

MAY 1972 50c

electronics

TODAY

INTERNATIONAL

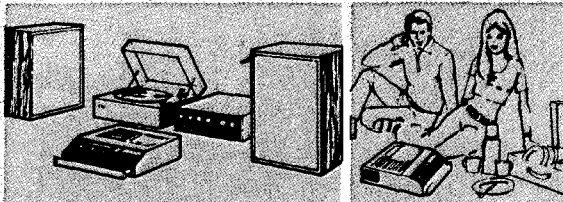
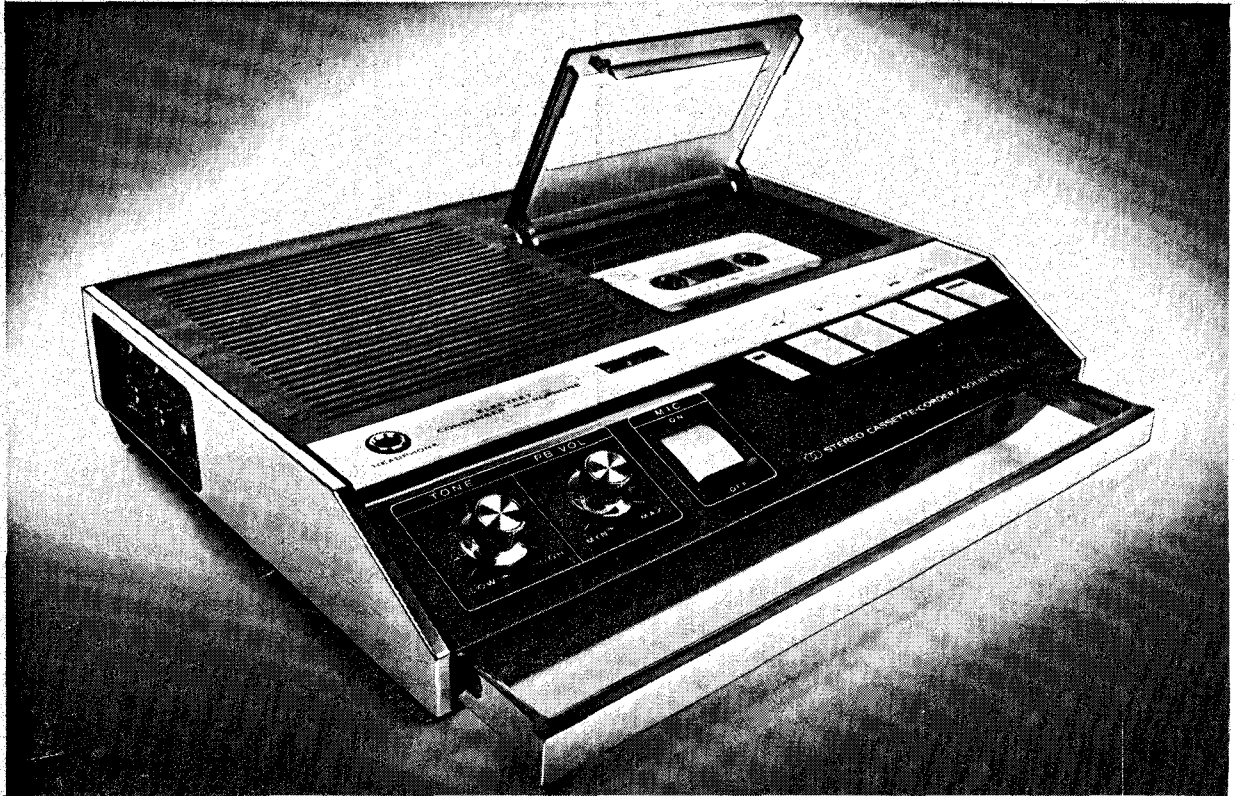


HOW TO BUILD THE
SOUND-
OPERATED
FLAME

ELECTRONICS IN ANTARCTIC ■ ICs IN CARS ■ SUPER-STEREO PROJECT
UNIQUE CAPACITORS ■ WIRING EXTENSION SPEAKERS ■ 3 HI-FI TESTS

Another ingenious Sony idea.

TC-146 stereo tape deck
that's a portable mono
cassette-corder, too!



Here's Sony's latest novel and neat combination! TC.146 is the tape deck with 'legs' — the go anywhere stereo tape deck that functions independently — a mono portable cassette-corder when you need it. The 1.5 watt output TC.146 in an elegant walnut finished cabinet has built-in carrying handle, electret condenser, microphone, built in 4-inch speaker and built-in Sony precision all the way. Features include ultra modern head gap and low-noise, low-distortion for wide frequency response, high signal to noise ratio. Tape end alarm, too. About \$210.

SPECIFICATIONS

- Power requirements: AC 240V, 50Hz; DC 6V; 4 "C" size flashlight batteries, rechargeable battery pack BP-16 (optional), car/boat battery with car battery cord DCC-126 (optional)
- Power consumption: AC 6W, DC 2.3W
- Tape cassette: SONY tape cassette C-30, C-60, C-90, C-120; SONY Hi-Fi cassette C-60HF, C-90HF, C-120HF; High performance tape or equiv.
- Tape speed: 1 7/8 ips
- Tracks: 4-track 2-channel stereo and 2-track monaural recording and playback
- Maximum recording time: 120 min. with C-120 (both sides)
- Circuits: 20 transistors, 1 FET, 7 diodes
- Speaker: 4" PM dynamic
- Power output: 1.5W (max.) with built-in speaker
- Frequency response: 40-10,000Hz
- Wow and flutter: 0.22%
- Signal-to-noise ratio: 45dB
- Input jacks: Microphone input jack x2, Auxiliary input jack x2
- Output jacks: Line out jack x2, Monitor jack x1, Headphone jack x1
- Other jacks: Rec/PB connector x1, Remote control jack x1
- Dimensions: 11 1/16 x 2 5/8 x 8 7/16"
- Weight: 6 lbs. 3 oz.

SONY

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KEMPTHORNE**

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TO: Jacoby Kempthorne, 469-475 Kent Street,
Sydney, N.S.W. 2000.

Please send me, without obligation or cost, information on
the TC.146.

NAME

ADDRESS

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electronics TODAY

INTERNATIONAL

MAY 1972

Wave Blue

Vol. 2 No. 2

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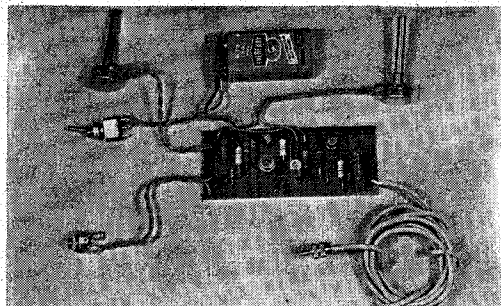
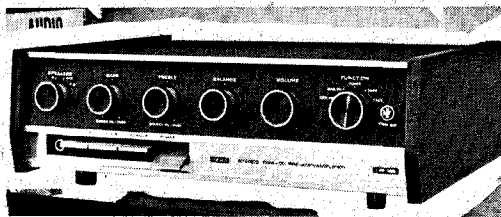
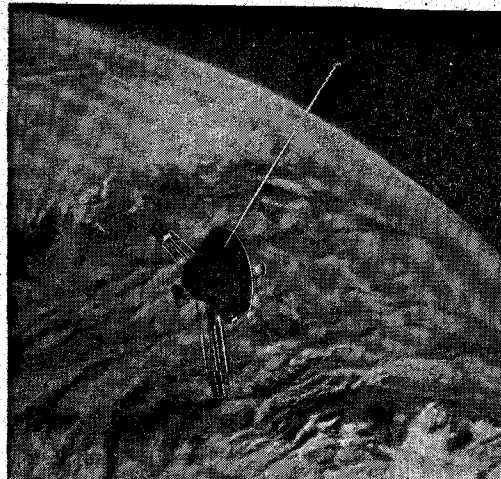
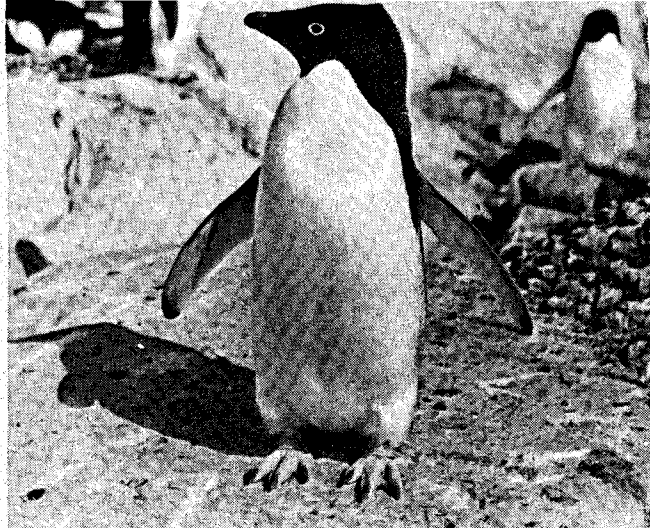
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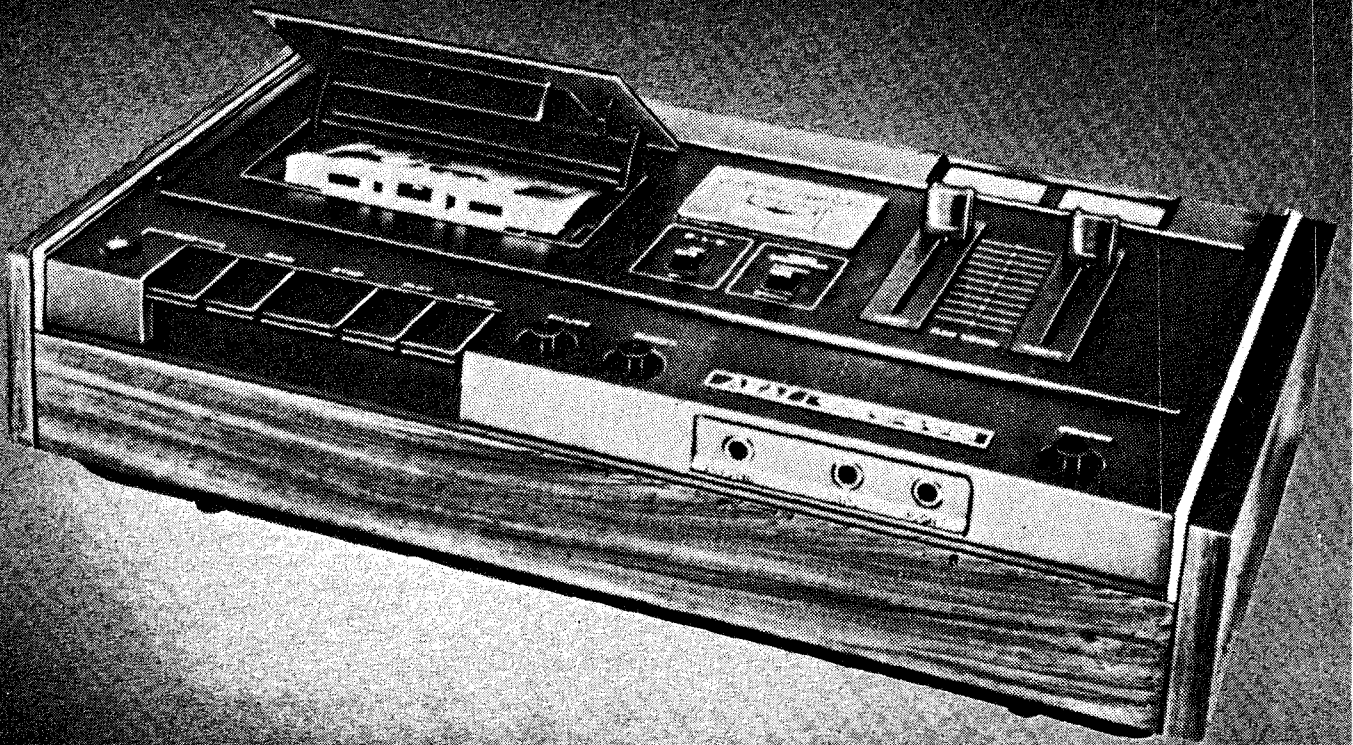
COVER: With bulb's glass envelope shot away, light filament is exposed to atmosphere, flares brilliantly for a few milliseconds before burning up. Action was stopped with sound-operated flash described this month.

ELECTRONICS TODAY INTERNATIONAL — MAY 1972



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GXC-40D
SPECIAL PRICE
\$232

AKAI's latest GXC-40D Cassette Stereo Tape Deck is the world's first cassette deck to incorporate the now world-famous GX (glass and single crystal ferrite) Head hitherto employed only in AKAI's professional high grade open reel tape recorders and decks. The AKAI-developed revolutionary GX Head is "dust free" and "wear free" and guaranteed for highest quality

sound for over 100 times the service life of conventional permalloy heads! And due to the employment of this hard gem-like head, the use of chromium dioxide tape, which exhibits excellent response, is now possible.

