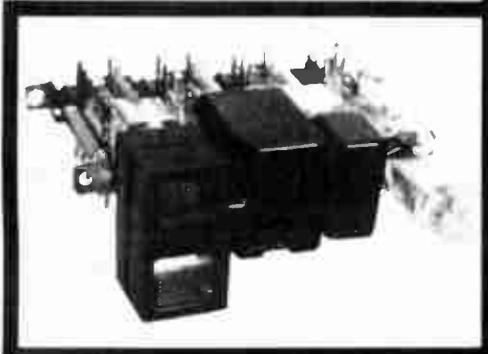
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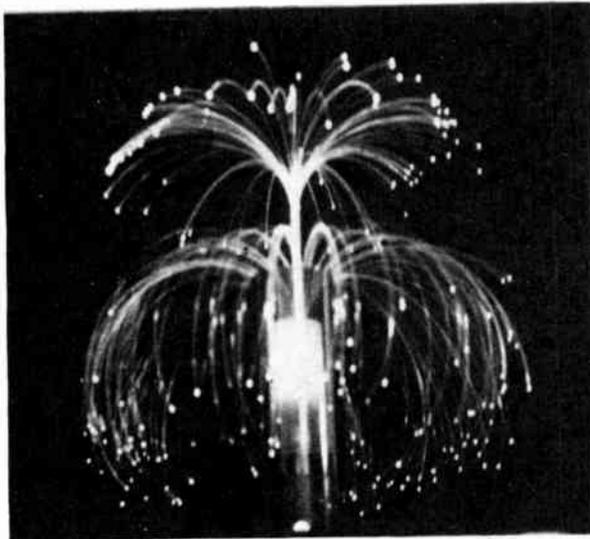
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# AUDIO NEWS

Featured at the 1972 Audio Show were these 'isodynamic' headphones from Wharfedale. The headphones employ a unique polyimide film diaphragm into which is bonded the flexible printed circuitry. Rubber magnets are another feature — these are magnetized perpendicularly to the diaphragm, thus providing a transverse field at right angles to the current flow. The 'phones weigh only 16 ozs (450 grams).



users' market, and such designs as the latest Revox A77 (Mark 3) could be seen and heard in use in practically every demonstration room, the domestic market would seem to be swinging towards cassette units, of varying degree of sophistication, many fitted with Dolby B noise reduction circuits. Philips DNL (dynamic noise limiter circuit) is incorporated in their latest N2510 Hi-Fi stereo cassette deck and in the Pye Model 9145 stereo cassette deck, intended for use with existing audio systems.

Agfa-Gevaert introduced a new range of compact cassettes, with new ferric oxide coating — known as their Super Series — and the running time of their C60 and C90 types has been extended by three minutes in each direction, a useful time overlap for recording purposes. TDK demonstrated their latest KROM-O<sup>2</sup> chromium-dioxide cassettes and other endless loop and head cleaner cassettes.

As might have been expected, with the current widespread promotion of 4-channel sound systems, a number of 'quadraphonic' demonstrations by different exhibitors supporting various techniques could be heard. None was wholly satisfying and no standard system appears to be emerging for the present. Repertoire is still small from such companies as EMI and CBS, and decoders are in short supply, although several manufacturers are working on this problem.

Ambient and 'surround sound' systems are becoming available such as, the B&O Beomaster 4000 with optional ambiophonic speaker channels, and Interconti Electronics launched the 'Quadrioseound' amplifier.

The conflicting systems of SQ, QS, JVC/CD4 etc, are still engaged in combat for the 4-channel market, and Professor Peter Felgert (University of Reading) gave a provocative lecture in the Hi-Fi theatre (one of 20 such talks during the Fair) on 'Commonsense and Quadraphonia', in which he offered his opinion, based on researches with John Wright, of IMF, that three channels — not four, can fully represent the sound field at a point, and can substantially reproduce this field in the region occupied by a listener's head and ears. He believes that the future of, what he calls, 'Pantophonic' sound, depends on escaping from the tyranny of 'quadraphonic 4-channel' thinking.

All in all, the 1972 Audio Show had great appeal to the masses, if not to the audio specialists. This is perhaps, not surprising, as one stand even had the Penthouse magazine girls displaying their wares!

(Continued on page 99)

# AUDIO NEWS

(Continued from page 98)

## CASSETTE TAPES FROM EMI



A new range of blank cassette tapes is being launched by EMI (Australia) Limited. They are fully imported from the U.K. and are manufactured by EMI Tape Limited of Hayes, Middlesex and feature the familiar His Master's Voice and EMI Trade Marks.

Designated "Hi Dynamic", the tapes include the standard C60 (60 minutes playing time), C90 (90 minutes) and C120 (120 minutes) versions for mono or stereo recording. The tape in each of these high quality cassettes has an excellent dynamic range with good print through characteristics. The cassette cases are of the screwed type rather than electronically welded. To complete the range is a cassette head cleaner.

## COMPATIBLE "HIGH ENERGY" OXIDE CASSETTES

A new "High Energy" tape cassette has been introduced by 3M Australia's Magnetic Products Division. The new Scotch brand cassette is based on a proprietary cobalt-modified ferric oxide formulation that 3M Company consider to be a major technological breakthrough.

The manufacturers say the oxide is the result of years of research aimed at providing the audiophile and critical music listener with the maximum undistorted output and dynamic range possible, without compromising any of the desirable physical features of the Company's low-noise "Dynarange" tapes.

"High Energy" cassettes are said to produce a greater undistorted output at all frequencies and show an improvement in dynamic range from 2dB at low frequencies to 6dB at the high end. The tape operates at standard low-noise bias and equalization levels, making it fully compatible with existing and envisioned equipment.

3M have borrowed some features recently added to their professional music mastering tape. In addition to the new oxide, the back side of the tape will employ a unique backing treatment.

Claimed to be exclusive to the "High Energy" cassettes is a micro-thin protective treatment on the back side of the tape. The innovation greatly reduces scattering of the wind, the primary cause of cassette jamming, and produces a smoother and cleaner running cassette.

"High Energy" cassettes will first be introduced in 60 and 90 minute lengths and are expected to retail at a premium. The price has not yet been established.

## NEW EVR MANUFACTURING GROUP

A number of international companies have joined forces in Tokyo to produce EVR (Electronic Video Recording) equipment.

The companies involved are Britain's Imperial Chemical Industries, Switzerland's Ciba-Geigy Ltd; and Hitachi Ltd, Mitsubishi Electric, and Mainichi Broadcasting - all from Japan.

The new company - to be known as Nippon EVR Ltd - have arranged to construct a \$6.5 million factory near Hiroshima. Production is planned to commence in July next year. Initial annual production is believed to be 300,000 units.

## TV STILLS FROM CASSETTES

Japan's Matsushita Electric Co. have developed a new video system that uses standard music cassettes to reproduce non-moving colour pictures on home TV (colour) receivers.

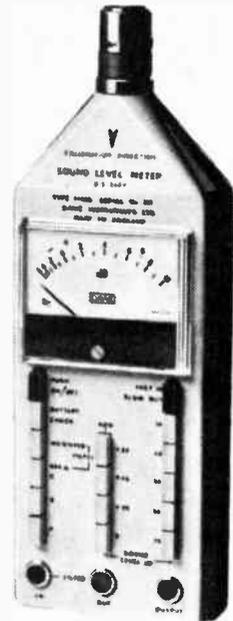
The system is primarily intended for educational applications.

Marketing plans are not yet finalised but we believe that the equipment is unlikely to be available for at least 10 to 12 months.

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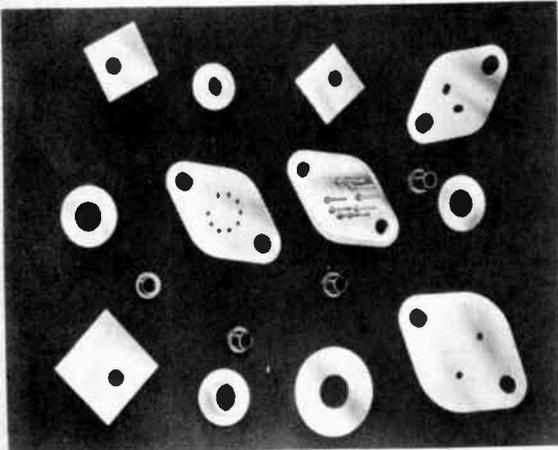
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# COMPONENT NEWS

## INSULATING WASHERS



Insulating washers for semiconductors in TO-3, TO-66 (two and nine pin), SO-55, DO-4, DO-5 and "thermatub" packages are now available from Jermyn.

Manufactured from I.C.I. "Melinex" polyester film, these washers offer several advantages over the usual mica types. Although only 0.002 in thick (compared with 0.005 in. for mica) the Melinex washers are very tough and flexible and will not crack or de-laminate.

The thermal performance is improved and for the TO-3 washer is typically  $0.8^{\circ}\text{C/W}$  including the two interfaces.

Further details: McMurdo (Australia) Pty. Ltd., Box 321, Clayton. 3168. Vic.

## MULTIFUNCTION MODULE PROVIDES WIDE RANGE OF PROGRAMMABLE FUNCTIONS



The ability to perform a wide range of computations including multiply, divide, square and exponentiate, in the 0 to +10V range, is now provided in a programmable  $1\frac{1}{2}'' \times 1\frac{1}{2}'' \times 0.6''$  module from Analog Devices, Inc.

Requiring only two external resistors for programming the expression  $Y(Z/X)^m$ , the new Model 433 will perform multiplication,

division or exponentiation up to the 5th power or root. It may also be used to develop more complex functions such as RMS or vector sums using inexpensive external operational amplifiers.

Designed around log/antilog circuitry, the most significant performance of the IC is as a divider, capable of holding accuracies over a wide 100 : 1 input signal range.

As a multiplier, the Model 433 has less than 0.5% of full scale overall error with 0.01%/ $^{\circ}\text{C}$  drift, when operating at levels from 10mV to 10V(60dB). Similar improvements over feedback techniques are obtained when implementing the square root. The IC provides the square root of a single input variable with no external components.

The IC can be used for generating both linear and nonlinear functions for on-the-spot computations, and for linearizing a wide range of transducer characteristics in medical, industrial and process control equipment designs. The accuracy performance and programmability of the device also make it suitable for analog computation or simulation and for use in test equipment designs. Further details: Parameters Pty. Ltd., 68 Alexander St., Crows Nest. NSW.

## DEFEATING POWER SURGES

A new family of semiconductor devices, designed to protect all types of electronic and electrical equipment against dangerous power surges are being manufactured and marketed by General Electric Co.

The devices known as GE-MOV (Metal Oxide Varistor) are available through Fairchild in Victoria and NSW.

The new semiconductor devices, fabricated from a polycrystalline ceramic, are a long-sought missing link in the protection of everything from television sets to multimillion-dollar computer installations against damaging transients.

The GE-MOV is a polycrystalline ceramic consisting of conductive zinc oxide grains with a thin, inter-granular bismuth oxide film that is insulating at low voltage and conducting at high voltage. The latter completely surrounds and isolates the individual grains of the zinc oxide.

The ceramic disc contains literally millions of tiny film devices at the zinc oxide grain boundaries, which are connected in three-dimensional, series-parallel networks. The voltage sensitive resistance of the thin films is the key to the operation.

The ceramic is formed by pressing and sintering, so that considerable freedom in the shape of the product is possible. Lead attachments are made to the metallized ceramic, and the device is epoxy encapsulated.

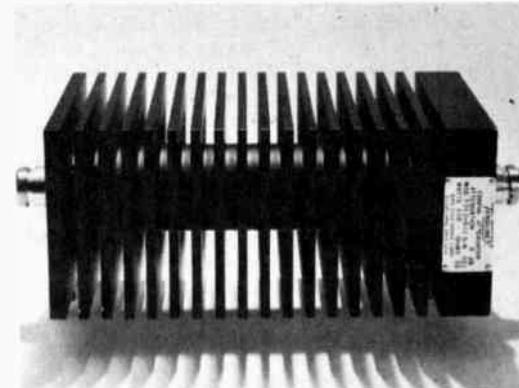
Early industrial application of GE-MOV will include protection of solid-state components in controls, instrumentation, clocks and timing circuitry, and solid-state relays. The varistors also will be used to protect switching contacts.

In the home, applications will include color television sets, stereo systems, and solid-state controlled appliances, such as dishwashers, ranges, blenders, and washing machines — protecting expensive components and minimizing service calls. GE-MOV will also become an integral part of future home wiring systems.