Other outstanding features of the GXC-40D: 2 heads including one recording/playback GX Head, special chromium dioxide tape

switch, distortion eliminating Over-Level Suspension (OLS) switch, hysteresis synchronous outer-rotor motor, fast forward, and pause button. The GXC-40 Cassette Stereo Tape Recorder is also available

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latest menace: electronic pollution!

The word pollution already looms large in human affairs — and it will loom larger still as this twentieth century swings into its final quarter.

Scientists all over the world are raising the alarm; a typical comment — from biologist Barry Commoner — warns that “we are destroying this planet as a suitable place for human habitation.”

With pesticides and herbicides filtering into our food, glass and plastic containers littering our countrysides and industrial detritus poisoning our rivers and oceans, we have more than sufficient cause for alarm.

And now, pollution of the electro-magnetic spectrum is causing ever-increasing concern. There is a proliferation of equipment generating spurious radio frequency emission — diathermy units, induction heaters, plastic welders, and a wide range of high-powered equipment using phase control techniques.

In addition, early-warning tactical radar systems use ever-increasing average powers, and these are becoming a real hazard.

As witness to this, the British Ministry of Defence warned recently that ‘over the horizon’ radar systems could cause sailors off Orford Ness (Suffolk) to experience slight shock, accompanied by sparking from metal rigging or structures. It also warned that radio sets may be damaged, and some electrically-triggered devices might be accidentally energized. As if this were not enough, warning has been given that people intercepting the radar beam for any length of time may suffer injury.

Surely the time has come when we must seriously consider international control of rfi-causing equipment.

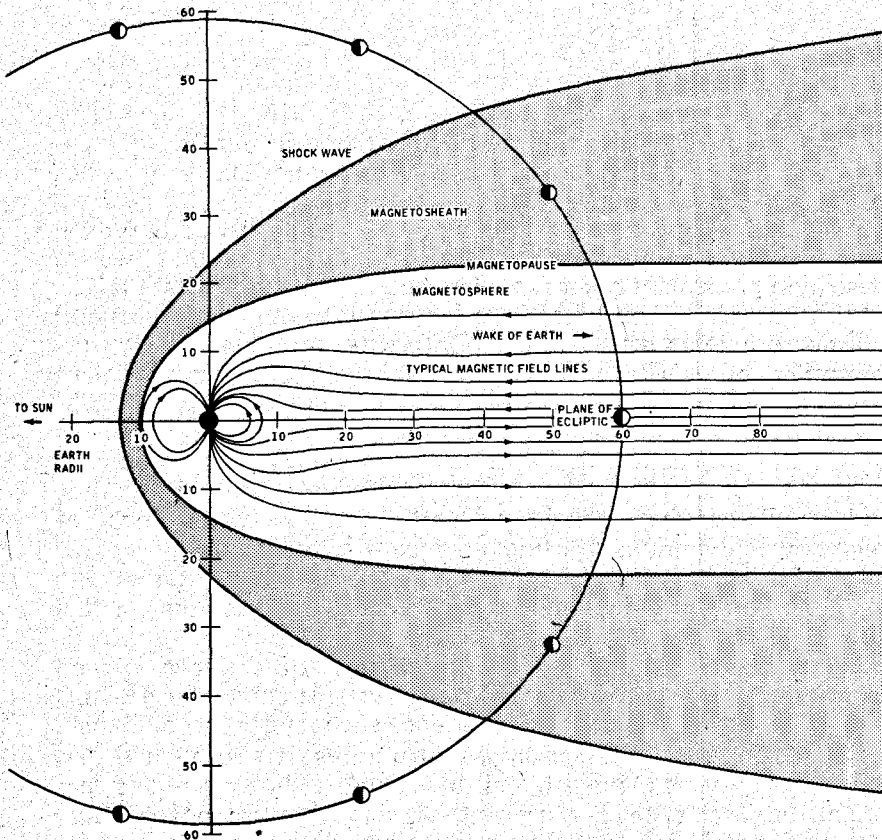
Having got this off our chest, we want to thank you, one and all, for the large number of letters and telephone calls wishing us well on the occasion of our first birthday.

Thank you — it was very much appreciated.



Time Flies

EARTH'S MAGNETIC FIELD



This recent drawing from NASA shows the observed magnetic field of the earth.

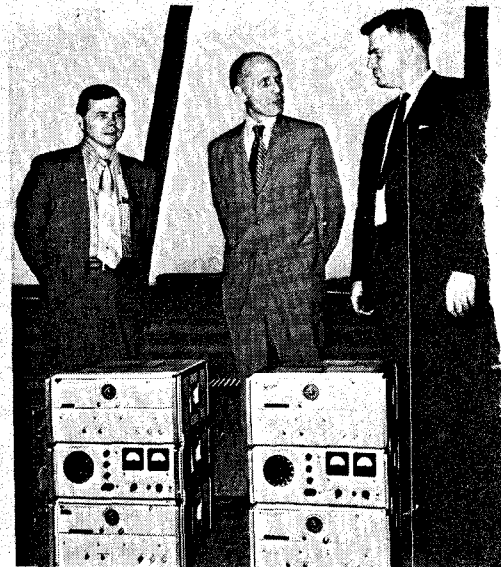
The solar wind 'blows' the magnetic lines towards the back side of the earth, thus forming the magnetosheath and the geomagnetic cavity. The geomagnetic cavity extends to at least 100 earth radii. In this drawing the Earth and Moon are not to scale.

TIME FLIES

Time dilation — the special part of Einstein's relativity theory that predicts more time will pass for stay-at-homes than for fast-moving space travellers returning to earth — underwent a new test recently; also tested by the experiment was the interaction

of gravity and time, a part of the General Theory. It was the first known experimental demonstration of these effects using actual time-recording clocks. The preliminary results seem to support Einstein.

Professor Joseph C. Hafele of Washington University, St. Louis, Mo., and Richard Keating of the U.S. Naval Observatory, Washington, D.C., flew a set of four Hewlett-Packard precision atomic clocks around the world. They flew the route once eastward and once westward, measuring how much time the clocks recorded during their trips, relative to the time observed on earth by the ensemble of Hewlett-Packard atomic clocks at the Naval Observatory which are the United States' official timekeeper. The experiment was funded by the Observatory. Preliminary, uncorrected results for the experiment indicate a slight loss for



Professor Hafele, L. Walker of Hewlett-Packard, and Richard Keating of the U.S. Naval Observatory, with atomic clocks flown round the world to test a key part of Einstein's theory of relativity.

the eastward trip and a definite gain for the westward trip, as Einstein's theory would predict for paths similarly flown.

To test the theory, the results of the experiment must be compared with the results the theory would predict. To predict the results, two aspects of relativity theory must be considered. One of these treats the interaction of velocity and time, the other the interaction of gravity and time. Both must be considered in predicting the results of the Hafele-Keating experiment. The expected results depend on the actual paths, velocities, and altitudes during the flights. For a total flight time of about 38 hours at 650 miles an hour, at an altitude of 35,000 feet around the equator, the predicted results are a loss for the eastward flight of about 110 nanoseconds relative to the clocks on earth, and a gain of about 300 nanoseconds for the westward flight. The only quantity man can measure with anything like this precision is, fortunately, time.

The experiment was made possible by the availability at the Naval Observatory of compact, extremely precise cesium beam atomic clocks and frequency standards (Model 5061A manufactured by the Hewlett-Packard Company in Santa Clara, California). Portable versions of the same instruments were carried around the world on both trips. Time comparisons of nanosecond precision were made possible with the Hewlett-Packard Computing Counter (Model 5360A). So far has the art of time measurement advanced, not one of the instruments used in the test was of special laboratory construction. All are standard and commercially

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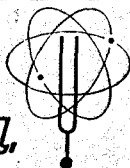


It's made by Sansui, especially for Australian conditions.

5G-210M

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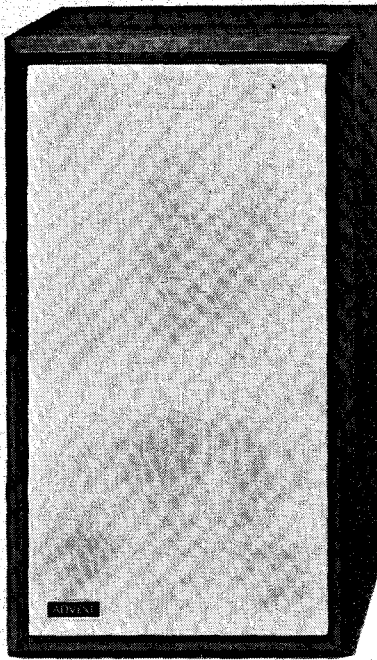
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**two reasons
why you should
think twice
about 'Advent'...**

1. the Advent loudspeaker



All major audio and electronic publications in the USA and Australia have reviewed the Advent Loudspeakers.

All have acclaimed it for superb performance.

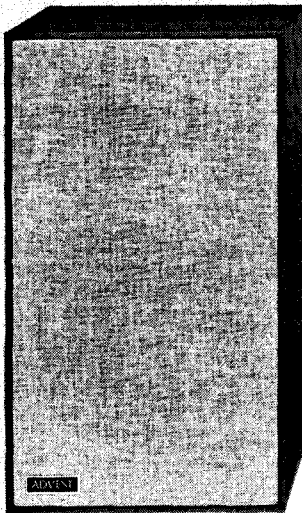
All have concluded that the Advent Loudspeaker is excellent value for money.

Here's what Advent set out to do . . . and achieved:

- To fit the highest category of loudspeaker quality, with overall performance at least the equal—in every audible and useful respect—of the most expensive speakers available.
- To do that at about half the average cost of the speakers now generally considered the best available.
- To be small enough, unobtrusive enough, and uncritical enough in placement to fit gracefully and usefully into a home.
- To produce enough output at low distortion to permit listening to music at satisfyingly loud levels in even the largest living room.
- To be driven comfortably by the majority of good amplifiers and receivers now available, with a power margin sufficient for the most demanding musical material.
- To sound convincing not only on the best recordings but on the great majority of recordings of all kinds.

Listen to an Advent . . . \$169 each (incredible value).

2. the smaller Advent loudspeaker



The Smaller Advent is the only loudspeaker costing less than the larger Advent capable of reproducing the entire musical range. Through the Smaller Advent you can hear the bottom octave of piano and pipe organ, the lowest notes of the double bass, or the bottom string of an electric bass guitar. (These low frequency sounds have a lot to do with the enjoyment you will derive from your musical system.) On all kinds of musical material, and, under most listening conditions likely to apply in most homes, the Smaller Advent is the equal of any speaker system available.

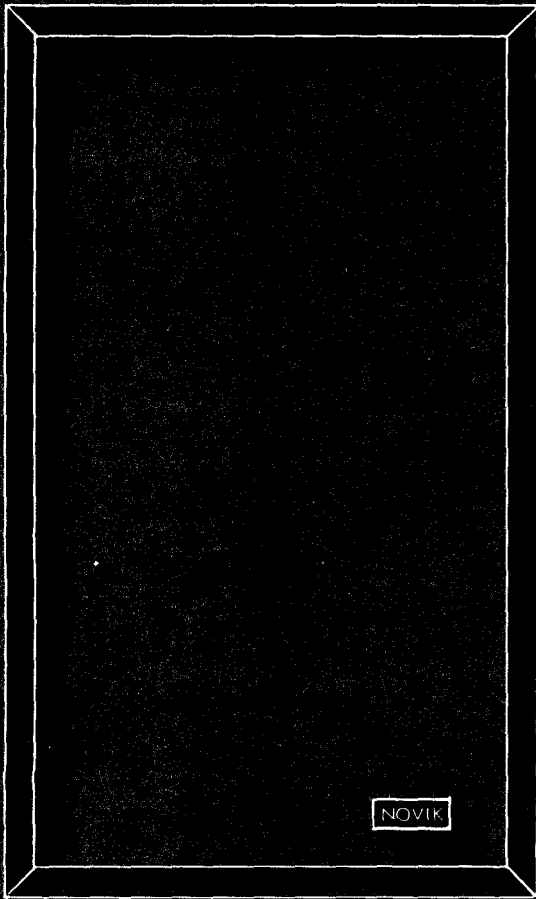
No technical sorcery is responsible for the surprising performance of the Smaller Advent Loudspeaker. To build into the speaker its excellent low frequency capabilities, Advent has had to give up a small amount of efficiency and power-handling ability: the Smaller Advents will not play as loudly as the larger Advents.

The Smaller Advent Loudspeaker is exactly tailored to work with moderately priced amplifiers in the 15-25 watt RMS per channel class. Listen to a Smaller Advent . . . it figures right \$129 each (incredible).

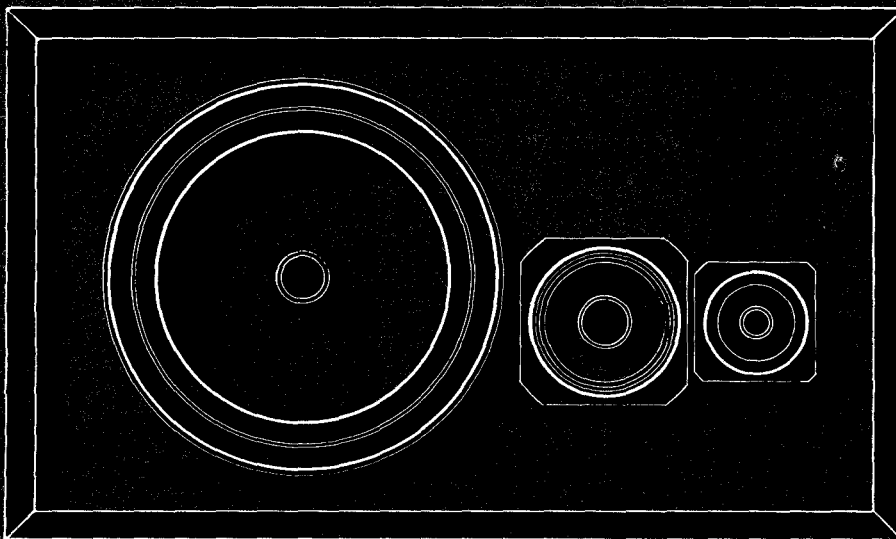


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news digest

available. Hundreds of the Hewlett-Packard atomic clocks are in regular use. They keep many nations' official time, and maintain their standards of frequency. They are also widely used in navigation, communication systems, and the Apollo tracing network. A miniature version has been developed and is being tested now for the Air Transport Association's newly-approved aircraft collision avoidance system.

AMPEX QUILTS CONSUMER MARKET

Possibly demonstrating the truth of the old adage that those who make money in any particular field are rarely the pioneers — Ampex, the first company in the USA to make tape recorders, is to quit the domestic market.

The move has been forced onto the company due to inadequate profitability. Ampex has produced a broad range of reel-to-reel and cassette recorders and these will gradually be phased out.

The semi-professional AX300 unit will remain in production and the company will continue to supply both prerecorded and blank tapes and will honour warranties and supply parts for all products.

Also remaining in production is Ampex's range of professional audio and video recorders. Work will still continue on the development of the Instavideo cartridge-type colour TV recorder.

FUEL CELL LATEST

In the USA the Lockheed Aircraft Corporation are currently developing a new type of fuel cell that they expect will produce up to 100 times more power than existing lead-acid batteries.

The Lockheed cell is fueled by water and an alkali metal such as sodium or lithium. The company claim to have developed methods of controlling the violent reactions that are normally produced when such materials are brought into contact, yet still extracting large quantities of electrical energy.

The cell is claimed to be pollution free, the only by-product being hydrogen which is collected and used as a secondary source of energy.

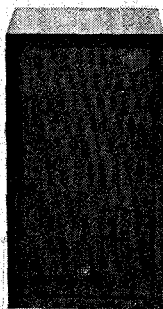
GOODBYE MYSTERE CHIPS

Our London correspondent tells us that following problems with a recent batch of integrated circuits a well known French aircraft manufacturer is looking for another supplier.

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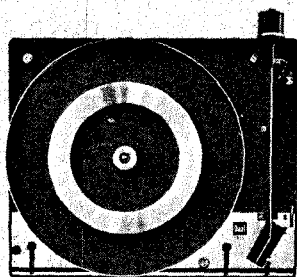
* Pioneer SA500

or

* Sansui AU101

or

* Kenwood KA2002



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RUN-IN RACKS FOR AR TURNTABLES

When an AR turntable is packed at the factory it is, literally, slightly used. It has been run in for 48 hours, and then given a final workout in one of AR's test rooms.

The tests, which include measurements of rumble, wow, flutter, speed accuracy, and speed regulation, are made on every AR turntable. Any turntable that doesn't meet NAB specifications for professional broadcast equipment is rejected. A day rarely goes by without rejections — manufacturing processes aren't perfect.

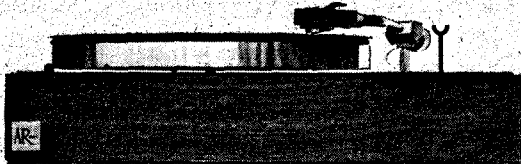
AR's quality control borders on the fanatical. It is one reason the AR

turntable has been rated number one by so many equipment reviews and comparison surveys, in a field of competing units costing up to twice as much.

The unique design of the AR turntable makes it insensitive to floor vibration or acoustic feedback. Its miniature synchronous motor and belt drive make the AR turntable inaudible during operation.

The rigid quality control makes AR's 3 year turntable guarantee possible. All repair costs are covered, parts, labour, shipping and even a new carton when one is needed.

\$169 RRP complete with arm, oiled walnut base and dust cover.



Acoustic Research Inc.

Massachusetts, U.S.A.

All AR audio equipment is on demonstration at the AR Music Room in the Sydney showrooms of the Australian Distributors.

Australian Distributors

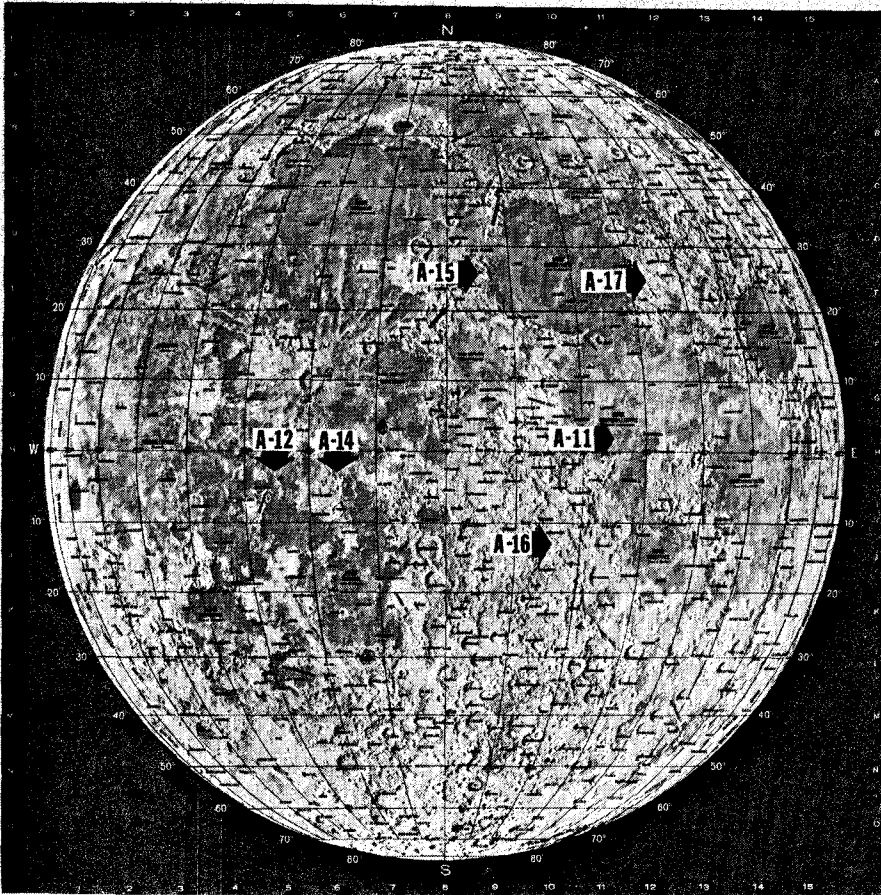
W. C. Wedderspoon Pty. Ltd.

Showroom: 193 Clarence Street, Sydney. 29-6681

AR sound equipment may be purchased from the following Australian Dealers:

N.S.W.: Magnetic Sound, Sydney. Photo Hi-Fi, Sydney. Sydney Hi-Fi, Sydney. Paxton Photographics, Sydney. Milversons Hi-Fi, Chatswood. DynaStereo, St. Peters. Newcastle Hi-Fi, Hamilton. **VIC.:** Douglas Trading, Melbourne. **S.A.:** Sound Spectrum, Adelaide. **A.C.T.:** Home crafts, Canberra. **W.A.:** Alberts Hi-Fi, Perth. Leslie Leonard, Perth. **QLD.:** Brisbane Agencies, Fortitude Valley.

APOLLO 16



Due to blast off (about one week after the printing date of this issue) the Apollo 16 lunar spacecraft will land in the Moon's Descartes area, in latitude 15.5°E and longitude 9.0°S .

This map shows the landing sites of all lunar probes from Apollo 11 through the projected Apollos 16 and 17.

NEW COLOUR TUBE

In Japan, Toshiba has developed a new type of colour TV picture tube. Unlike the conventional shadowmask tube in which round holes are formed through the shadowmask, the new Toshiba tube has an array of rectangular holes arranged in a vertical pattern.

Three electron guns are used — arranged horizontally in-line.

Advantages claimed for the new tube include higher level of brightness, better resolution and contrast, and freedom from convergence and deflection adjustments.

First commercial TV receiver to use the new tube is the 9" Sharp currently available in the US at a list price of \$300.

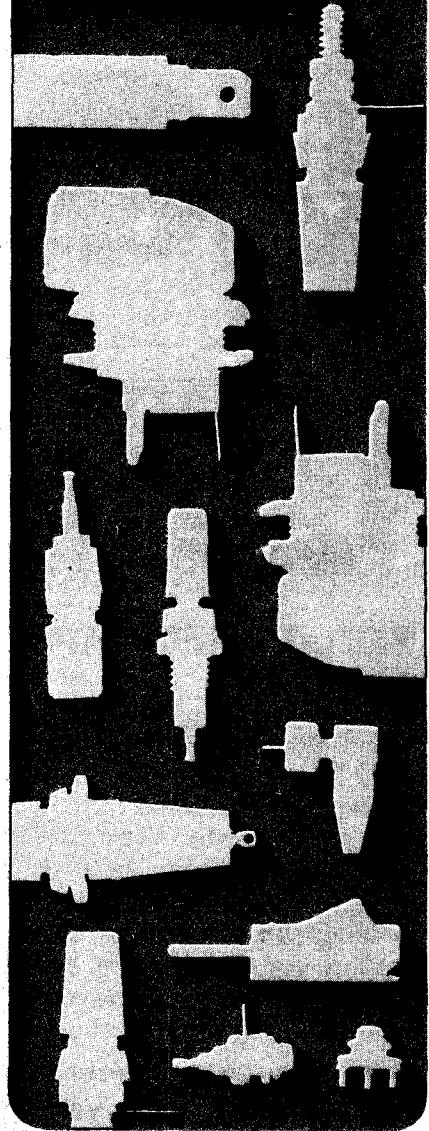
PLESSEY ROLA MANAGER OVERSEAS

Plessey Rola business manager, Mr. Maurice Smith, has begun a world tour during which he will visit other Plessey operations in the U.S., U.K., Europe and South Africa.

Although the trip was scheduled before the announcement of the starting date for colour television transmissions in Australia, its purpose is to assess the latest developments in the electronics components field particularly in relation to colour television.

Whilst in New York, Mr. Smith will attend the IEEE Exhibition where Plessey Rola is to exhibit loudspeakers, loudspeaker enclosures, professional quality printed circuit boards and magnetic materials.

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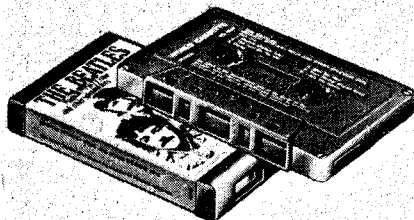
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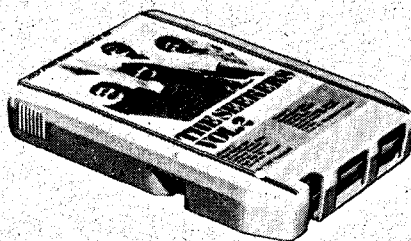
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CASSETTES



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news digest

AMERICAN COMPUTER EXHIBITION

ON APRIL 17, the Hon. William McMahon, (Prime Minister of Australia — at the time of writing) will open the largest exhibition of U.S. computer equipment to have ever been displayed at the United States Trade Center. Mr. McMahon will be accompanied by Mrs. McMahon. Also present will be the U.S. Ambassador and Mrs. Walter Rice, the Chief Secretary of N.S.W., Mr. Eric Willis and leaders in industry and commerce.