There are many potential applications for the new varistor in the automotive industry. Through its unique shapability, it will serve many systems as both an electrical and mechanical device. For example, it may be used to protect audio equipment and sophisticated controls for headlight high-beam regulators and anti-skid units. In cars of the future, GE-MOV will play a role in electronically controlled transmissions, alternators, and fuel injection systems, as well as in range finders and automatic braking systems.

Further details: Fairchild Aust. Pty. Ltd., 420 Mt. Dandenong Rd., Croydon. Vic.

## NEW DRY RF ATTENUATOR



A new 50 ohm high-power RF Attenuator has just been announced by the Bird Electronic Corporation.

Model 8343-060 Tenuline Co-axial Attenuator has a continuous input power rating of 100 watts in free air (i.e. without an additional heat sink). Nominal attenuation is 6 dB from dc to 1,000 MHz over a wide temperature range ( $-40^{\circ}\text{C}$ . to  $+45^{\circ}\text{C}$ .) Maximum frequency deviation is  $\pm 1/2$  dB from dc to 500 MHz and  $3/4$  dB from 500 to 1,000 MHz with input VSWR for these ranges of only 1.10 and 1.15 respectively. Since the unit is symmetrical, the output VSWR is similarly low.

Another major feature resulting in low VSWR is the use of the patented QC Quick-Change connectors, which permit

mating with male or female N, BNC, TNC, UHF, C, SC, HN, GR 874 and 7/8" EIA lines without the need for performance degrading adaptors.

Further details from Warburton Franki Ltd, 372 Eastern Valley Way, Chatswood, NSW 2067.

## NEW ZELTEX PRODUCT GUIDE

A new 16 page product guide describes the Zeltex line of linear products, data conversion modules, multichannel A-D conversion systems, and power supply modules available from Racal Electronics Pty. Limited.

Forty-eight new low-cost modular power supplies are listed, including miniature DIP compatible supplies offering AC or DC input and single, dual and triple outputs.

All pertinent electrical and mechanical specifications, as well as photos, general product descriptions, performance charts, and circuit diagrams are included in the listing. Prices and ordering information are also available.

Instrumentation Division  
Racal Electronics Pty Limited  
47 Talavera Road,  
North Ryde, N.S.W. 2113.

## TRANSISTOR BREADBOARDS AID CIRCUIT DEVELOPMENT

A new transistor breadboard offers time and money savings in the development of electronic equipment.

Designed and marketed by McMurdo (Australia) Pty. Ltd., the breadboard is invaluable to research laboratories, training institutions and design engineers as well as electronics hobbyists.

The device provides a rapid and economical means of interconnecting integrated circuits and checking circuit designs. It also makes available a fast and accurate way to assemble temporary test units.

The breadboard saves time for the experimenter by eliminating the need for soldering components.

Connections are made by using pluggable wire links, supplied with the unit in 2, 3, and 8in. lengths.

Integrated circuit sockets are fitted to the breadboard. Transistor and integrated circuit units (TO5 or dual-in-line) can be plugged into the sockets either directly or by using special adaptors also available from McMurdo.

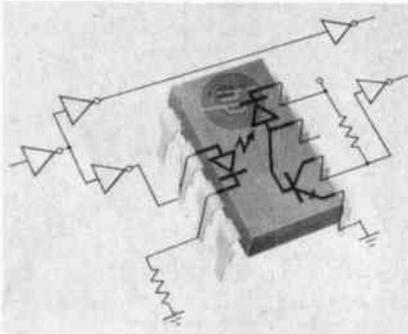
The sockets feature an extractor "key" which minimises the chance of damaging the IC's when removing them.

A 24-way edge connector is supplied and a full range of optional jumper leads is available. The breadboard itself is fibreglass

and interconnecting pins and contacts are gold plated.

Further details: McMurdo (Australia) Pty. Ltd., Box 321, Clayton, Vic. 3168.

## VERY HIGH-SPEED OPTICAL ISOLATORS



Three new HEWLETT-PACKARD optically-coupled isolators are the fastest with gain. These Model 5082-4350 Series isolators have a propagation time of only 225 nanoseconds. Bandwidth is 5 MHz, compared to previously available units with bandwidths to about 200 kHz. Maximum gain-bandwidth product is achieved by coupling the solid state light source (LED) to a monolithic IC chip consisting of a photodiode detector driving a transistor amplifier. All are contained in one mini-DIP package.

Each of the three isolators is designed for a different purpose. The 5082-4350 which drives a high speed transistor. All are in one 8-pin mini-DIP package. isolation applications; the 5082-4351 is a high gain device with a CTR of 22%. The 5082-4352 isolator, with CTR between 15 and 22% is designed for critical gain control applications. All three devices can be direct-coupled to TTL loads at TTL speeds without additional buffers or triggers.

Common mode rejection of the 5082-4350 Series is 10V at 1 MHz. Dc isolation (input-output) is 2500V. Maximum forward dc current is 20 mA; forward peak current is 40 mA maximum.

These new isolators couple a light-emitting diode to a p-n photodiode which drives a high speed transistor. All are in one eight-pin mini-DIP package. Output of the photodiode is amplified by the transistor. Thus gain as well as a high degree of ac and dc coupling is obtained.

Applications include computer interfacing, floating power supply feedback networks, substitutes for pulse transformers and mechanical relays, and a means of eliminating ground loop currents between modules of a system.

Further details: Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Vic. 3146.

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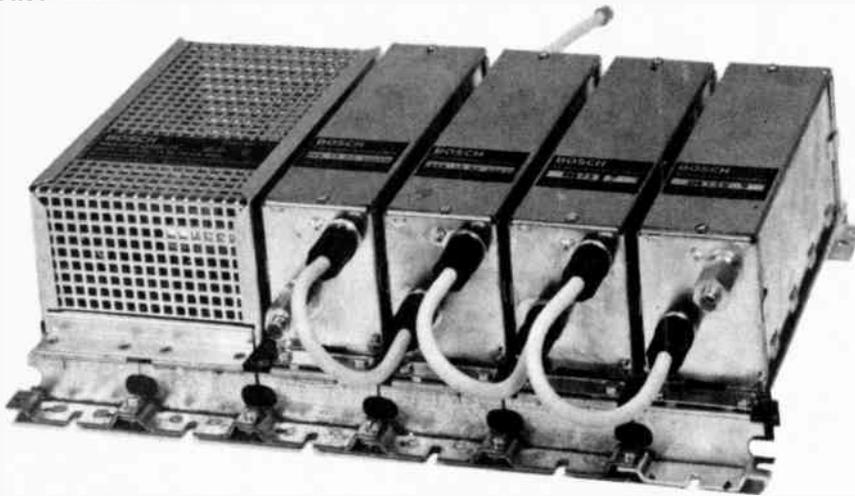
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# EQUIPMENT NEWS

## ANTENNA DISTRIBUTION AMPLIFIERS



Robert Bosch (Australia) Pty. Ltd., now have available a range of electronic transistorised TV antenna distribution amplifiers for monochrome and colour operations. These amplifiers are manufactured by Robert Bosch Elektronik GmbH. of West Germany – another member of the Bosch Group of Companies.

The range includes models to suit one household consumer, to 800 consumers in a multi-storey building. There's even models for a complete township of 40,000 persons, where the TV signal may not be good, due

to the location of the town e.g. set in a valley surrounded by mountains.

Each channel frequency is separately amplified, thus ensuring maximum output without cross modulation of the different channel frequencies. Due to this separate amplification of individual channels, a first class picture without interference is always achieved. This is an important requirement for colour reception.

Further details: Robert Bosch (Aust.) Pty. Ltd., 1, Spring St., Chatswood, NSW.

## PORTABLE TRANSDUCER MONITOR



Transducers (CEL) have introduced a portable instrument for use with transducers based on the strain gauge principle for measuring pressure, load etc. Two versions of the instrument are available, one of which is powered from its own internal PP9 batteries and the other which uses the mains.

Bridge resistances from 60 to 1,000 ohms can be supplied with the instrument and two, 10 turn, precision potentiometers provide zero and full scale adjustment facilities with an interaction of less than 2%. Full scale deflection can be set between 0.6 mV per volt and 2 mV per volt. To assist in the setting up procedure, a calibration switch connects a precision resistor across one arm of the bridge network.

Indication is by a rugged 90 mm diameter 270° moving coil meter scaled 0 – 100%, although special dials can be engraved to order. According to the manufacturers, linearity and hysteresis are  $\pm 1\%$  or better, and measurements can be repeated to at least  $\pm 0.5\%$ .

To increase the versatility of the instrument a jack socket is fitted which will provide 1 mA into 100 ohms for driving chart recorders.

Two PP9 batteries will give 60 hours continuous operation with temperature coefficients stated to be 0.2%/°C for the zero setting and 0.1%/°C for the span control (f.s.d.). The mains powered version achieves 0.1%/°C for both the zero and span settings.

The instrument measures 229 x 122 x 197 mm and weighs 3.4 kg. A leather carrying case can be supplied.

Further details: Transducers (CEL) Ltd., Trafford Rd., Reading, Berks, England.

## AUTOMATIC MEASUREMENT OF AMPLITUDE, PHASE AND GROUP DELAY

A new 50Hz to 13MHz Network Analyser is a two-channel, frequency selective voltmeter and is fully programmable. Called the Hewlett-Packard Model 3040A Network Analyser, the new system consists of a Hewlett-Packard Model 3570A Tracking Detector with any one of four new Hewlett-Packard automatic synthesizers – Models 3320A/B – as its source. Thus, the Model 3040A measures amplitude level, phase and group delay at frequencies as precise and stable as those of the source. Swept displays can be obtained if either Model 3330A or B is the signal source.

In measuring amplitude, the instrument has three bandwidths: 10 Hz, 100 Hz and 3kHz. Amplitude level is measured over a 120 dB range. The dynamic display range is 100 dB and amplitude is measured to a resolution of 0.01 dB. Both digital and analog outputs are available.

Phase shift in degrees is measured and displayed in four digits.

Group delay measurements are made quickly and automatically using an available option. While the band of interest is being swept in precisely known increments of frequency, the analyzer simultaneously makes phase measurements. The built-in microprocessor now calculates delay for each step. The scan may be displayed on any of the conventional devices – CRT, X-Y recorder, etc. Group delay is computed and displayed in units of time. Range of sensitivity is from 1 nanosecond to 10 microseconds.

The model 3040A is fully programmable, and uses the same ASCII-bus system available with the synthesizers.

The major areas of application of the Model 3570A include design, production and testing of telecommunications devices and modules.

Many of the newer telecommunications devices, such as monolithic crystal filters, need exceedingly precise characterization of amplitude, phase, group delay and

frequency. The new Model 3040A Network Analyzer with a precision frequency source, such as one of the synthesizers, provides the precision necessary to test these devices and speed to realize substantial production test time savings.

Further details: Hewlett-Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria 3146.

### GENERAL-PURPOSE, DC POWER SUPPLIES



Two new general-purpose, laboratory dc power supplies have been added to the Hewlett-Packard line of low-cost bench supplies. Designated Models 6211A and 6212A, they are both rated at 0 - 100 volts, 0 - 100 milliamperes. Model 6211A is constant voltage/current limited; Model 6212A is constant voltage/constant current. Uses for these supplies include circuit design, testing, student experiments, laboratory use, or wherever a low-cost dc power source is needed.

There are now eight units in HP's series of low-cost bench supplies. Other current and voltage ratings are: 10 V at 1 A, 25 V at 400 mA and 50 V at 200 mA. The standard features of this all-silicon line include 0.01% load and line regulation, 200 micro-volt rms/1 millivolt peak-to-peak ripple and noise (dc to 20 MHz) and a switchable front panel meter. Output is isolated so that these supplies may be floated at up to 300 volts above ground. Coarse and fine controls are also standard on all supplies.

Each of the supplies measures 5½ by 3¼ by 8 inches and weighs 4½ pounds. They are housed in impact-resistant cases. Interlocking feet on the cases allow several units to be stacked. Kits are available for single or multi-unit rack mounting.

Further details: Hewlett-Packard Pty. Ltd., 22-26 Weir St., Glen Iris, Victoria 3147.