Thirty six U.S. manufacturers will exhibit the latest developments in the small and medium sized computer field. Much of the equipment has not been seen in Australia previously. The response from computer companies both in Australia and the United States has been so great that it has resulted in the Trade Center having to utilize exhibition space on the 5th floor of the U.S. Consulate as well as the Ground Floor Exhibition Area.

Research has shown that there is a whole new market available for small computers. Many organizations have use for a computer capacity but do not have either the need or the financial resources for a large computer. The new generation of small computers has been designed for these people.

The opening at 11.30 a.m. on Monday, April 17 promises to be one of the most exciting openings of a trade show to have taken place in Australia.

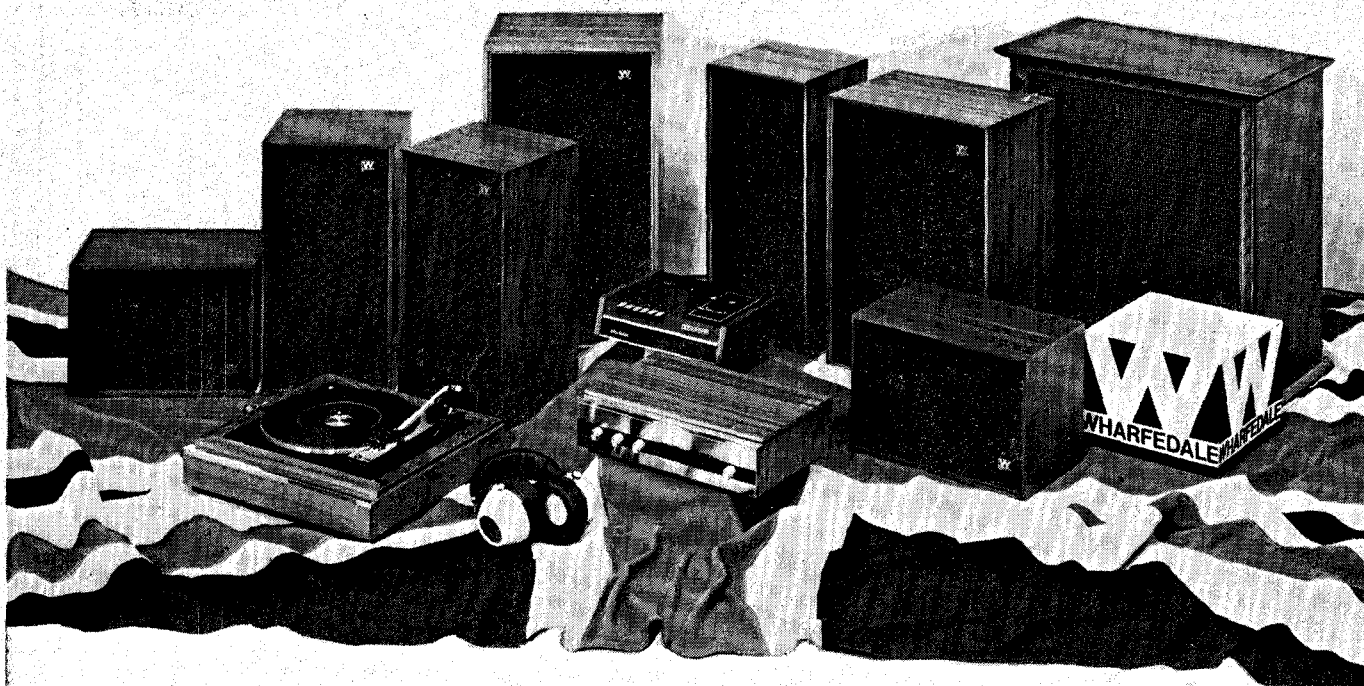
The first U.S. Trade Center exhibition was 'Computer Communications & Display'. This exhibition was a tremendous success. The April exhibition of mini-computers looks like being even more successful. Persons and organizations interested in the computer field can contact the Director of the United States Trade Center, 37 Pitt Street, Sydney. Telephone 27-6635.



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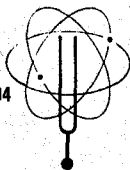
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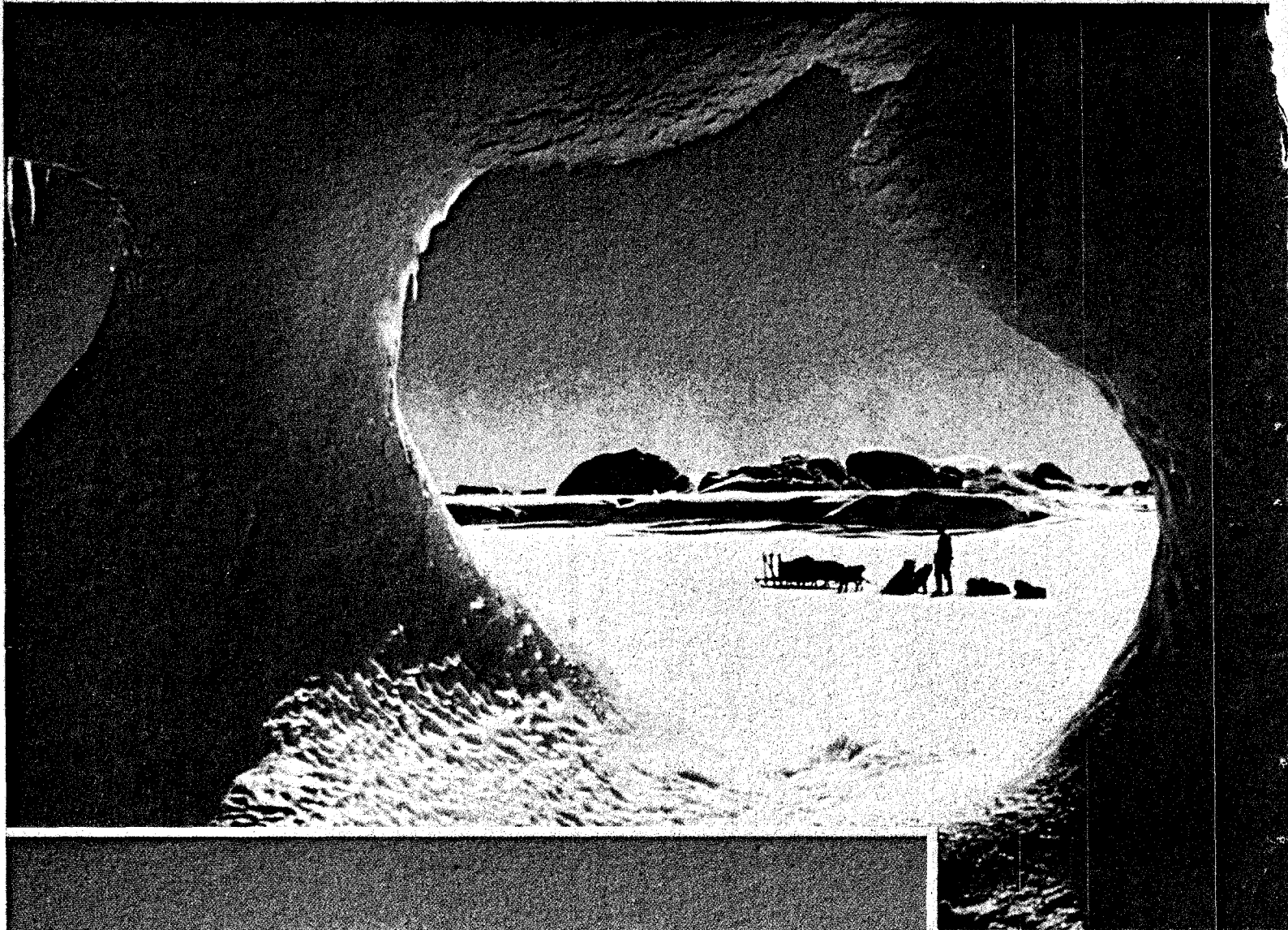


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ELECTRONICS IN



*Iceberg, near Davis, Antarctica
(ANARE photograph by W. Dingle)*

*Field camp on the Antarctic Plateau
near Mawson (ANARE photograph
by A. Williams)*

The remoteness and environmental severity of inland Antarctica presents an unusual challenge to the engineering of scientific instrumentation.

This article by Ian Bird and Alan Humphreys of the Antarctic Division of Australia's Dept. of Supply describes the problems involved in constructing a totally unmanned observatory to operate at temperatures as low as -100°C .

THE ANTARCTIC

by Ian G. Bird, AMIREE,
FRMT., and Alan Humphreys,
AMIREE

Engineers at Australia's Antarctic Division of the Department of Supply have designed and constructed an automatic, unmanned geophysical observatory about fifty miles south of Casey Base, on the coast of Antarctica, about 2500 miles south of Perth W.A.

The installation, which is now in service, has instruments for recording auroral displays, magnetic micro-pulsations, ionospheric opacity (riometer), wind direction, barometric pressure and air temperature.

The equipment, designed to run unattended for up to one year, consumes only 1.5 watts average power.

Data is recorded both on magnetic tape and photographic film: operations are programmed from a crystal chronometer. Data relating to magnetic micro-pulsations are logged continuously; other data such as night-time auroral photographs are taken at five minute intervals, whilst meteorological observations are made hourly.

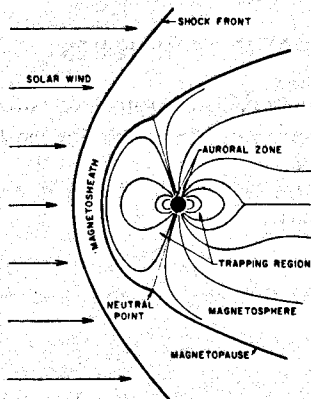
THE PURPOSE OF THE INSTALLATION

The observatory is primarily intended for the study of solar terrestrial physics, and for research into the upper atmosphere.

One of the effects currently being studied by the observatory is the interaction between the "solar wind" and the earth's magnetosphere.

The sun constantly ejects streams of charged particles into space. This emission is termed the "solar wind". The earth's magnetosphere (see Fig. 1) captures these particles and guides them towards the earth's surface in the polar regions surrounding the geomagnetic poles. The effects of the interaction between the solar wind and the upper atmosphere of the earth is dramatically illustrated by magnetic storms, ionospheric disturbances (causing radio blackouts) and auroral displays.

Study of these phenomena is of importance to fundamental physics and has great practical significance to space travel. It has always been of concern to HF radio communicators as the solar emissions cause sudden fades



Configuration of the Earth's magnetic field, showing the distortion produced by the solar 'wind'.

and radio blackouts and many other effects.

Knowledge of the meteorology and glaciology of Antarctica is intrinsically important not only for itself but also to the greater understanding of world weather.

POWER CONSIDERATIONS

For inland Antarctica, conventional remote-station power systems such as wind-driven generators, propane thermoelectric generators or primary cells are of dubious reliability; radio isotope thermoelectric generators

provide a feasible power source but at high cost. To provide even a few watts can be difficult and costly.

A design criterion therefore, was to limit power requirement by devising low-power instrumentation capable of operation at low temperatures, and it was apparent at the outset that no power could be provided specially for thermal control of the instrument shelter.

Precharged storage batteries provide the bulk of the 1.5 watt requirement of the prototype observatory; additional capacity is provided by solar and special wind-powered generators.

LOW TEMPERATURE BATTERIES

Energy around 40 watt hours per pound weight is commonly available from primary cells at moderate temperatures; however, as temperature falls, so chemical reactivity is reduced, and at -40°C , almost no power may be drawn from primary cells (Figure 2).

Secondary batteries (lead-acid and nickel-cadmium), have a known performance to -30°C . For specific low temperature application, modifications to the electrolyte will optimize performance. At the 50-hour charge and discharge rate, a special lead-acid battery showed 45 percent charge - discharge cycle efficiency at

The design and development phases of the observatory were carried out in the Antarctic Division's Melbourne laboratory. (ANARE photograph).



ELECTRONICS IN THE ANTARCTIC

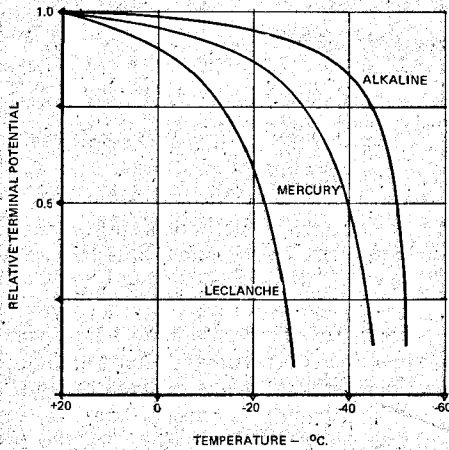


Fig. 2. This graph shows the terminal potential of primary cells discharged at the 100 hour rate.

-60°C, and 20 percent at -65°C.

For lead-acid cells, excess electrolyte and a fully charged specific gravity of 1.310 are used to maintain near optimum conditions: these procedures allow for efficient operation to -60°C. Nicad Cells are optimized at a specific gravity of 1.230 which is constant with state of charge; efficient operation to -50°C results.

The prototype observatory uses both lead-acid and Nicad batteries for comparative assessment.

CHARGING TECHNIQUES

(i) Solar

For six months of the year, energy is available from the Sun. For moderate outlay a silicon solar cell array provides worthwhile power in average sunlight.

(ii) Wind

Worthwhile energy can be obtained at wind speeds around five metres

second with ability to survive gusts of 75 metres second. Antarctic experience with propeller-driven generators has shown moderate reliability under these conditions in coastal regions but the low inland temperatures provide added problems. Development is continuing in this area. A variety of small generators has been developed and during 1963 Antarctic Division developed a five watt turbine generator for operation in rugged conditions. This generator, (Fig. 3), has performed well at remote sites south of Mawson station and could be scaled to provide greater power. The predominantly constant wind direction allows fixed orientation.

(iii) Radio Isotopes

Light-weight isotope power generators using the alpha emitter, Plutonium 238, provide about one watt per pound weight of generator. Cost is typically \$150,000 for a five watt strontium-90 powered generator costs about \$30,000 but requires heavy biological shielding. Strontium 90 generators have been used reliably in various remote station applications including Antarctica.

One advantage of thermo-electric conversion is that due to conversion inefficiencies, heat is available for elevating the temperature of batteries and instruments.

MINIMIZING THE POWER REQUIREMENT

Power consumption, far lower than ordinarily achieved with standard components, was achieved as follows: Supply Voltage

A nominal six volt power system regulated to five volts was chosen as being the minimum generally to operate solid state and other devices. Operation at this voltage is the main factor contributing to the efficiency of the circuitry.

Logic Components

TTL logic consuming 2.5 milliwatts per gate was used; standard 54 series logic requires 10 milliwatts. Recently released complementary-symmetry metal-oxide semi-conductor (COSMOS) logic is under evaluation; its quiescent consumption of 50 nanowatts per gate shows the future trend.

Linear Microcircuits

Amplifiers of the uA741 type were used to give 90 dB gain at 2.5 milliwatts consumption (Figure 4). Micropower circuits such as RM4132, with a gain of 108 dB at 5 volts and 0.1 milliwatts consumption, offer future advantage.

Discrete Component Circuits

The high gain of some transistors at microamp collector currents, opens a

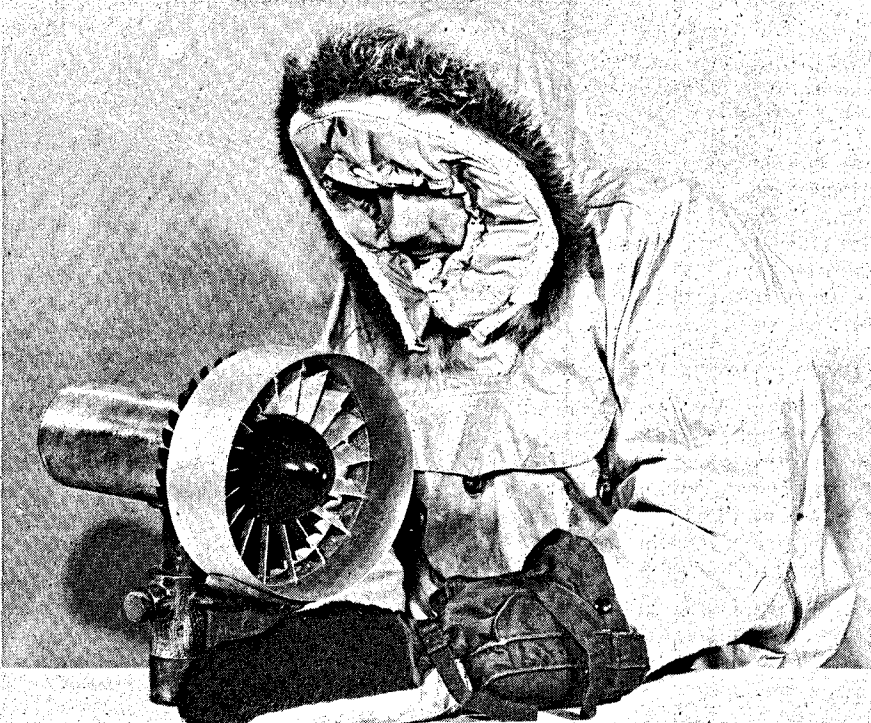


Fig. 3. This five Watt turbine generator has been specially developed for rugged conditions. (ANARE photograph).

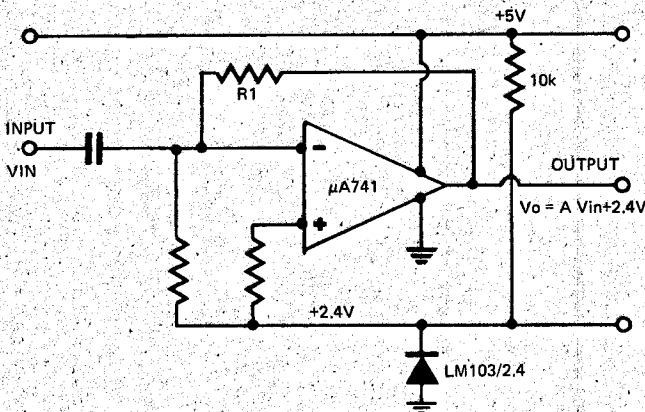


Fig. 4. Micro-circuit biasing arrangement for a single 5V supply.

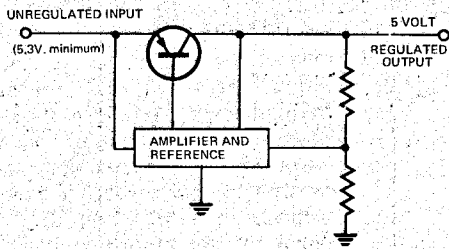


Fig. 5. Basic circuit of low-loss regulator.

annual return of data for processing in Australia.

In the long term, as complexity and time resolution requirements increase, on-site recording capacity will prove inadequate and regular read-out will need to be considered; this could be to a satellite.

DATA SAMPLING RATES

At manned observatories, chart speeds of 15 cm per hour are typical for the common geophysical instruments (riometer and magnetometer), the resulting time resolution being about fifteen seconds. Examination shows that data-scaling rarely exceeds one-minute intervals, except for magnetic micropulsations. Hence a sampling rate of 40 per hour was decided upon, with an auxiliary rate of one per hour for meteorology and housekeeping. This allows 9000 hours of operation to a single 2400 ft. tape reel. Magnetic micropulsations are monitored continuously and recorded on a separate analogue tape recorder.

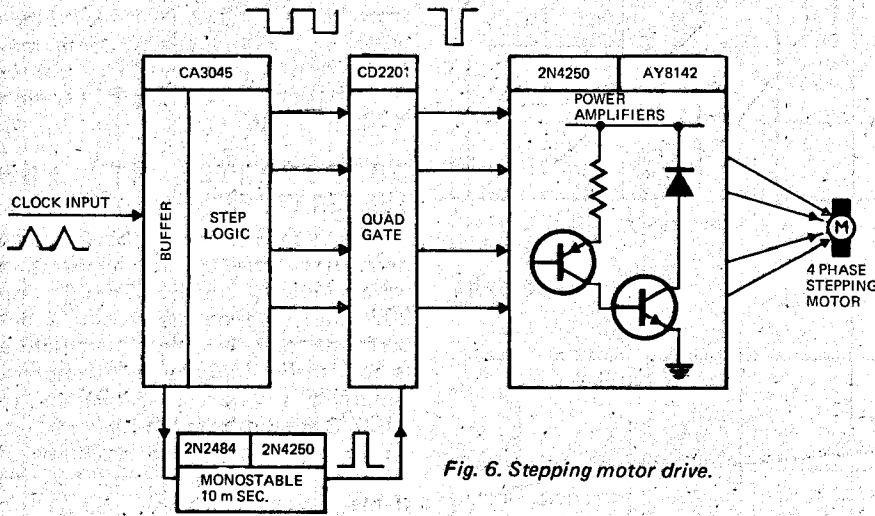


Fig. 6. Stepping motor drive.

field for low-power design. This principle was used for continuous loads such as the Chronometer to attain a power advantage of 1000 over conventional microcircuits. (Cosmos MSI will remove this advantage.) Standby power is limited by low quiescent current circuits.

Voltage Regulator

The regulator (Figure 5) differs from the usual arrangement by application of a PNP series control transistor: this allows regulation down to a series voltage drop just above collector saturation voltage.

Motors

Precision dc motors and stepping motors are required to drive the tape and film transport mechanisms; power requirement is limited by pulse-powering the tape capstan stepping-motors (Figure 6) and minimizing the duty cycle of the dc motors (1:300 for tape deck).

Thermal Control

Although the observatory instrumentation has been specifically designed to operate at low ambient temperatures — the chronometer quartz crystal reference requires a stable environment. Power to achieve this has been limited to 100 milliwatts.

DATA ACQUISITION

Station scientific data are recorded (currently) on paper chart, magnetic tape and film; some routine analysis is completed at the station but the bulk is done by computer-aided processes in Australia. The proposed automatic stations offer a similar facility for the

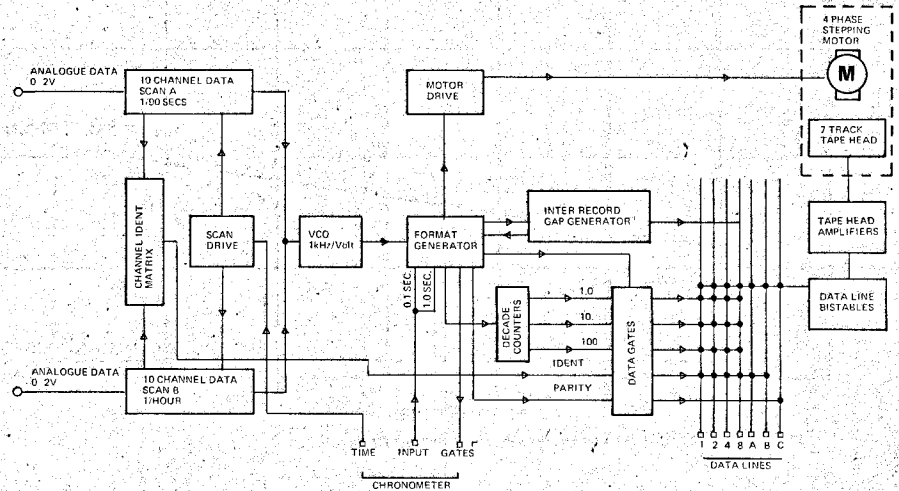


Fig. 7. Digital data logger.

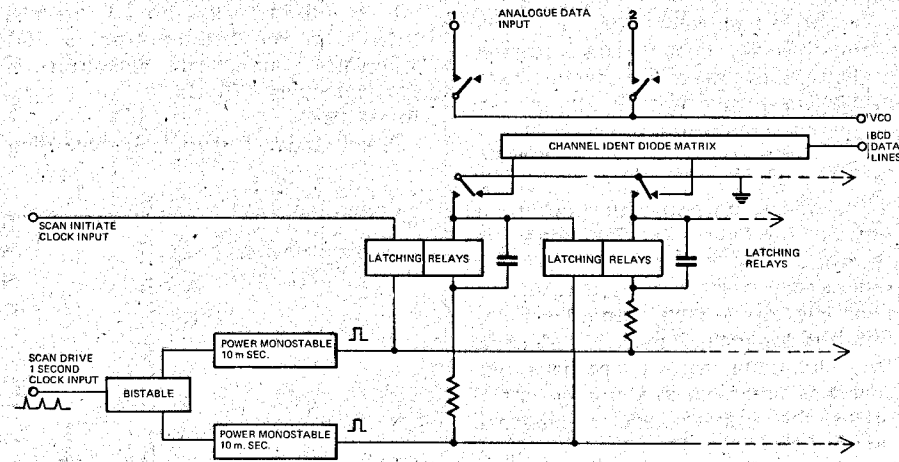
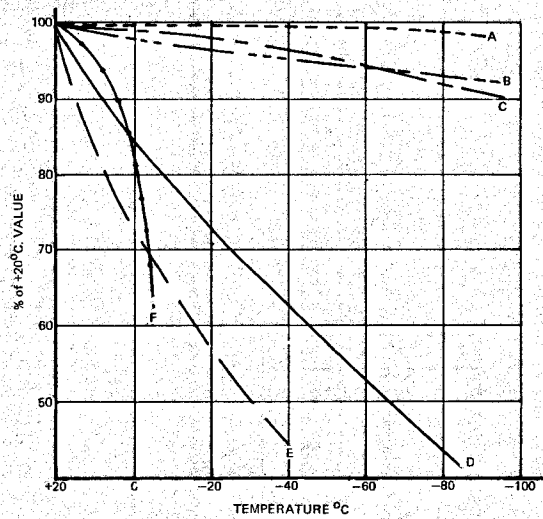


Fig. 8. Analogue multiplexer.