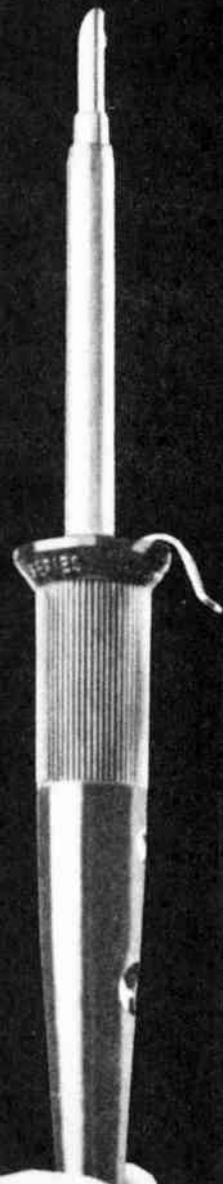
Turn to page 105

# 100 tips for superior soldering

Adcola Australia lead the world with over 100 different standard tips, covering the entire field of production and servicing. Micro-miniature and instrument work; printed circuits; heavy tag, chassis and wire soldering. All are sealed to prevent seizing in the barrel.

Each tip is matched to one of the seven long-life, fast-heating Adcola 'M' Series soldering tools — from ¾ oz. to 5 ozs. — each of which is available in at least three temperature ranges.

Benefits — swift work, durable joints, no damage to components, no joint embrittlement, lower soldering and maintenance costs. When it comes to soldering, the best tip is Adcola.



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 S.A.: Graphic Electronic Industries Pty. Ltd. Bleir Athol (Tel. 21 5644)  
 QLD.: T. H. Martin Pty. Ltd., Brisbane (Tel. 21 5644)  
 W.A.: Everett Agency Pty. Ltd., Perth (Tel. 8 4137)

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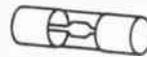
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So, before you buy any old standard DMM, check out this new Dana Model 4300 Multimeter. It has all the performance specs you need . . . plus all these features designed to make your job easier and safer. Write for literature on Dana Model 4300 today. Or phone any of the numbers below.

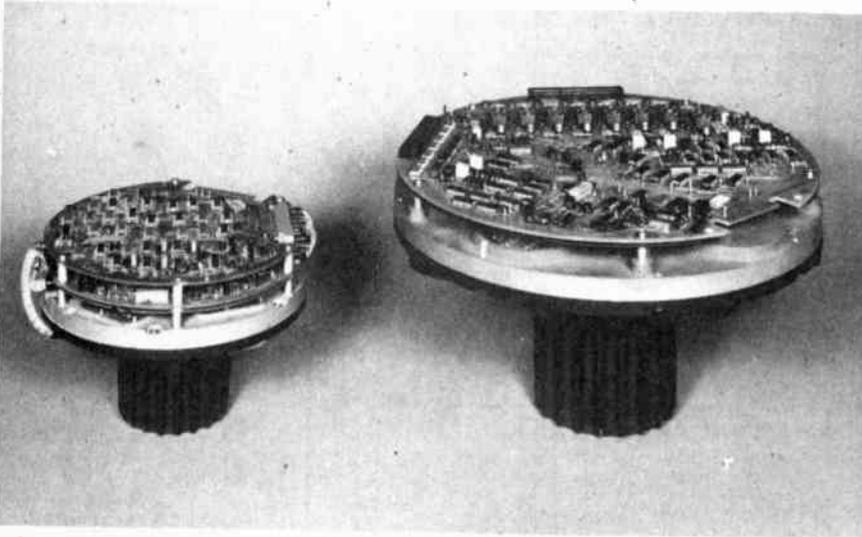


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# EQUIPMENT NEWS

## DISC MEMORIES



British Merchandising Pty Limited, who have recently been appointed agents for Singer Librascope of the USA, have now released the complete line of L107 disc memories in Australia.

The latest model in the popular L107 series, designated the L107B, providing up to 18,000 bits of storage on 256 tracks, is on the right of the photograph. Originating from the very small 9" x 7" Model L107A, which offers up to 7,000,000 bits storage capacity, the L107B at 14.7" x 9" represents the most compact disc file system available today.

All L107 models feature TTL, NRZ interface and are available with either 8.5 or 17 milliseconds average access times, and a 2MHz bit rate.

Flying, head-per-track design contributes to high reliability. Ruggedized for industrial

applications, all L107 disc memories can operate at 10G shock and 2G vibration without special mounting. In addition, the L107MA militarized version meets severe military specifications for altitude, temperature, saltspray, sand and humidity.

The self-contained, plug-in, read/write L107 magnetic disc memories are designed for applications requiring high speed, low cost data storage. These include requiring high speed, low cost data storage. These include field expandable extension of minicomputer memory, communications terminal storage, main or auxiliary memory for inventory control and production checkout systems:

Further details: British Merchandising Pty Limited, 49 York Street, Sydney, NSW 2000.

## TAPE RECORDERS PTY/LTD JOINS RACAL

Mr. Bruce Goddard, Managing Director of Racal Electronics Pty Limited has announced that the shareholders of Tape Recorders Pty Limited have accepted an offer by Racal for the purchase of all the shares of Tape Recorders Pty Limited.

Tape Recorders Pty Limited has been marketing products of the UK company Racal Thermionic Ltd. in Australia for some time. The company will now operate from Racal's headquarters in North Ryde. The product range includes Instrumentation, Incremental Multichannel Communications and Digital Tape Recorders.

In future all enquiries should be directed to: Tape Recorders Pty Limited, 47 Talavera Road, North Ryde, NSW. 2113.

## POTENTIOMETRIC RECORDERS

Siemens Industries Limited has introduced a new range of high quality low cost potentiometric recorders. Various types are available ranging from single channel continuous line to 12 point dotted line recorders.

These recorders, manufactured by Fuji Electric Co. Ltd. of Japan, employing solid state electronics and precision mechanical construction, complement the well-established range of Siemens kompensographs.

An extensive range of Fuji recorders is stocked locally in readiness for calibration in Siemens' Melbourne workshop.

Turn to page 107

# UNITED TRADE SALES P/L

280 LONSDALE STREET,  
MELBOURNE, 3000  
PHONE 663-3815 (Opposite Myers)

**CASSETTE TAPEHEADS.** Transistor, mono @ \$1.50 ea. P/P. 15 cents.

**UHER TAPEREORDER MOTORS AND TRANSISTORISED MOTOR CONTROL MODULES.** \$5.50 the pair. 75 cents P/P.

**HEADPHONES LOW IMPEDANCE.** New \$1.50 P/P, 50 cents.

**ELECTROLYTIC CAPACITORS.** 500  $\mu$ F. 50 volt. 50 cents. 640  $\mu$ F. 16 volt. 25 cents. 32  $\mu$ F. 350 volt. 35 cents, P/P. 10 cents.

**MINIATURE POTS.** 250 ohm. PRESET or 10K. PRESET. @ 15 cents each. P/P 10 cents.

**LOOP STICKS.** 4 1/2". \$1.00 ea. 8" \$1.25 ea. (Broadcast only) P/P. 15 cents.

**POWER TRANSFORMERS — BRAND NEW.** Primary 230 Volt AC-Sec. 26-0-26 volts 280 ma-Sec No. 2 90 volts, Size 2 1/4" x 2" x 7/8". Only 1.50 ea. P/P 50 cents.

**SPECIAL — CURLY CORDS.** 25 cents ea. P/P 15 cents.

### MULTIMETERS —

	Sens. OC	Sens. AC	PRICE
C-1000	1,000 o/v	1,000 o/v	\$6.75
CT500/P	20,000 o/v	10,000 o/v	\$18.75
AS			
100D/P	100,000 o/v	10,000 o/v	\$34.50

Add 60 cents for pack/post

**WIDMAIER SWITCHES.** 2 sets, change over contacts. \$2.00 each. P/P 20 cents.

**DENSHI CONSTRUCTION KITS,** no soldering required. There are 16 Projects, including Transistor Radio, Morse Code Oscillator, Continuity Tester, Signal Injector, Transistor Wireless Microphone, Transistor Reflex Radio and numerous others. These kits are priced at only \$11.50. P/P 80 cents.

**PIANO KEY SWITCHES.** 6 keys, 4 sections with 6 changeovers, \$1.00 ea. P/P 40 cents.

**SILICON DIODES.** 100 P.I.V. -145 amps. \$4.50 ea. P/P 40 cents.

**PHONE JACKS** 3.5 and 2.5mm 10 cents ea. P/post 6 cents.

**COMPUTER BOARDS.** Size 1. Contains 4-0c45, glass encapsulated. 2 min. toroids. 10 diodes \$1.00 ea. P/P 20 cents. Size 2. Average 10 Transistors, 30 diodes, resistors and capacitors. All components have long leads. \$2.50 ea. P/P 40 cents.

**RECORD PLAYER MOTORS — c/w speed control.** 6v — \$1.00 each. 9v \$3.50 each. Plus 40c. P/P.

**PUSH BUTTON CAR RADIO TUNERS — BROADCAST c/w coils.** \$5.00 each plus 50c P/P.

**2 SB407 TRANSISTORS — 30 watt.** \$1.25 each plus 20c P/P.

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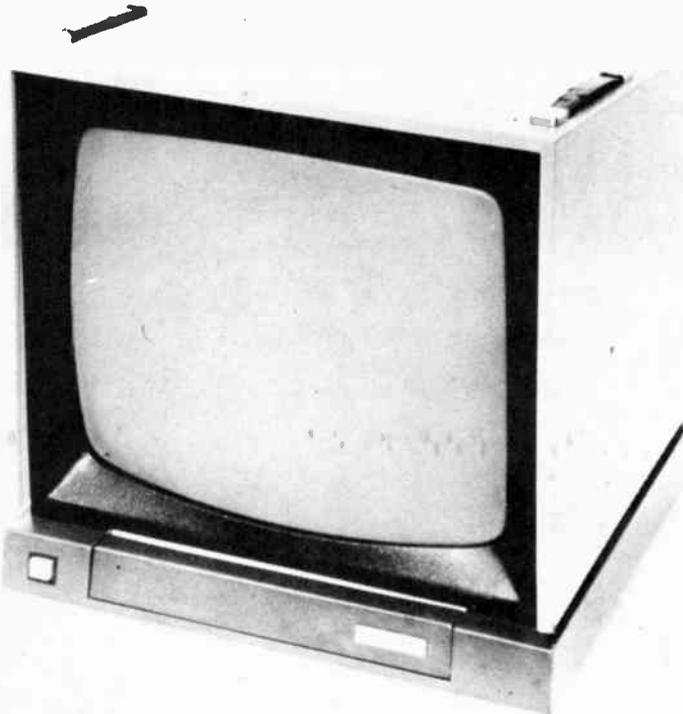
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**TEST INSTRUMENTS**

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## EQUIPMENT NEWS

### SOLID-STATE VIDEO MONITORS



A range of solid-state video monitors is available from AWA Rediffusion Pty Ltd., the Australian agents for Electrohome, of Ontario, Canada.

Electrohome monitors have been used as an integral part of message centres in hotels, theatres and at conventions. Other applications include: computer and data display uses and industrial, education and commercial TV monitoring systems,

including television stations, hospitals and airports.

Nine, eleven and twenty-three inch screen sizes are offered with a 10 MHz performance and a variety of standard features including separate sync input, underscan, VTR time constant switch etc.

Further details: AWA Rediffusion Pty. Ltd., Box 96, P.O., North Ryde, N.S.W. 2113.

### BATTERY POWER SUPPLIES

A range of rechargeable battery power supplies are now available to fill the need for dc power away from the mains or where it is not feasible to install a mains power supply. These units, known as the 'SHOPACK' use gel electrolytic cells which give them extremely high current and ampere/hour ratings. The units all have a patented sensing/charging circuit which controls the charge on individual cells thus compensating for cell differences and varying discharge states. The patented circuit also prevents any possibility of overcharging the unit.

The 'SHOPACK' is available in standard models covering the range of 1 to 20 ampere/hours, at ratings of 6 to 120Vdc continuous current ratings of up to 25 amps and short duration loads of 100 amps. For special requirements the 'SHOPACK' can be

supplied with higher voltages, ampere/hour, and current ratings. Further details: John Hadland (Aust.) Pty. Ltd., 28 Chester Street, Oakleigh, Vic., 3166.

### POWER SUPPLIES

Integral Design have recently released three new power supplies intended for use with both analog and digital integrated circuits.

They have excellent load and line regulation, are isolated to  $\pm 300V$  and incorporate LED overload indication.

Models available are 5V, 1A or 3A and  $\pm 5V$ , 1A, models with variable outputs are also available.

Further details: Integral Design, 105 Hawthorne Rd., Caulfield, Vic. 3161.