ELECTRONICS IN THE ANTARCTIC

Fig. 9. These curves illustrate the low temperature performance of various components.

- A: Polycarbonate capacitor
- B: Solid tantalum capacitor
- C: Polyester capacitor
- D: Silicon transistor (current gain)
- E: Germanium transistor (current gain)
- F: Etched aluminium foil electrolytic capacitor



on 1/4" tape has been used widely in magnetic micro-pulsation equipment. For a tape speed of 2 1/4 in. per hour, frequencies to 2Hz can be recorded, however some data is lost to tape "drop out". The analogue tape deck capstan is pulsed at five steps per second, thus sampling the analogue signal at the recording head. A fair reproduction of signals to 1.5 Hz is recorded. A single 2400 ft reel of tape provides 12,000 hours of continuous recording. Average power consumption for continuous operation is 50 milliwatts.

COMPONENTS AT LOW TEMPERATURES

Most components show some parameter change as temperature varies; Military Standard Specification 202 rates components to -55°C, but performance below this temperature is not usually stated by manufacturers. Antarctic Division investigations to -100°C are illustrated in Figure 9.

This work shows the feasibility of selecting resistors and capacitors for stable operation at very low temperatures; high gain silicon transistors have current gains of around 100 at -80°C — adequate for most requirements.

INTEGRATED CIRCUITS

Operational amplifier parameters; gain, output voltage swing, and input offset are all temperature dependent. For amplifier uA741, using a single 5 volt supply, temperature variation from 0°C to -80°C causes about 4 dB reduction in open-loop gain, and output voltage swing falls to about 60 percent of the 0° value — 2.5 volts; these variations are not unduly restrictive on design. However, effects of the input offset drift, limit the practical closed-loop gain; for a gain of 45 dB the output voltage drifts 10 percent for a temperature fall of 80°C and one percent for 25 dB closed-loop gain. For higher gains, low drift amplifiers such as uA725 may be used.

Variation of logic levels with temperature is also of concern (Figure 10), at -80°C there obviously is adequate margin for satisfactory

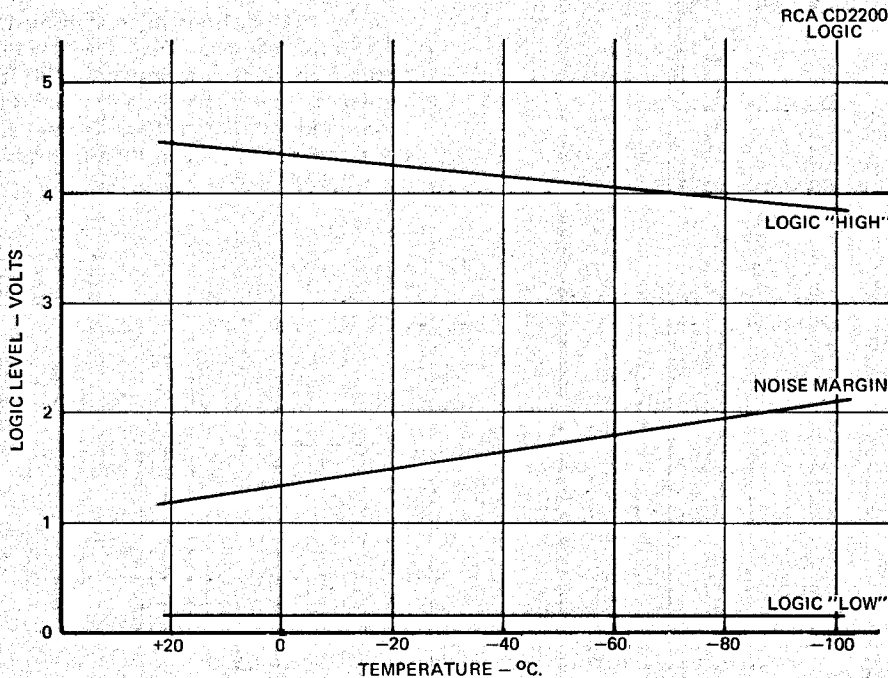


Fig. 10. Variation of logic level voltage with temperature.

RECORDING TECHNIQUES

Digital

To obtain high reliability, low power consumption, large data storage capacity and ease of subsequent data processing, magnetic tape was chosen as the recording medium.

To record the primary data directly in computer format is advantageous; digital recording also makes optimum use of the tape. The data logger is shown in Figure 7. Maximum input rate is one measurement per second recorded on 1/2 inch computer tape, 556 bits per inch, 7 track NRZ1 logic to include the various tape gaps and spaces is provided. A stepping motor drives the capstan, and dc motors power the tape tension control; a pinch roller is avoided to minimize tape skew.

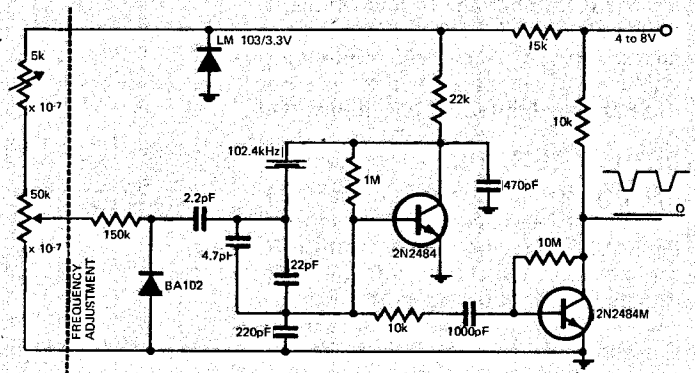
The input scan is provided by a shift register of latching relays (Figure 8);

programming is controlled by the chronometer. The logger operates at 90 second intervals for 30 seconds, average power consumption is 450 milliwatts and test operation is satisfactory at -70°C.

Analogue

Direct slow speed analogue recording

Fig. 11. Chronometer reference oscillator.



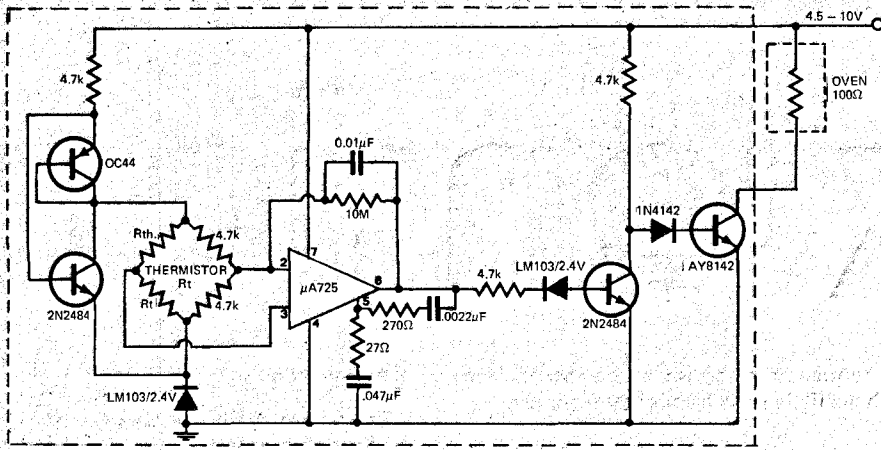


Fig. 12. Basic circuit of oven temperature controller.

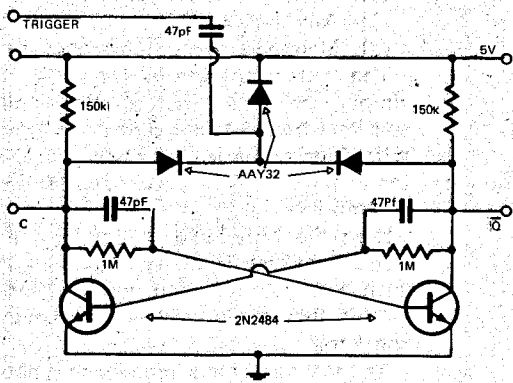


Fig. 13. Basic binary circuit.

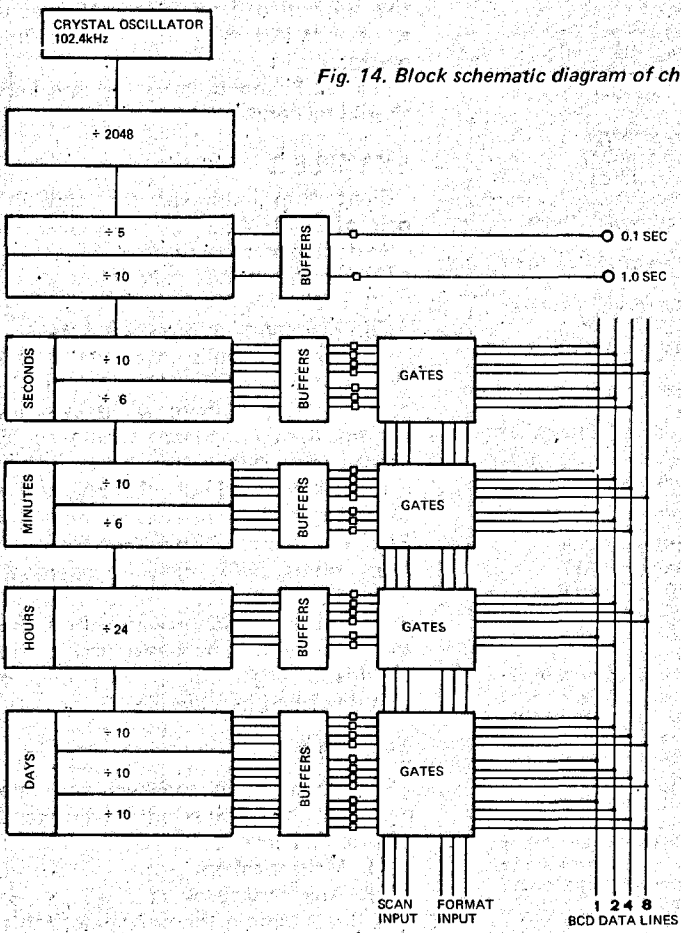


Fig. 14. Block schematic diagram of chronometer.

operation; the increased noise immunity is useful.

MECHANICAL COMPONENTS

For efficient mechanical design, friction must be minimized; lubricants play an important part in this. The viscosity of conventional low-temperature lubricating oil increases about 1000 times for a temperature fall from +20°C to -60°C; silicone oil viscosity increases about 10 times, dry bonded lubricants such as "Molykote 88" (molybdenum disulphide in vinyl butyral resin) have excellent low temperature performance and are ideal for lubricating ball races and small gear reducers. Teflon coating also has been used for reducing friction in slow-moving gear trains and geneva drives.

Springs increase in brittleness at low temperatures and require careful design. It has proved desirable for all mechanical drives to be positive, that is, not to rely on friction, and to avoid rapid acceleration of mechanical components.

ELECTRICAL CABLE

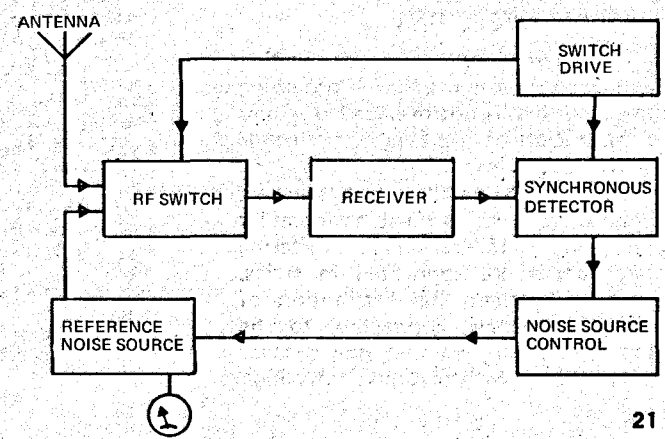
Commonly used flexible cables of PVC are liable to fracture below 0°C; polythene cables are moderately flexible to -40°C; teflon cables are flexible at -100°C; silicone rubber also has good low-temperature performance. For the observatory, requirement for flexibility was eliminated. Polythene dielectric and sheathed coaxial cables to antennae are fully protected; all equipment wiring is teflon-insulated and fixed in position.

FILM AND TAPE

Measurements of the mechanical strength of photographic film shows that, while the tensile strength may increase about 30 percent for a

(Continued on page 81)

Fig. 15. Riometer - block schematic drawing.



How often would you have liked to add extension speakers and not been quite sure what to do? This article tells you how.

extension

Some amplifiers have provision for connecting and switching extension speakers in and out of circuit. Many do not.

Yet this facility is most useful — for music is often required in more than one room, but without the expense of duplicating equipment, or lugging bulky speakers about the house.

At first sight, wiring extension speakers is a simple enough task — but there is more to it than at first appears. Here then — in answer to requests from many readers — is how to do it.

Modern transistor amplifiers operate best with load impedances between four and eight ohms, and as with these amplifiers the power developed in the load is proportional to load impedance, one cannot necessarily just wire extra speakers in parallel with the existing ones without possibly overloading the amplifier.

Generally, load impedances of less than four ohms may damage the amplifier, whilst impedances greater than 16 ohms will prevent the amplifier developing full power — it is for this reason that 16 ohm speakers are rarely made nowadays — and will not be discussed in this article.

The circuits shown here assume that the amplifier has an output impedance of between four and eight ohms. Most amplifiers have nowadays — if in doubt, the output impedance is almost invariably quoted in the manufacturer's handbook. Amplifiers with switched (or tap selected) output impedances — such as transformer coupled units — should be set to four ohms when these extension speaker circuits are used.

BASIC CONNECTIONS

The basic rule for connecting extension speakers is that — providing the amplifier is not overloaded — any combination of speakers of similar or different impedances may be connected in parallel, but speakers connected in series must have similar impedances. If speakers of differing impedances are connected in series, each will affect the distribution of power/frequency connected to the remainder, for example one speaker may end up with predominantly high

frequency response and another may have little high frequency response.

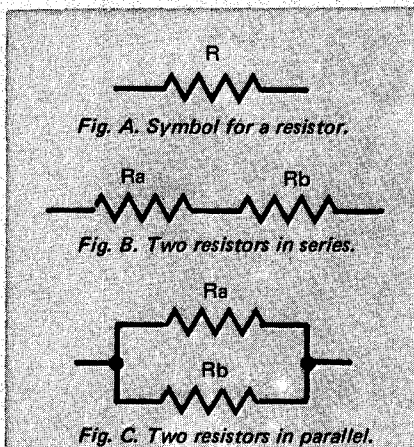


Fig. A. Symbol for a resistor.

Fig. B. Two resistors in series.

Fig. C. Two resistors in parallel.

RULES OF COMBINATION

Some readers who wish to add extension speakers may not be familiar with electronics. For their benefit here are the rules for calculating the combined impedance of series and parallel speaker combinations.

For this purpose, each speaker may be considered as a resistance, the symbol for which is shown in Fig. A. Series connected resistors are shown in Fig. B and parallel connected resistors in Fig. C.

The combined value of two resistors connected in series is given by simply adding the individual resistance values. Thus:

The combined resistance $R_s = R_a + R_b$.

Parallel combinations present slightly more difficulty.

For the same two resistors in parallel:

The combined resistance

$$R_p = \frac{R_a \times R_b}{R_a + R_b}$$

Hence if we parallel an 8 ohm resistor with a 15 ohm resistor

$$R_p = \frac{8 \times 15}{8 + 15} = \frac{120}{23} = 5.2 \text{ ohms approx.}$$

The term resistance, strictly speaking, may only be applied when speaking in terms of direct current (dc), whereas speakers are driven by alternating currents (ac). The term impedance is used to denote the effective resistance of a speaker (or any other device) to alternating current.

When putting speakers in parallel or series the same rules as above apply but we talk in terms of impedances rather than resistances.

EXAMPLE 1

Four ohm main speakers — one pair of four ohm extension speakers.

Switching arrangements:

- (1) Main speakers only
- (2) Auxiliary speakers only
- (3) Main and auxiliary speakers

The extension speakers cannot be simply paralleled across the main speakers because four ohms paralleled with four ohms is two ohms — and a load such as this will probably damage an amplifier.

Here the only way to connect the extra speakers is by wiring them in such a way that, when switched into circuit, they are in series with the main speakers.

As their combined impedance is now eight ohms the subsequent mismatch will cause some loss of power to each speaker. Fortunately the response of the human ear is logarithmic and so the subjective drop in sound level is somewhat less than one might at first expect.

Figure 1 shows how the speakers should be connected.

EXAMPLE 2

Eight ohm main speakers and one pair of eight ohm extension speakers.

Switching arrangements:

- (1) Main speakers only
- (2) Auxiliary speakers only
- (3) Main and auxiliary speakers

In this example the main and extension speakers are wired in parallel. If they were wired in series the resultant impedance would be 16 ohms and hence amplifier power would be reduced considerably. If the speakers are paralleled (as shown in Fig. 2), the resultant impedance of four ohms will provide adequate output. The overall sound level will not alter appreciably when the extra speakers are switched into circuit, and so this arrangement is preferable to that described in Example 1.

EXAMPLE 3

Four ohm main speakers and one pair of eight ohm extension speakers.

Switching arrangements:

- (1) Main speakers
- (2) Auxiliary speakers

In this example the only practicable

speakers

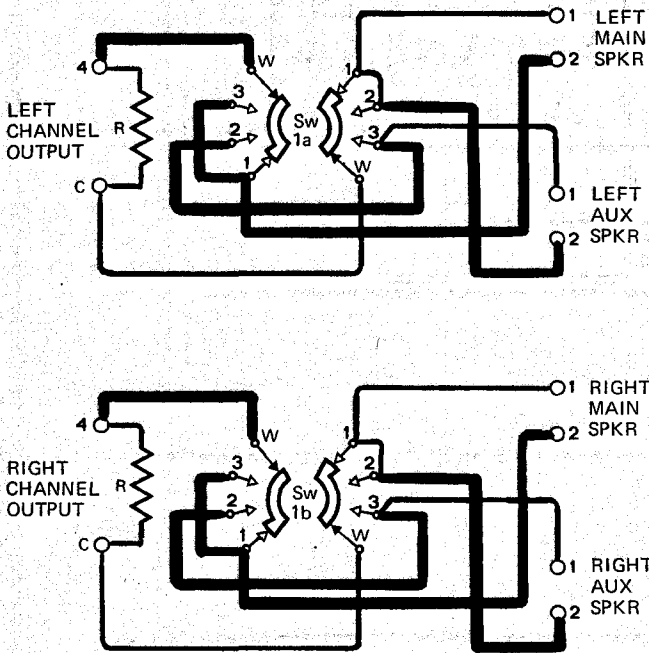


Fig. 1. Four ohm main speakers with one pair of four ohm extension speakers.

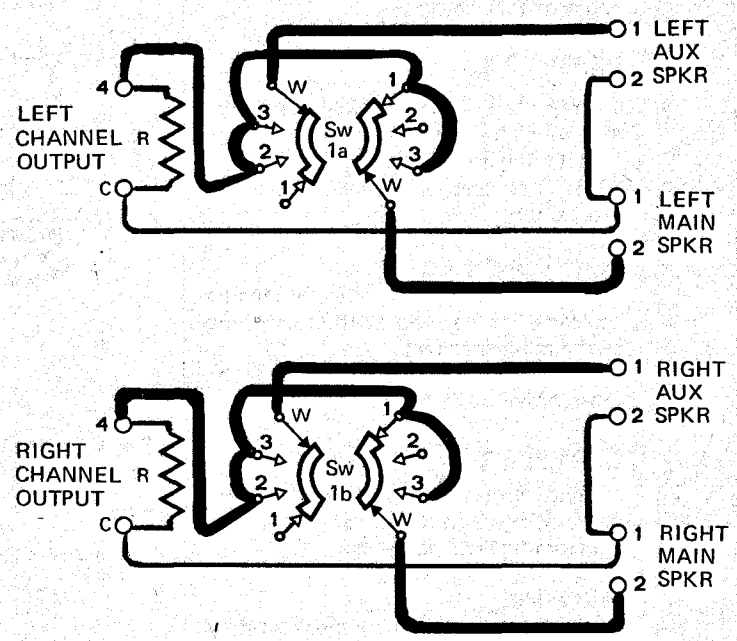


Fig. 2. Eight ohm main speakers and one pair of eight ohm extension speakers.

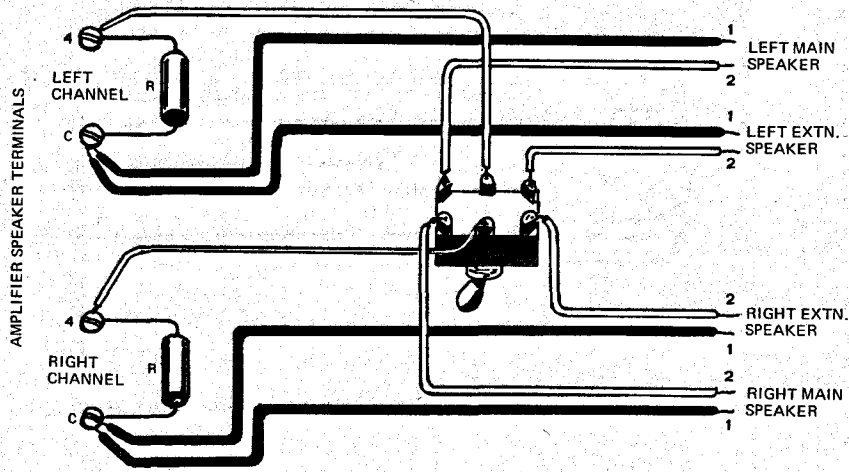


Fig. 3. Four ohm main speakers and one pair of eight ohm extension speakers.

extension speakers

way of interconnecting main and auxiliary speakers is by wiring them in series, as a parallel connection will reduce the combined impedance to a possibly unsafe level. In the arrangement shown in Fig. 3 we can use the main speakers alone, and the auxiliary speakers alone — but not both sets simultaneously — remember that any attempt to series connect speakers of different impedances will cause distortion.

EXAMPLE 4

Four ohm main speakers and two sets of eight ohm extension speakers. Switching arrangements:

- (1) Any pair of speakers may be used alone
- (2) Both pairs of extension speakers may be used together
- (3) Neither pairs of extension speakers can be used at the same time as the main speakers

Figure 4 shows how the interconnections are made.

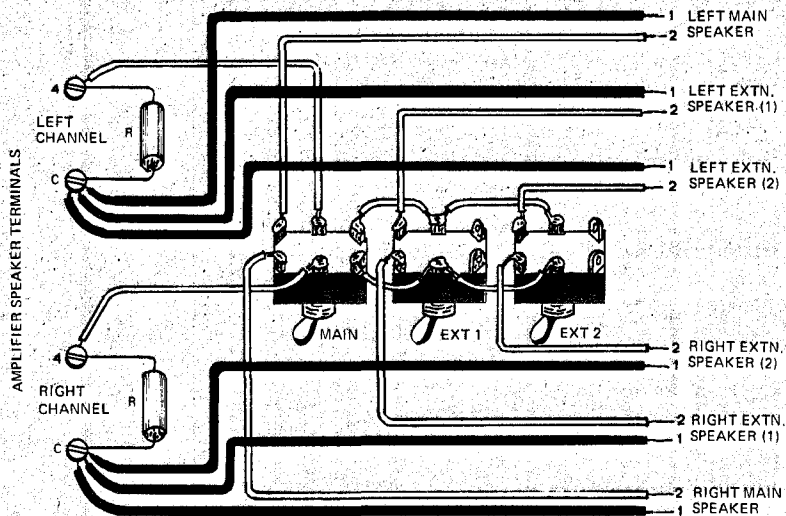


Fig. 4. Four ohm main speakers and two sets of eight ohm extension speakers.

EXAMPLE 5

Eight ohm main speakers and two pairs of eight ohm extension speakers. Switching arrangements:

- (1) Any pair of speakers may be used alone
- (2) Any two pairs of speakers may be used together
- (3) All speakers must not be used simultaneously

Wiring arrangements are shown in Fig. 5.

INSTALLATION

In all cases 50 ohm 5 watt resistors are wired across the speakers outputs. These reduce the annoying click that is otherwise experienced when switching from one speaker combination to another. Apart from this function, many amplifiers will oscillate at very high frequency (in the Megahertz range) if the output is open-circuited. The resistors will prevent this occurring whilst switching.

Speaker wiring should be run in twin-core flex (23/0076 is ideal). If possible try to obtain flex that has each conductor colour coded — or identified in some way — as it is most important to maintain the connection sequence shown in the diagrams. Crossed-over wiring will result in incorrect speaker phasing and consequent cancellation of some frequencies.