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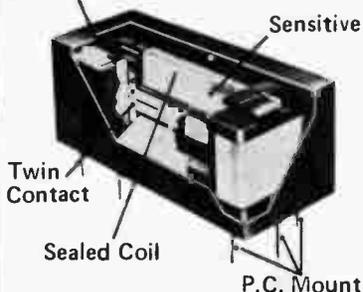
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Bi-Stable Option

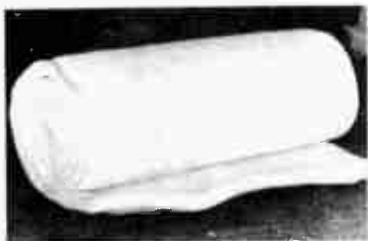


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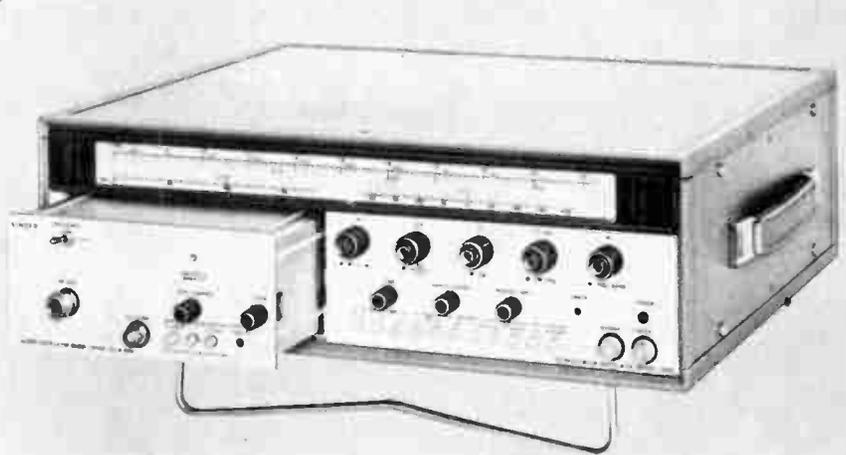
# WONDER WOOL PTY. LTD.

87 James Street, Leichhardt  
N.S.W., 2040.

Box 548 G.P.O., Sydney 2001.  
Phone: 56 2780.

# EQUIPMENT NEWS

## SOLID-STATE SWEEP GENERATOR



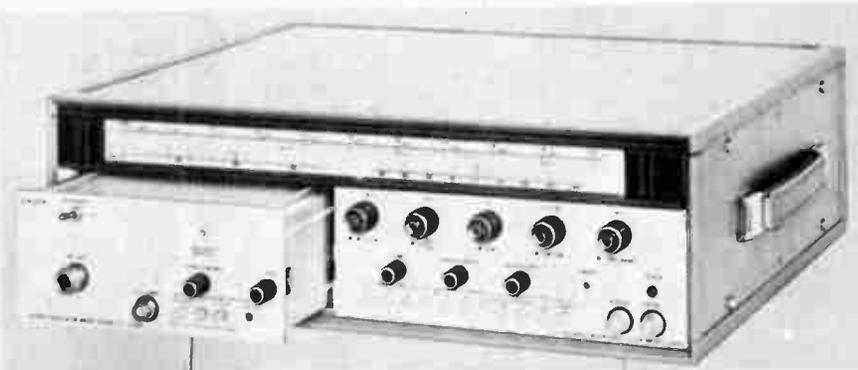
The Singer Company has just released a flexible solid-state oscillator system, the Model 6600. The instrument provides stable CW and Sweep frequency coverage from 100 kHz to 18 GHz with a series of 19 plug in units.

In addition to the plug-in covering the standard microwave bands, there are two broad-band units; 100 kHz to 110 MHz and 10 MHz to 2 GHz; and three narrowband communication units; 1.8 to 2.5 GHz, 3.6 to 4.3 GHz, and 5.9 to 6.5 GHz. All units feature high output power (e.g. 100 mW up to 500 mHz; 30 mW, 2-4 GHz), stable CW

with exceptionally low residual FM (e.g. less than 3 kHz peak, 1-2 GHz) and closed loop levelling with external or internal PIN diode levelling above 1 GHz. Simplified front panel controls include lighted pushbutton function selectors, 3 independent sweep modes (full-band, marker, and delta F sweep), calibrated delta F sweep, and CW vernier. Remote programming is available as an option.

Further details: DC Industries Pty Ltd., 32 Smith St., Collingwood, Vic. 3066.

## AUTOMATIC SYNTHESIZER



Two new frequency synthesizers with a stability of  $\pm 1 \times 10^{-8}$  per day, -50 dB signal-to-phase noise and a constant resolution of 0.1 Hz up to 13 MHz are introduced by Hewlett-Packard. These new signal sources, the Hewlett-Packard Model 3330A and Model 3330B, have read-only-memories (ROM's) built in for control of all instrument operations. An external computer is NOT needed for sweep

control; the built-in ROM remembers the sweep parameters as programmed from the instrument keyboard.

Four-digit amplitude control to a resolution of 0.01 dB over a 100 dB range is standard on the Model 3330B. The Model 3330A has a manual control for amplitude, and output is levelled to  $\pm 0.5$  dB. Its amplitude range is about 0 to +13 dB. Both instruments are programmable (except for

**MICRO-ADS**

amplitude on the Model 3330A).

Frequency stability can be improved to  $\pm 1 \times 10^{-9}$  per day with an available option. Another option provides a reference source of somewhat less stability. However, these instruments can be phase locked for operation from any source.

Spectral purity, not normally associated with frequency synthesizers, is a feature of both units. Spurious is greater than 70 dB below the carrier, and harmonics are greater than 60 dB to 40 dB below the carrier, depending on the frequency setting.

As sweepers, the instruments use digital sweeping for linearity. Either single or continuous sweeps may be set up. Frequency parameters are entered from the keyboard or remotely; the size of the sweep step can be as small as 0.1 kHz. Parameters such as centre frequency, frequency step, time per step and the number of steps go into the memory, then are executed by pressing a single button. The ROM operates the sweep as set up until told to stop. Many of the sweep parameters can be changed whilst the instrument is sweeping. The Model 330B sweeps amplitude in steps as small as 0.01 dB. The amplitude can be stepped at the end of each frequency sweep cycle to produce a family of curves.

Both instruments are fully programmable. All necessary status and control lines required for interfacing are standard. Each control has a specific 7-bit parallel ASCII code assigned to it. An addressing feature allows operation of several units in parallel. Only one programming device or interface card is needed to fully programme multiple units.

Both the Models 3330A/B can be amplitude modulated using an external signal of up to 100 kHz.

Further details: Hewlett-Packard Australia Pty Ltd, 22-26 Weir Street, Glen Iris, 3146, Victoria.

**DYNAIR  
ELECTRONICS EQUIPMENT**

AWA Rediffusion Pty. Ltd; have been appointed by Dynair Electronics Inc. of San Diego, California, to market their equipment in Australia.

This range of products complements the existing range of equipment and systems available from AWA Rediffusion for the professional CCTV user, and for Broadcast TV requirements.

The Dynair product range includes the highly successful "Mini" series units for CCTV use through to video programmers/special effects generators, routing switchers, modulators and allied TV control and transmission equipment.

A significant feature of all Dynair products is their high technical standard ensuring full PAL colour TV performance at realistic prices.

A 94-page catalogue is available on request from AWA Rediffusion Pty. Ltd., P.O. Box 96, North Ryde, 2113.

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**CRYSTAL RADIO KIT No. 28207**, tunes AM broadcast band, simple 1 hour construction, no batteries, ideal for beginner, \$4.25 post and pack .50c

**AM TUNER AMPLIFIER KIT No. 28241**, build your own 3 transistor tuner and amplifier, all parts transistors, tuning gang, transformers, speaker etc. \$12.50 p.p. .75c

**10 PROJECT ELECTRONIC KIT, NO.28202**, 10 working projects, SOLAR BATTERY, builds radios, oscillators, signal generators, all solid state. \$7.50 p.p. .75c

**15 PROJECT ELECTRONIC KIT No.1544**, learn electronics with each project. Build these, morse code oscillator, radios, alarms, sirens etc. \$9.90 p.p. .85c

**IC-20 20 PROJECT ELECTRONIC KIT**, learn about integrated circuits with this educational kit, 20 working projects including integrated circuit. \$11.90 p.p. .95c

**50 PROJECT KIT No.28201 DELUXE MODEL**, 50 working projects, educational entertaining, all solid state, includes everything, nothing to buy, constructed in hardwood case, panel meter, radios, amplifiers, burglar alarms, tachometer, test equipment, good value - \$19.50 p.p. \$1.20

**DELUXE 150 ELECTRONIC PROJECT KIT** using integrated circuits. Contains all parts for 150 different working projects including I.C. diode & transistor radio, electronic switches, relays, alarms, test equipment, etc. etc. Very good value, Prices \$30.95, p.p. 95c.

**ELECTRONICS TODAY INTERNATIONAL MICRO ADS RATE IS ONLY \$7.50 PER SINGLE COLUMN INCH OR 76c PER LINE. TO PLACE YOUR MICRO AD, MERELY FILL IN THE FORM BELOW AND SEND TO ELECTRONICS TODAY INTERNATIONAL, MICRO ADS, 21-23 BATHURST STREET, SYDNEY, 2000.**

**FINNED ALUMINIUM HEATSINK/BOXES.** Use as heatsink or two mating sections will form a sealed box, internal racks for P.C. board (etc.) mounting provided ideal for C.D.I., P.A. amplifiers, inverters and 100's of uses. Available in two sizes plain or anodized in red, black, blue or gold. 6"Lx 4"Wx 3"D plain @ \$2.35 or anodized @ \$2.80. 4"Lx 4"Wx 3" plain @ \$1.85 or anodized @ \$2.35 P. & P. for up to two boxes 50 cents. Oil filled capacitors for C.D.I. 1.0 mfd at 400 VW 1000 Volts test \$1.80 P. & P. 25 cents. All Mail Orders despatched same day. Send Money Order or Bank Cheque to: H. P. H. Electronics, P.O. Box 15, LIVERPOOL, N.S.W. 2170.

**ECONOMICAL I.C.'s:** You need - we quote (S.A.E. Please). SN7490N Decade counter only \$1.50 each + 20c post with free data! DF! Service, P.O. Box 188, Blackwood, S.A. 5051.

**BE A COMPUTER TECHNICIAN -** Part-time course commences Feb. Enroll now. Contact D. H. Tow on 929-5004. Advisory Computer Information Centre, Suite 606, 107 Walker St., North Sydney.

**DECADE COUNTERS.** Numerical Indicator Tube mounted edgewise on printed circuit board, with TTL I.C.'s and P.C. socket complete \$16.50 each. Write for data sheets. Booth, 37 Lewis Street, Wickham, 2293.

**XMAS SPECIAL** Mix of untested silicon and germanium trans., 20 for \$1. SURTAN, Box 317, GPO Sydney 2001.

**FREE CATALOGUE -** Electronic Kit construction plans of all descriptions. Sydney Electronics, P.O. Box 76, GPO, Sydney, 2001.

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Micro Ads**

21-23 Bathurst St., Sydney. 2000

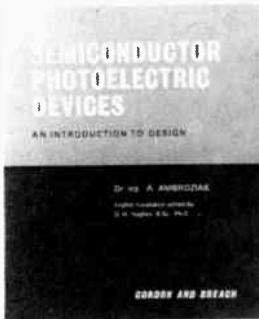
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# BOOK REVIEWS

REVIEWER: Brian Chapman



**SEMI-CONDUCTOR PHOTOELECTRIC DEVICES** – An Introduction to Design by Dr. Inz A. Ambroziak. Published by Iliffe Books Ltd. 1965. Hard covers 328 pages 8" x 6½". Review copy supplied by Butterworths (Aust) Pty. Ltd. Australian price \$14.60.

Semiconductor, photoelectric devices are having far reaching effects on our technology. Practically every traditional opto-electronic device has been replaced by its solid-state counterpart. In addition a whole host of new devices have created a technology with ramifications beyond the wildest dreams of many scientists a few years ago.

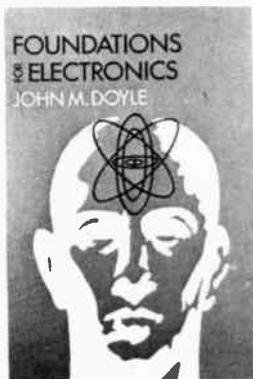
The LED and the phototransistor because of their minute size and low power consumption are finding many new applications, whilst the possible applications of semiconductor lasers are still being explored. For example the practical realization of optical communication links with fantastic information transmission capacity are now within reach of technology. The world of opto-electronics is truly an exciting one.

This book is a classic work on semiconductor photoelectric devices and was translated from the original Polish by O.H. Hughes Ph.D. Dr. Ambroziak is a leader in the photo-electric design field and has been awarded prizes for papers on his fundamental research work.

The text is very complete, covering all aspects of the topic from fundamental parameters of semi-conductors used as photoelectric devices, to the construction and theory of housings for photo devices.

Graphs, tables and drawings are used throughout the text to aid the theoretical discussion which contains all the necessary formulae to completely describe the physical processes involved.

This book will be a standard work for engineers and technicians involved in the design and manufacture of such devices, and will be of considerable value to engineers and students in general electronics who wish to improve their familiarity with the field. – B.C.



**FOUNDATION FOR ELECTRONICS** by John M. Doyle. Published by Rinehart Press San Francisco. Hard cover 455 pages 9¾" x 6¼". Review copy supplied by Holt Rinehart and Winston (Aust) Pty. Ltd. Australian price \$14.15.

"Foundation for Electronics" is a basic text on dc, ac, magnetic and network theory, suitable for use in the first year of a university course in electronic engineering or other allied fields.

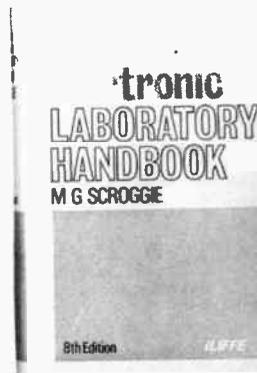
Although the opening chapters of the book require only a knowledge of basic algebra, the level of mathematical knowledge required increases as one progresses through the book. This increase is consistent with a concurrent course in mathematics extending to matrices, determinants and complex algebra.

An unusual feature of the book is an opening paragraph to each chapter entitled "Highlights of what you will learn" the aim of which is to encourage the student to browse through the book

before undertaking a detailed study. This device, I feel, is largely unnecessary; what student does not browse through the text anyway – usually horrifying himself in the process. Nevertheless it may create some additional interest.

All the conventional topics are treated – current and voltage, resistance, network theorems, magnetism and inductance, capacitance, ac circuits, basic electrical measurements, mesh-current analysis and node-voltage analysis. The treatment is good, with plenty of worked examples and scads of problems at the end of each chapter. Tables of trigonometric and exponential functions are provided at the end of the book and in all the whole is a well rounded presentation of the basics of electrical-network theory.

It should be a very useful addition to the standard texts of any student engineer. – B.C.



**RADIO AND ELECTRONIC LABORATORY HANDBOOK** by M.G. Scroggie. Bsc, CEng, FIEE. 8th edition 1971. Published by Iliffe Books. 614 pages 5½ x 8½, hard covers. Australian price \$15.00. Review copy supplied by Butterworths (Australia) Pty Ltd.

Mr Scroggie, better known perhaps as "Cathode Ray", has been active in electronic literature for some 50 years and in that time has written over 800 technical articles and several books. Apart from the present volume under discussion, two of his most read books are "Foundations of Wireless and Electronics" and "Second Thoughts on Radio Theory".

The Radio and Electronic Laboratory Handbook has been a standard reference on the general principles of measurement and laboratory practice since it first appeared some 30 years ago. Don't get the idea that Mr Scroggie is an 'old fogey', or not up with modern technology just because he has been around for a long time. On the contrary, his works still remain among the most readable, without sacrificing accuracy or detail, of popular electronic literature available.

This eighth edition has been further extended over previous editions by the inclusion of material on semiconductors, integrated circuits, operational amplifiers and digital instruments, and is therefore technically right up to the minute.

The book opens with discussions on the purpose and layout of a laboratory and then the fundamental principles of measurement are treated at great length with much clarity in the third chapter. Six chapters deal with basic measuring circuits, indicators, standards and composite equipment. Four chapters on the measurement of audio, RF and active devices are then followed by another on the measurement of equipment characteristics.

An essential feature of measurement, often overlooked, is the interpretation and recording of results and the methods of determining limits of error. This is the subject of the second last chapter, which is a mine of useful and timely advice on making the most of your results.

Lastly a really excellent reference section of 100 pages gives formulae, tables, design rules etc, most commonly required in the laboratory.

Throughout the book numerous references are given to texts and papers which provide further reading for those who require additional information on any particular subject. This is an extremely valuable feature that considerably extends the usefulness of the book.

This book rightfully belongs among the standard references found in the workshop of every serious experimenter. – B.C.

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# RECORDINGS... CLASSICAL

REVIEWER: John Araneta.



**GERSHWIN - PIANO CONCERTO IN F RHAPSODY IN BLUE "I got rhythm" Variations - Werner Haas (piano), Edo de Waart (cond.), Monte Carlo Op. Orch. PHILIPS SAL 6500 118.**

German, Dutch, and Monagesque elements seem a strange combination for this obviously American music, but I am not saying the results are predictable given such forces. The concerto especially is accorded rather slack rhythms from the orchestra, wind and brass barely passable at times in their solos. Things cry out to be "whacked" into place. The second movement proceeds more comfortably but with no "swell" or bloom. The Finale is as slack as the opening movement with considerable deterioration towards the end. To be fair not even major American orchestras can sound properly incisive in this music. However deeply felt Gershwin's piano writing here, his orchestration is a hardly transparent affair. Yes, a Bernstein can surprise us in this work, but not even he can convince me those final chords are anything but wretched-sounding. Not until Porgy and Bess, does Gershwin achieve something approaching orchestral mastery, but even the more, skilfully managed Variation of 1934 has its problems of orchestral balance. In the Variations and the Grofe-orchestrated Rhapsody, conductor and orchestra repeat their sluggish treatment of the Concerto. There are moments in the Rhapsody when the orchestra takes an almost French provincial band sound and rhythm which sounds plain silly. And where is the "oomph" and "feel"? If there is anything positive on this record it must be Werner Haas' playing. Once again one wants more incisiveness ala Levant or Bernstein but Haas plays brilliantly and also seems considerably more sympathetic to his music than conductor or orchestra. Yes, this music can be performed idiomatically by non-Americans. I can

remember a splendid performance of the Rhapsody by the Iturbis which was rhythmically crisp and almost devoted-sounding, but if you do not mind the slack in these performances the recording is certainly good. - J.A.A.

**SCULTHORPE - SNOW, MOON AND FLOWERS, NIGHT, LANDSCAPE, Meale - Coruscations, Sculthorpe - Sonatina, Edwards - Monos II - Roger Woodward (piano) HMV OASD-7567.**

A recital of contemporary piano music can be at best an amusing exercise, more often simply irritating or boring. What's new? Fat chance. To begin with I must admit I am prejudiced against a piano's sound as a vehicle for achieving anything new. Rather shamefacedly I often may find a so-called contemporary piano piece worth the bother because it is precisely at this point in time already traditional, reminding one of the past masters of 20th century piano writing. Otherwise we must have (what!) the same type of post-Weberian intervals and sequences, after that the same, then the same, and so on, one or two typical Weberian rhythms. I have heard it before. Or liven it up with a tape (make your own), stand on the piano and utter yuck, yuck to all who murmur. Are we not all misunderstood? I am quite willing to be proved wrong about the piano's being no longer a vehicle for the new. The sooner, the better. Until then I would rather not hear yet another new old series. Complaints about all those same sounding Baroque composers? What's the difference? And so with this record.

We have (surprise) a good piece, Meale's Coruscations. It's trad. but good. Well made. Another? Yes, Sculthorpe's Sonatina. Admittedly sounds like so and so, and so, but good. Monos II? Yes, good. Not as good as the first two but good. Why? Meale and Sculthorpe certainly have absorbed the idioms respective to their pieces. So the idioms are already old, so what? Hello, here comes trouble. "Sun, Moon and Flowers" and "Night" by Sculthorpe. I remember they were charming pieces for the piano. They were. Roger Woodward has decided to play them by actual manual contact of the strings. You see, you may get the Japanese allusion smack in the face. No, we just cannot have it in the title. Ditto, "Night". How about "Landscape"? I like the annotator's revelation that the original pre-recorded tape was discarded because it only "used a limited number of different musical ideas." This is better? No speaking voice on tape, no stimme! Let's have the same sequence again. Right. Now, where is that record of Bellini rarities? - J.A.A.



**MENDELSSOHN - VIOLIN CONCERTOS IN D MINOR AND E MINOR Yehudi Menuhin (violin), Fruhbeck de Burgos (Cond.) London Symphony Orchestra HMV OASD-2809.**

Having once heard the D minor a few years back, I was not that anxious to hear it again and started off with this yet another recording of the E minor. Well, I thought, at least one does not have to have another Bruch First or similarly well known concerto with it. To my mind this concerto is invariably associated with Menuhin (is this his fourth recording of the work) and his unique feeling for it remains undiminished and certainly comparable to any of the earlier readings. Perhaps there was greater assurance of tone on ASD-334 but strangely there is here a fullness and an almost autumnal warmth not encountered before. The second movement is very movingly done, better than on the above record. If this E minor has a reflective quality to it, this D minor shows Menuhin surprisingly spontaneous and youthful. Any scant shortcomings I may have noticed in the E minor is non-existent here and this concerto from the fourteen year old Mendelssohn is not exactly an easy matter. If this-concerto is no masterpiece, it is, at least in this performance, an enjoyable and refreshing work. Not the least of the credit for this fine record goes to the conductor Fruhbeck de Burgos. Fruhbeck has always had a way with Mendelssohn and here he invests the E minor with an appropriate freshness, fine phrasing, and care for details. Indeed I would say that Fruhbeck's very exuberant conducting of the early D minor makes all the difference for this concerto. This recording does present true collaboration from all concerned. Good sound and fine pressing. - J.A.A.

(Turn to page 115)

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# CLASSICAL

**BERLIOZ - THE DAMNATION OF FAUST.** Soloists Lamoureux Orchestra of Paris, Igor Markevitch (cond.) DGG 2705026 (2 LPS).

Despite the resurgence of interest in Berlioz in the past fifteen years or so, it is surprising the Damnation of Faust has not had the popularity it deserves. Listening to this reissue from DGG, one marvels at the audacity and originality Berlioz put into this score. Is it not significant that while Germans still insist on calling Gounod's treatment Margarethe, they do not hesitate to use Faust for Berlioz's dramatic legend? This Faust along with Busoni's opera are perhaps the finest treatments in music of the legend. But it is not just that March, or that astonishing crash when Mephisto appears, or even that Ride to Hell (who else would dare treat or more properly, invent such an episode) which make this music worthwhile. Berlioz's legend has an almost cinematic swiftness which is nothing short of remarkable for its time. As for dramatic treatment we have one of the few real devils in music, a Faust rather more believable than Goethe's own (at least to our minds he for once ends properly) and both Goethe and Berlioz would agree Gretchen must always be like Gretchen. Certainly, some of the most expressive passages in Berlioz are found in his treatment of the Gretchen episode. Need I say more? This Berlioz score has always been one of my favourites and it always seems distressing to find people who have recordings of the Te Deum or the Symphonie Funebre and have never bothered to hear a bar of this work.

This recording by Markevitch has been for a long time now the preferred reading of this work. It still is, and the recording was one of DGG's early best. I notice the fourth side has been remastered and that technical defects previously encountered in all sets have been eliminated. Markevitch countenances a few cuts but not much and his reading is always intense and nervous. His forces are evidently caught up by this feeling and give all their worth. At the price (\$7.96) I rather feel cheated but those who love their Berlioz need not hesitate. - J.A.A.

**BRITTEN - STRING QUARTET NO. 2 in C - TIPPETT - STRING QUARTET NO. 2 in F SHARP - Carl Pini Quartet HMV SOXLP 7552.**

Coming soon after this quartet's fine recordings of the Bloch and Debussy quartets, I must confess this record is very much of a disappointment. To begin with, much of the blame must be laid on the engineering aspects of this disc. I played the Britten first and quickly got up to see whether I had the stereo switch off but everything was in fact in order. The range on this record is of the sort one would expect from none too good quartet recordings done in the fifties in mono or very early stereo. There is simply no depth, presence, differentiation and blend. These qualities are particularly important in recordings of this sort. One cannot start off with a consideration of the playing when

had the popularity it deserves with the record-playing public. Listening to this reissue from DGG, one marvels at the audacity and originality Berlioz put into this score. Is it not significant that while Germans still insist on calling Gounod's treatment Margarethe, they do not hesitate to use Faust for there must also be technical disadvantages like what we have here. Cramped or thin string sound? No power? Ragged ensemble playing? It would simply not be fair to say the fault lies with the performers. But while I must stress that so much of the original characteristics of a performance can be altered in the recording process, poor recording per se can hardly hide the fact that the performances here are far below the standards of the best live performances by this quartet. Intonation is a particularly acute problem in the Tippett and especially the Britten. There is little sense of line (listen to the Chacony in the Britten), and the phrasing leads one to wonder how familiar these quartets are to the players. Faster passages are very often a scramble of sound, although here again the final result may be a great deal due to the engineering. It is a pity a recording like this could be passed by EMI, and I have no wish to dissuade this quartet from their commendable efforts to record unusual material. Call this an off day. - J.A.A.



**KATHLEEN FERRIER SINGS - HMV HLM 7002**

The second part of this recital consists of arias by Handel and Green, and duets (w/Isobel Baillie) by Purcell and Mendelssohn. Victorian realisations of the earlier pieces, a generally sentimentalized delivery mars this side of the record. But Ferrier's Kindertotenlieder is a different matter altogether. There are a number of present interpretations showing greater vocal purity than this one. Ferrier's main fault, her vibrato, seems strangely appropriate in these songs, an almost tonal embodiment of grief. There is in any case no other interpretation on record that to my mind approaches Ferrier's for beauty of phrase and intense delivery. Most modern interpreters opt for a more tonally scaled-down reading; Ferrier is unashamedly emotion, and I feel, at least when this cycle is sung by a woman, that a similarly

committed delivery is to be preferred. At any rate, I doubt there can be many who can listen to that final verse of "In diesem Wetter" in complete detachment. Bruno Walter's accompaniment with the Vienna Philharmonic is still to my mind, one of the finest there has ever been. - J.A.A.

**MARIA CALLAS - Arias from Verdi - HMV OASD-2791.**

Non-devotees of the Diva may well wonder what may have induced EMI and Callas herself to release this record. For those who know and cherish Callas' Tosca, Gioconda, Carmen & Lucia this record may seem a rather painful experience, nor can this recording serve as an introduction to this singer's art, and I do not think it was ever intended as any such. The general tone of the voice is frayed, the top very weak, and that famous wobble all too much in evidence. For the Callas-hater, there is much here one can easily ridicule. But as ever there is that marvellous clarion quality to the voice, that unique sense of identification with the words and character. One can argue forever about whether opera is first song or drama. It is neither. Callas in her great moments makes you appreciate that fact; such an instance on this record is her magnificent entrance in "Ritorna vincitor". Yes, the tone is now unbeautiful but few today phrase as she did, and it is now almost tiresome to point out those portamentos. This record then does serve as a document of what can be done in some arias with La Callas' techniques. - J.A.A.

**TCHAIKOVSKY - Symphony No. 2 "Little Russian" Bernstein, New York Philharmonic SBR-235508**

Like this recording of the "Winter Dreams" Symphony, this reading of the Second by Bernstein is undoubtedly one of the best there is: there is splendid panache, drive and every lyrical moment is given full-blooded treatment. I especially like his very marcato treatment of the opening of the second movement Andante marziale. Everything moves forward in this performance and not because of the speed, I assure you. In so many romantic works, it is performance that makes or breaks a work. Bernstein certainly makes it, and one can at times forget this is one of Tchaikovsky's weakly constructed moments. It is certainly a pity Bernstein does not elect to conduct more of the neglected 19th century repertoire. Just imagine a Bernstein with Meyerbeer! But having said this, I must confess this domestic pressing certainly helps to drive one away from this performance. Strings wiry, distorted, no body, flat, out of phase, surface noise, you name it. Why cannot CBS here use the original matrices for their records I do not know. Even granting the usual complaint of bloodlessness which seems to affect the domestic CBS product, I happen to have some older locally pressed discs which nowhere seem as bad as some of the latest releases. If you must have this work, an import copy is certainly worth hunting or writing for. - J.A.A. ●

REVIEWER:  
Michael Delaney.



**"CARL & THE PASSIONS - So Tough"** - The Beach Boys. W.E.A. Stereo. MS.2090. You Need A Mess Of Help To Stand Alone - Here She Comes - He Come Down - Marcella - Hold On Dear Brother - Make It Good - All This Is That - Cuddle Up.

This is the new Beach Boys - a seven piece band minus Bruce Johnston and plus two guitarists from the now disbanded Flame, Ricky Fataar and Blondie Chaplin. Their first album "So Tough" has enjoyed a lot of success overseas, but, frankly, considering that it's supposed to represent some kind of new phase in their artistic development - a chance to increase their waning productivity; it's a bit disappointing.

It's probably just a simple case of growing pains: they haven't had quite enough time to work out what they want to do and so they're hanging back until it clicks for itself. But, still, you would've expected them to have done something a little less ordinary. After all, they're no spring chickens when it comes to making music. They've got a sizeable reputation to uphold and a creative standard well known for its subtlety and sense of the unique. Right.

"So Tough" is filled with pleasant songs - nicely inoffensive stuff that you can either take or leave. But it doesn't hold its own as an album. In many ways, it's unfortunate that it came so soon after "Surf's Up" because it just isn't anywhere near as good. The musicianship may be varied and discerning; the instrumentation well executed and the harmonies sensitive. But, once again, the whole effect is lost on a bunch of songs that - in part - lack quality and end up unable to relate in concept.

For a start, Chaplin and Fataar are not good writers: their sense of melody is limited and their inventiveness poor. Neither has the style to add anything substantially different to the overall personality of the group. And that was the main reason for them joining in the first place: to inject some new blood. At the worst, they

sometimes seem to have the opposite effect, making the music a little mediocre. Quite simply, their influence is a restriction - devoid of colour and lacking depth. They stunt the band.

As individuals, the Beach Boys seem to be running pretty low on imagination. Their songwriting, taken as a whole, has fallen into a rut, following much the same pattern as on "Surf's Up". Generally, the music is listless: the melodies all sound vaguely familiar and the arrangements are repetitive - coming back to established methods. Somehow, the band has lost its spark - its will to create. And then again, it's quite possible that they've just run out of ideas.

"So Tough" isn't a good album because the material is too disjointed. There's none of the loveliness - none of the striking vivacity and grace that went into "Surf's Up". In comparison, most of the tracks just don't grip: Brian Wilson's "You Need A Mess Of Help To Stand Alone" loses out in sounding too much like "Marcella" which, in turn, harks right back to "Do It Again". And that sets the standard for the whole show - their level of ingenuity is way down.

As a band, the Beach Boys used to do wonderful things with their music. They were never loud or explosive because the melodies didn't need it. Songs like "Feel Flows", "Don't Go Near The Water" and the classic "Surf's Up" were theirs and theirs alone: swift, hypnotic, tasteful and delicate. They had a rapport - a haunting fluidity that made them touch on emotions that few thought possible in rock 'n' roll.

It's a shame that things have to change so quickly because, in some aspects, the Beach Boys have been left behind. "So Tough" isn't so tough at all - kind of slugging around without any impact. It comes across insipid and slightly stale: they can still go through the motions of sounding like the Beach Boys but the magic isn't there. They simply don't come together as a team: each is off on his own tangent performing as best he can by himself. But it doesn't work.

There's a couple of nice things on the album that shouldn't go without credit just the same: Dennis Wilson's "Cuddle Up" and "Make It Good" are two fine songs, a little over accentuated, but still fine. Had the rest of the album been a bit more vital, they would've gone down a storm. As it is, they seem over-bearing and mostly out of proportion.

Apart from its musical inconsistency, "So Tough" suffers from an appalling balance: the songs fail to complement each other and, at times, even clash. It's kind of like having too many cooks and not enough broth - the band is working out with a rash of separate directions none of which get established. All the moods and feelings are chopped about, broken and disposed of well before they have the chance to build anything really interesting.

Another problem is dynamics. The group gets it on to a point, but then can't seem to drive it home. They don't deliver anything real - anything to latch onto. "Here She Comes" and the gospel-like "He Come Down" are affected the most, working up to a chunky rhythm without following it through. Both songs come out vacuum - wasting time and effort.

"So Tough" is an album that falls short - an album that doesn't communicate. The only song that you could call an unqualified success is "All This And That" - an attempt to enkindle the beauty of "Feel Flows". But even that has been done before. M.D.



**"FANNY HILL"** - Fanny. W.E.A. Stereo. MS.2058. Ain't That Peculiar - Knock On My Door - Blind Alley - You've Got A Home - Borrowed Time - Wonderful Feeling - Hey Bulldog - Think About The Children - Rock Bottom Blues - Sound & The Fury - The First Time.

I'm glad that ladies have started to rock 'n' roll because they can do it really neat and satisfying. Most of the music so far has been relatively feather-weight with the action still coming from solo performers: Carly Simon, Merry Clayton, Carole King and the late Janis Joplin. But there's a couple of lady bands the likes of Fanny who've begun to change priorities right the way around. Simply this: they rock like bitches.

To be frank, rock 'n' roll was never meant to be played by ladies because it's largely an aggression thing - the louder and dirtier it is the greater the response. And rock depends a whole lot on response - something that very few women have succeeded in evoking from a predominantly male audience.

Janis got by alright because she sang mad and passionate. Occasionally she'd touch on a nice boogie, but her thing was the blues and not, as some seem to think, hard rock. Carole King and Merry Clayton have come pretty close at times in cuts like "I Feel The

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That's how The Stereophile magazine described the Amcron DC 300 after an exhaustive performance test. Experts of High Fidelity magazine, in their review said: "It is built like the proverbial Sherman Tank and its performance is so good, it seems to mock the measuring equipment used for evaluating it." And, "when we compare the DC 300 with other available power amps the difference is almost beyond belief."

Our philosophy at Amcron is that there's no such thing as good-better-best. Variations in product scope and function, yes, but deviation from the highest degree of perfection attainable — no! Our dedicated aim is to continue to produce audio equipment which sets the ultimate standard of reference. We cannot apologise for our prices. Because every item of equipment that carries our name has been designed by our engineers to be measurably and audibly superior to anything else available — regardless of cost.



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### AMCRON DC 300 POWER AMPLIFIER

has the lowest distortion level of any commercially available power amplifier — IM distortion across the entire power spectrum from .01 watt to 150 watts per channel typically below .05%. And the purest sound. It has the lowest noise level of any commercially available power amplifier — guaranteed at 110 db S/N below 150 watts output. Power is guaranteed at 180 watts per channel RMS with 8 ohm loads. Less than \$1,000.



### AMCRON IC 150 PRE-AMPLIFIER

is an experience in silence, and it, too, has set new records for IM and harmonic distortion. Audio Magazine said: "When it came time to measure IM and THD, our test set-up proved to be completely useless." Less than \$470.



### AMCRON D-60 POWER AMPLIFIER

has superb square wave and overload response, with a power bandwidth of 5-30,000 Hz and an exceptional damping factor of over 200. It is a perfect matchmate for the IC 150 stereo console, if you want the quality of the AMCRON DC 300, but do not require its power, e.g. when using high efficiency speakers. Less than \$430.

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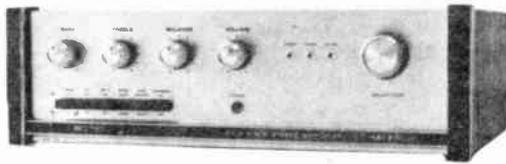
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**INTERDYN**

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**INTERDYN**

## POP TRENDS

Earth Move" and 'Gimme Shelter' respectively. Even so, they're still into a form of music that rarely gets down and gets with it. Both of them prefer blues or jazz to simple rock 'n' roll.

Then you get a band like Fanny – four ladies who actually call themselves Fanny and mean it. They don't play blues and they're just about as far removed from jazz as you'll find anywhere this side of Steppenwolf. No. Fanny gets it on. They go right out of their way to meet rock on its own terms – basic and rude and mostly electrifying. They lay what they've got on the line with no farting about. And it's great – good and solid.

"Fanny Hill" is the album that'll break them huge. Their first two discs, "Fanny" and "Charity Ball", didn't do all that much in any set direction – kind of loosing energy on a bunch of songs that tried to rock but couldn't. "Charity Ball" almost made it, producing a hit single from the title track, though that was quickly forgotten in any case. Not that this matters in the long run because, with "Fanny Hill" out on the rage, they have made it and will continue to do so better and better.

The thing that'll keep Fanny going isn't just that they're adequate musicians because these days you've got to be to do anything. No. Their biggest asset is in the songs. Fanny writes killer material – real hard core stuff not unlike the Beatles circa "Rubber Soul". There's even a touch of the Stones thrown in for good measure: "Borrowed Time" packs a wallop like "Brown Sugar". And it may come as a surprise, but it's just as funky.

The music doesn't really need much description because it's the type of rock 'n' roll that everybody knows. The melodies might be new, but the feel is something that has been with us ever since Chuck Berry. And this is the thing that Fanny plays up for all it's worth.

"Fanny Hill" is like two sides of the one coin. There's the boogie and there's the ballad – both of which come across just fine. "Blind Alley", "Borrowed Time" and "Ain't That Peculiar" rock like maniacs – immediate, vital, punchy and colourful. Then there's the ballads – "You've Got A Home", "Wonderful Feeling" and two gospel sounding cuts, "Think About The Children" and "Sound And The Fury". That's the sensitive stuff – songs about love and people: people loving and loving people.

"You've Got A Home" is a bottler – one of the loveliest and most moving things I've heard since "Superstar":

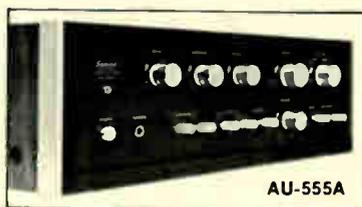
'I didn't plan it.  
but I'm glad that you were born.  
Someday I'll have to tell you  
why  
I've chosen to live alone.  
You may not have a father  
but you've got a home.'

Fanny is a great band and "Fanny Hill" is a great album. They do what they do with taste, intelligence and emotion. This is something that shouldn't be overlooked. Now that I've said all that, I can go and play it through again, like I've been playing for the last two weeks.

– M.D.

# Select Sansui Stereo amplifiers for...

Superior design  
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Sparkling performance



AU-555A

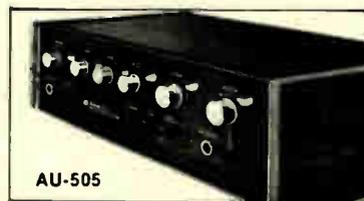
When you're considering the purchase of a complete new stereo system, the control amplifier is the key to the whole program. So it's worthy of detailed analysis.

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The startling difference you will notice with any Sansui stereo amplifier is the *tonal*

*quality* and the obvious *dynamic range*. In every price bracket your new Sansui amplifier sounds like a much more expensive unit. These are not idle words. In the review of the least expensive Sansui amplifier, the AU-101, a leading Australian journal said ... "*... few amplifiers, regardless of price, give an overall test result as good as this*". Another review said ... "*... better than most other amplifiers at twice the price*". With those comments made about the AU-101 (recommended price \$149) can you imagine how effective the other models in the Sansui range are? With more power and, let's face it, higher price tags?

*Let's look at the complete Sansui stereo amplifier range:*



AU-505

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AU-666	70 watts RMS	10-40,000 Hz. $\pm$ 1 dB.	\$325
AU-888	90 watts RMS	10-70,000 Hz. $\pm$ 1 dB.	\$403
AU-999	100 watts RMS	5-100,000 Hz. $\pm$ 1 dB.	\$460

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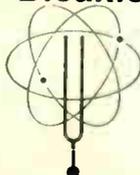
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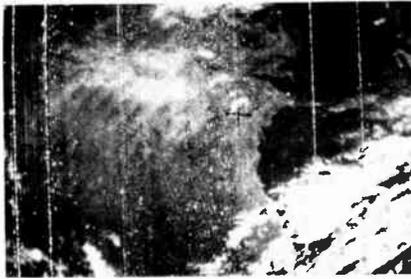
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# INPUT GATE

LETTERS  
FROM  
OUR READERS

## WEATHER SATELLITES



I enclose a couple of pictures made on Oct. 28 1972 — transmitted by the APT weather satellite. (One picture is reproduced above — Ed).

These were obtained via a 21" TV tube (giving an 12" square display). The transistors in this set have been dc coupled to the yoke, the former being fed from valve cathode followers.

To save on dividers, a tuning fork is used; this has been filed down to 512Hz and mounted in a small oven.

I would like to receive other satellite information and would be grateful for data.

W.H. Petrie, Qld.

*We will publish details of specific satellites of probable interest to radio amateurs as details come to hand.*

*Apart from this we can provide some limited information about specific satellites. Readers who require this information must state the precise name or nomenclature of the satellite concerned.*

## T.D. KURRY FOR MADRAS

Perhaps the heat of Madras Curry has made A.E.M. a compulsive knocker. (Electronics Today Int. 14th Dec., 1972).

His outburst against everything from "tits" to "fellow travellers" requires little comment but his views on TDK recording tape cassettes should be corrected.

Some years ago TDK developed an entirely new cassette and tape for Hi-Fi enthusiasts and it became known as the "No-Jam" Cassette in U.S.A. and Asia. Naturally other manufacturers have recognised TDK's advances and are now producing similar types of cassettes. The fact remains that TDK sellers have a unique tapered flange, the pin is shown in the advertisement as "Stainless steel", and the bobbin clamp is different and holds the tape securely at two points.

A.E.M. is an obvious reactionary and resents all types of revolution, whether a TDK cassette revolution or an

Electronics Today International revolution.

Vive la difference Mr. Editor!

M. Goldfinch,  
Convoy International, Sydney. NSW.

*\* Several readers have assumed that by publishing AEM's letter last month (in which he took exception to an advertisement for TDK tape), we concurred with his criticism.*

*This is by no means the case. As with any readers' letters published in ETI, the opinions expressed are those of the writer. Letters are selected for publication for their interest value alone, and their selection should in no way be seen as an endorsement (or otherwise) of the contents.*

## CONFLICTING STATEMENTS

The recently published Australian Hi-Fi Stereo Buyer's Guide states in an article (on page 13) that 'the more speakers in a system the better the system works and sounds'. Yet in the December 1972 issue of Electronics Today International you state quite categorically that 'there is no relationship between the number of drive units in any given enclosure and the resultant sound quality'.

Apart from that, in the November 1971 issue of ETI you quoted the efficiency of the Sonab OA-5 loudspeaker as 0.3% — yet the Stereo Buyer's Guide quotes a figure of no less than 93% for the very same unit.

Why don't you both get your facts straight?

C.C. Parramatta.

*In common with other publications, we do not normally comment on copy appearing in a competitive magazine. In this case the sheer weight of queries related to this matter leaves us with no choice.*

*Regarding your first point — if it were true that the greater the number of speaker drive units the better the resultant sound, then leading speaker enclosure manufacturers would build them that way.*

*The fact is that with rare exceptions they don't — as a glance through the specifications of enclosures made by companies such as A&R, Advent, Bowers & Wilkins, Fisher, KLF, Leak, Sonab, etc will show.*

*It is not the quantity of drive units — it is the quality of the drive units — and how well they are used, that counts. Drive units are relatively cheap — the knowledge of how to use them is not.*

*The second point raised is a matter of definition and measurement, not opinion. Because of this we have asked our acoustical consultant — Louis A. Challis of Louis A. Challis & Associates to comment. Here are his remarks:—*

*'The efficiency of a loudspeaker is defined as the ratio of acoustic watts/output to electrical watts input for any given level of sound.*

*Our measurements are taken using a known level of electrical power input — and a measurement is then made of the acoustical power output. These measurements are taken in our NATA registered laboratory and have a known order of accuracy.*

*The figure of 0.3% observed for the Sonab OA-5 speaker is roughly what we had expected and is typical of loudspeakers of this general type of construction.*

*It should be borne in mind that if this speaker really had an efficiency of 93%, a power input of less than 15 watts would result in an acoustic power output in excess of the pipe organ in the Sydney Town Hall (which is around 12 acoustic watts played at peak intensity).*

*Assuming that by 'Efficiency' the commonly accepted definition is implied, a figure of 93% is clearly incorrect.'*

## ANTI-WORLD

One of the things that I really like about ETI — and which sets it apart from all the other electronics journals — is the extraordinarily wide range of topics that it covers.

It is probably for this reason that it is read in the (philosophy) department of the university at which I teach, and you may be surprised to know that at least six other people here read my copy after I have finished with it.

I found the article 'Searching for the Antiworld' (Dec. 1972) of particular interest. May I however point out a couple of minor inaccuracies.

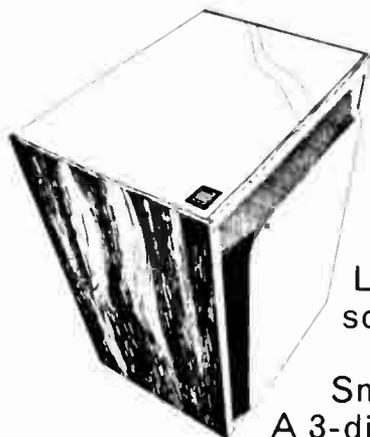
C. D. Anderson, discoverer of the positron and co-discoverer of the muon is a physicist not an astronomer.

The author states that the Leidenfrost experiment is similar (or related to) electrolysis. This is not correct. In fact a far more accurate description is given in Jan Vernon's review of Alfven's 'Worlds — Antiworlds — Antimatter in Cosmology' in your same issue.

J.S. Cape Town, South Africa.



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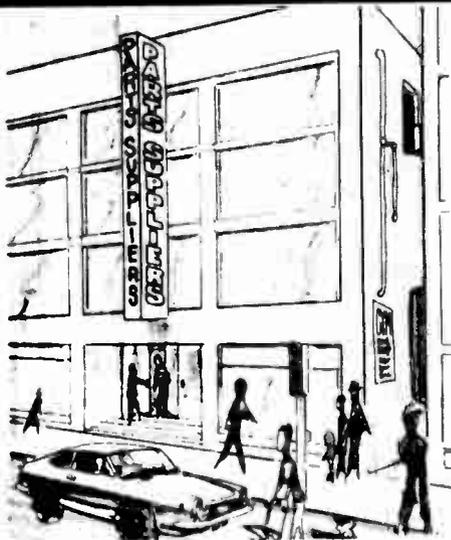
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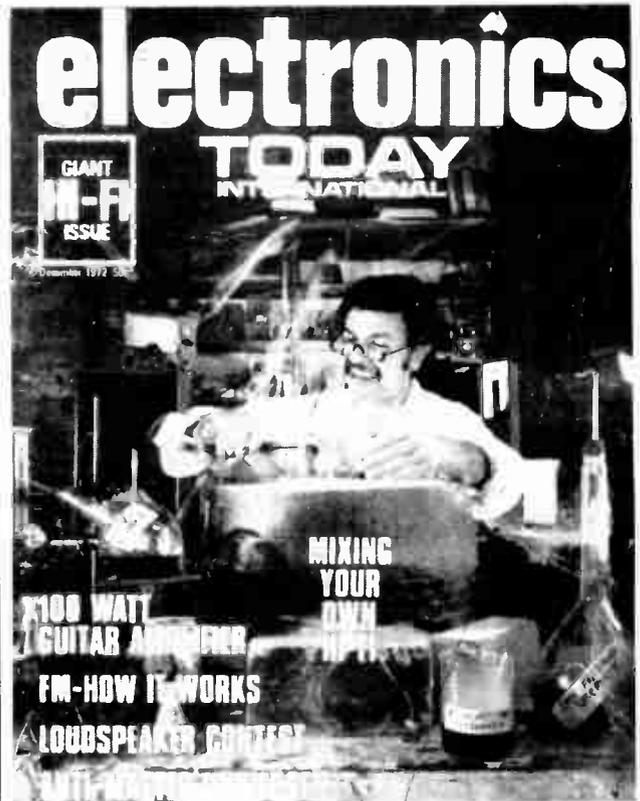
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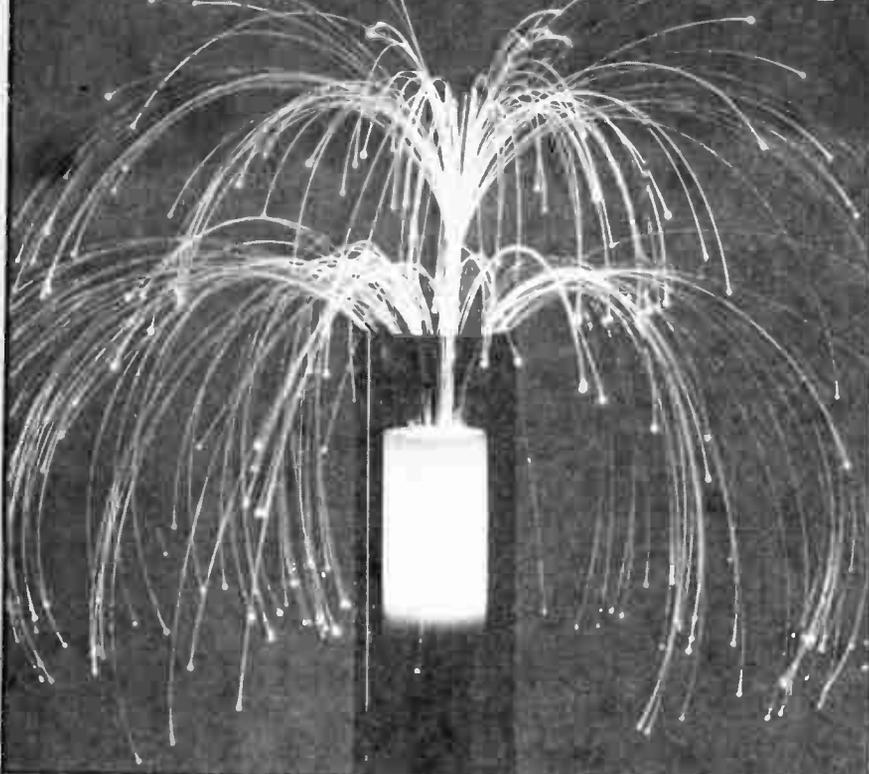
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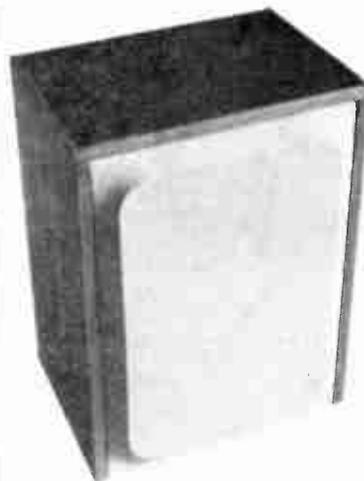
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# news digest

(Continued from page 14)

guidance. They have experienced experts, including research geologists, on staff, many of whom have been involved with the technique since its early 'classified' days."

## DRAFT STANDARD FOR DIAGRAMS, CHARTS AND TABLES FOR ELECTROTECHNOLOGY

The Standards Association is seeking comment on a draft Australian standard for diagrams, charts and tables for electrotechnology issued as DR 72193.

The purpose of the draft is to prescribe a single, unambiguous system for the establishment and use of item designations for electrical and electronic components, parts and equipment. It is intended to be used for the interchange of information in diagrams, catalogues or technical manuals and in conjunction with relevant graphical symbols on drawings.

It is recognized that the proposed system differs in several respects from those now in use in Australia, but it is emphasized that although some designations are changed the most common usages remain. This system has been adopted by the IEC and is already being introduced by a number of countries. Its advantage, especially for international usage, is the logic and simplicity of the single letter approach, when compared with other systems now in use.

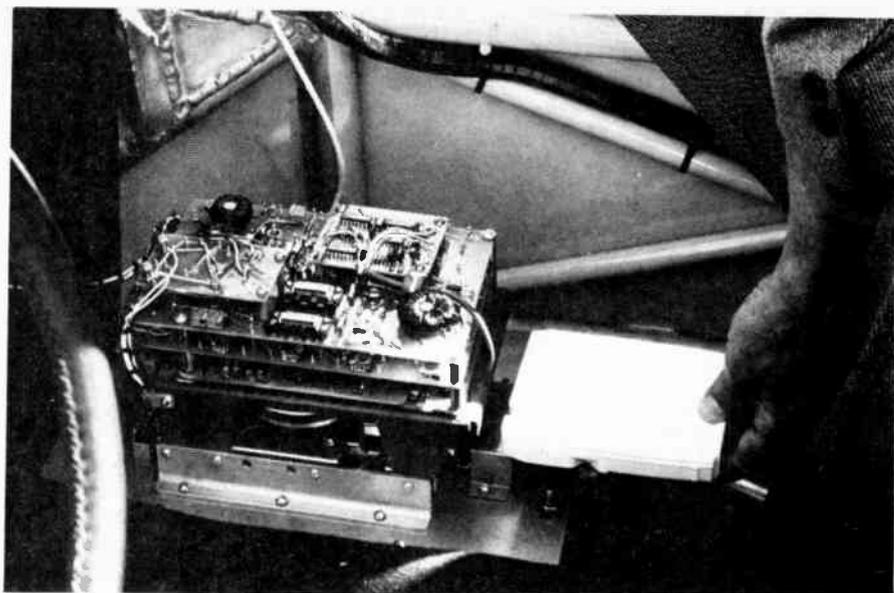
Copies of DR 72193 may be obtained without charge from the various offices of the Standards Association in all capital cities and at Newcastle.

Constructive comment on this draft is invited from persons and organizations experienced in the use of electrical diagrams and associated systems of item designation. Comment should reach the Headquarters of the Association, 80-86 Arthur Street, North Sydney, N.S.W. 2060, or any branch office not later than 28 February 1973.

## ELECTRONIC CRASH RECORDER

With automobile traffic still claiming more victims than wars, (approximately 50,000 fatalities a year in the U.S. alone), the U.S.A.'s Department of Transportation is clearly interested in reducing this toll.

One major step in that direction is the development of an electronic crash recorder by Avco Systems Division of



Wilmington, Massachusetts. Under contract to the Department of Transportation's National Highway Traffic Safety Administration, Avco has designed a sophisticated recorder that will automatically record vital data immediately prior to an accident and at the time of impact.

Ready to begin the first of a long series of tests, the crash recorder was installed this month in a Porsche 917-10 racing car, driven by Mark

Donohue, in association with Roger Penske Racers of Newtown Square, Pennsylvania. The installation was supervised jointly by the Department of Transportation and Avco. Scheduled to remain in the Donohue car for the entire racing season, the recorder will get its first real endurance test.

The electronic device is a compact unit (smaller than a breadbox) linked directly with sensors at vital

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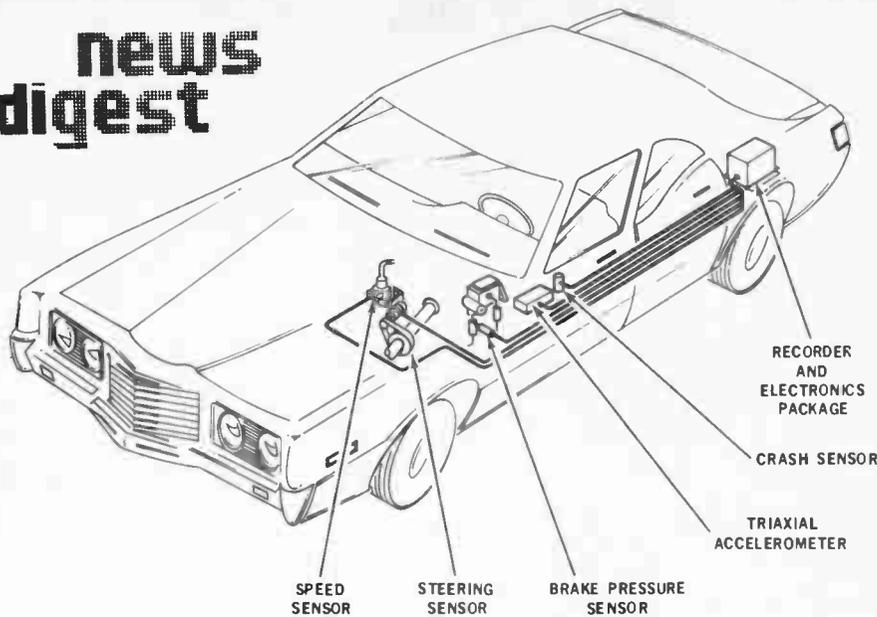


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# news digest



mechanical points in the car. The sensors feed back information to a continuously running tape, measuring acceleration, deceleration and brake pressure. In the event of a crash, the tape recorder shuts down automatically after six seconds, but in the moments before, vital information has been electronically logged. Doug Toms, Administrator of the

Department of Transportation's National Highway Traffic Safety Administration, stated, "it could be an invaluable aid to the vehicle owner and the investigating officer to find out how fast the vehicle was going when it hit the object: to know what kind of G forces were on the object; to know whether or not the restraint system was working; to assist the occupant in

product liability cases because he then has a third-party kind of assessment of what took place. It would provide a wealth of information to the manufacturer for improving his product. It would help the victim to know exactly what happened to him. It would provide information to the investigating officer and State agencies controlling this environment. I think it would be beneficial all round.

Charles Conlon, Avco Program Manager, sees the crash recorder as a breakthrough in achieving greater safety on the highways. The project has an important application since no one has really had any accurate information regarding actual accident conditions until the development of this device. Actual crash data will help solve the dilemma of why people are sometimes killed in mild crashes while others walk away from seemingly severe accidents.

Although the initial stages of testing the crash recorder are just now getting underway, Avco spokesmen feel its impact will be felt throughout the automobile industry. For as more and more data is gathered and analyzed, there may emerge new concepts that can be translated into a greater safety on our highways — and quite possibly, a radical reduction of deaths and injuries.

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- Reel size 7
- Tape speed 3<sup>3</sup>/<sub>4</sub> ips and 7<sup>1</sup>/<sub>2</sub> ips
- Triple motor mechanism
- Wow and flutter .08% at 7<sup>1</sup>/<sub>2</sub> ips
- F/R 30 to 22,000 Hz at 7<sup>1</sup>/<sub>2</sub> ips
- S/N Ratio 55dB



**Automatic Reverse Stereo Tape Deck Model A-1250**

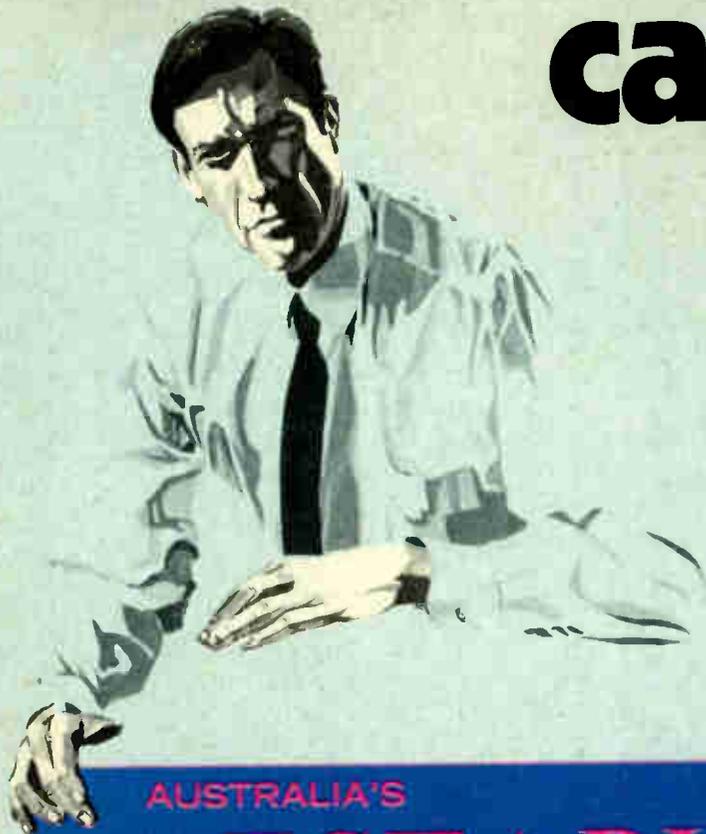
- 3 heads-4-head function
- Reel size 7
- Tape speed 3<sup>3</sup>/<sub>4</sub> ips and 7<sup>1</sup>/<sub>2</sub> ips
- Triple motor mechanism
- Wow and flutter .08% at 7<sup>1</sup>/<sub>2</sub> ips
- F/R 30 to 22,000 Hz at 7<sup>1</sup>/<sub>2</sub> ips
- S/N Ratio 55dB



**Combination Head Stereo Tape Deck Model A-030**

- Reel size 7
- Tape speed 3<sup>3</sup>/<sub>4</sub> ips and 7<sup>1</sup>/<sub>2</sub> ips
- One motor mechanism
- Wow and flutter .08% at 7<sup>1</sup>/<sub>2</sub> ips
- F/R 30 to 22,000 Hz at 7<sup>1</sup>/<sub>2</sub> ips
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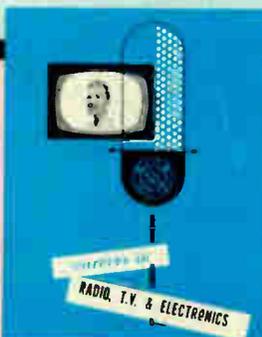
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