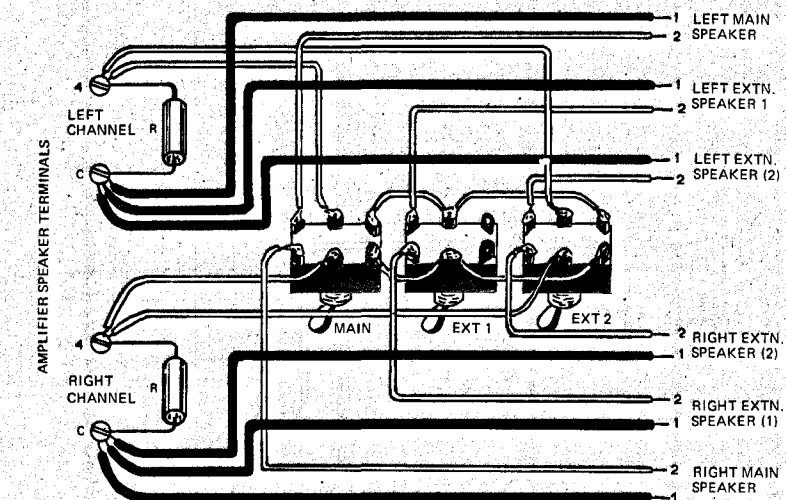


Fig. 5. Eight ohm main speakers and two pairs of eight ohm extension speakers.

A lighter gauge wire (14/0076) may be used for runs of less than 50 feet. However this lighter wire is not as readily obtainable as the 23/0076.

Ordinary hook-up wire may be used to interconnect the switch units — but again be quite sure to connect all leads exactly as shown.

At last. Stereo for fidgets.



Up till now, listening to stereo has been tough for people who can't sit still.

Because with conventional speakers the only place to sit has been at the apex of the critical sound paths. And two inches to the left won't do.

But now there are Carlsson speakers.

They function quite differently.

They're omni-directional. The very first that really work. The sound comes out of the top.

They were created by Stig Carlsson, formerly Professor of Acoustics at the Royal Institute of Technology in Stockholm. After years of research into sound reproduction.

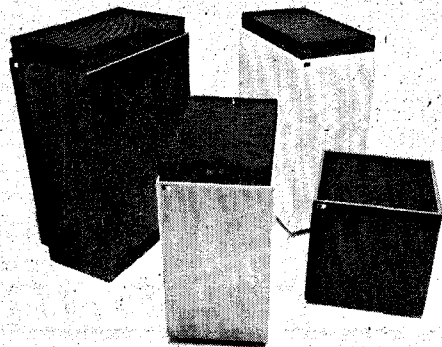
What are Carlsson speakers really like?

They fill a whole room with stereo sound. Wherever you sit, however much you move around, you're

surrounded with stereo sound. Immersed in it. No other speaker anywhere in the world will give you that.

Carlsson speakers were introduced into Australia barely a couple of months ago.

Write or phone us and we'll send you the Sonab literature and the name of your nearest dealer.



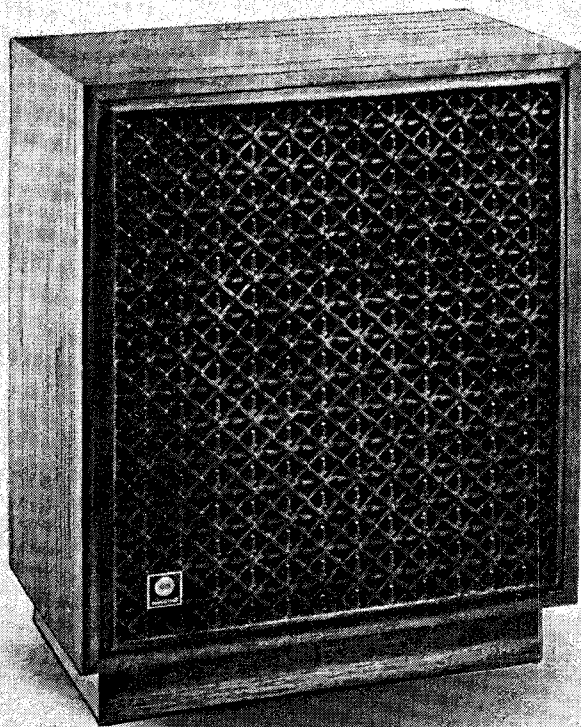
Sonab

Sonab of Sweden Pty. Ltd., 114 Walker Street, North Sydney, N.S.W. 2060. Telephone: 929 4288/4554.

"The finest loudspeakers I've ever listened to, regardless of price, type or size. . . ."

Rectilinear III

Rectilinear High Efficiency loudspeakers flatter your amplifier . . . because they don't make it work so hard.



"They produce beautiful bass tones without boom, accurate midrange tones without a trace of coloration, and crystal-clear treble tones without a hint of harshness. And they do it at any volume, including 'window-rattling' sound levels".

That's how **Ronald M. Berney**, electronics editor of *Popular Science* described a pair of Rectilinear III speaker systems in an article "The Stereo System I wish I owned".

Julian Hirsch (of Hirsch-Houck) wrote in "Equipment Test Reports" in "Stereo Review", "In our opinion we have never heard better sound reproduction in our home from any speaker of any size or price".

Other rave reviews include:

"The transient response of the speaker is superb . . . The overall quality is extreme in its fidelity to 'live' music. The bass is solid and firm, the midrange is clear and neutral, and highs are bell-like in their cleanliness".

"It all comes down to this: there are only a handful of speakers that I find completely satisfactory . . . I have had these Rectilinear III units for a month now. Lately I have found myself listening to them just for the pleasure of it. They are among the very best speakers on the market today".

"American Record Guide".

"Rectilinear III . . . has had tremendous impact on the hi-fi industry . . . This speaker's virtue is the fact that it is the first and only full-range dynamic speaker system that possesses sound quality which is directly comparable to electrostatic speakers. . . . Flute and violin concertos as well as string quartet were reproduced with honest clarity . . . Piano and organ music were effortlessly reproduced in a manner that suggested the instruments were being performed live. Jazz and rock music were unpretentious and true sounding. . . ."

"Buyers Guide".

The Rectilinear III has four small brothers, priced from \$129.00, with the same superb sound, high power handling capacity and 5 year parts and labour warranty. Make sure you hear them.

SOLE AUSTRALIAN DISTRIBUTORS

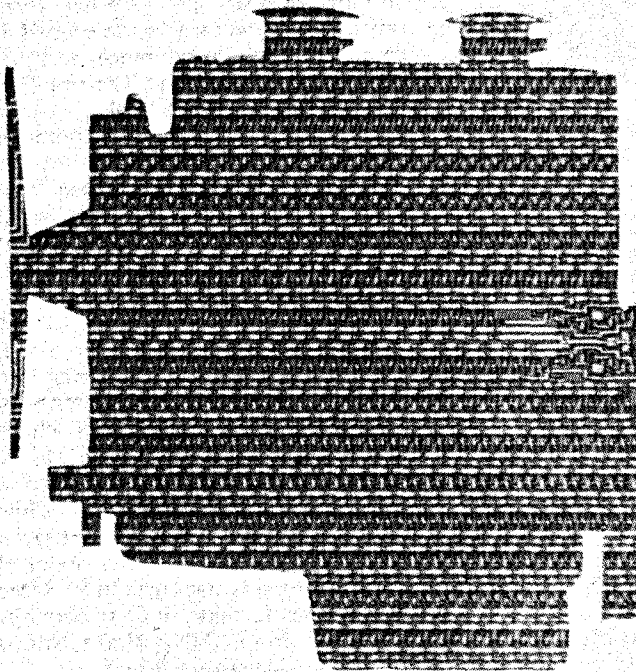
Leroya Industries PTY. LTD.

266 HAY STREET, SUBIACO, W.A. 6008

Integrated circuits in motor vehicles

by Brian Shepherd, Eng. M.I.E.E. Chief Electronics Engineer — Smiths Industries Ltd.

Integrated circuits are now available for use in fuel injection, anti-lock braking, tachometers, speedometers, automatic transmissions etc.



IT IS no longer a question of will electronics be used in large quantities in automobiles, it is purely a question of *when*.

Apart from certain areas affected by existing and proposed legislation the answer to this question will be, as always, "when it is economic". What is surprising, however, is that, in the majority of cases, this economic break point is not very far away.

If legislation calls for special safety features or warning systems to be installed, then custom integrated circuits will be called for. Once one accepts one or two ICs, the effect will snowball. It is more economic to combine a safety-belt logic system with an overspeed warning than to keep them separate. It is even more economic to add the tachometer circuit.

And so the system will grow until electronics encompasses almost every

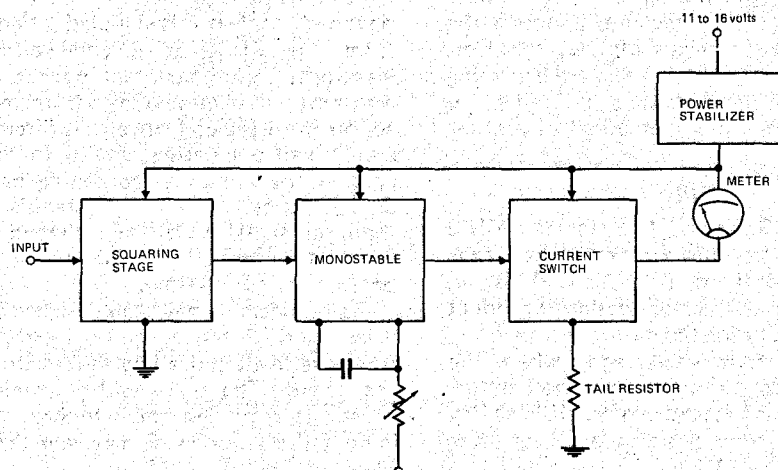
vehicle function. Although many IC designers feel that this overall systems approach is the starting point — because they see the obvious economics of total integration — it would be disastrous to start that way.

The early "getting the feet wet" approach will build more confidence and help to allay the fears that many car designers have of the electronics "black box" approach of total car control.

These fears are not totally without foundation. The environment of the automobile is extremely severe, and not the least problem is electrical interference. A strong-willed designer is needed to produce reliable instruments in the face of the economic pressures.

At the same time as the above operational techniques begin to take place a further change will occur, in this case in the methods of displaying information. Here electronics represent a great barrier; but nevertheless, the marriage of large-scale integration techniques to some of the new displays can well produce a cheaper solution. The ability to control a number of light emitting diodes or many segments of a liquid crystal, plasma, or electroluminescent panel, from one integrated circuit, opens the door to many novel display techniques.

At the present time the snowball is very small. Integrated circuits are in use in motor-cars, in tachometers,



Integrated circuits in motor vehicles

Fig. 2. IC tachometer package mounted on a thick film.

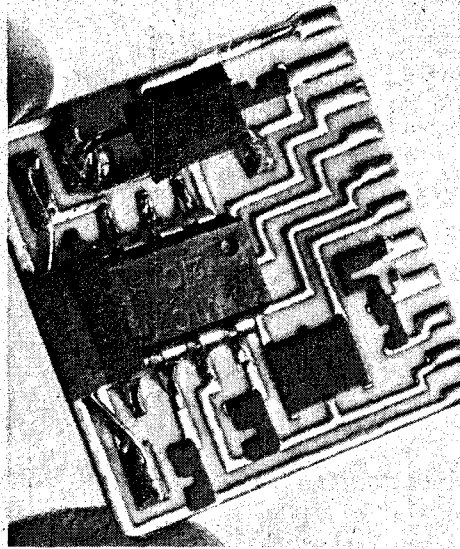
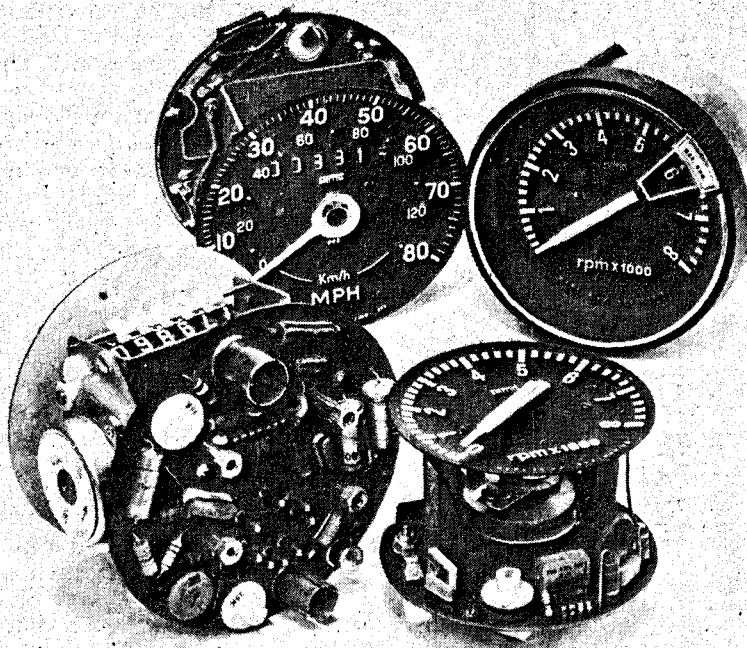


Fig. 3. Traditional appearance — but new technique, both instruments shown here use integrated circuitry.



alternator regulators and car radios, and in commercial vehicles in speedometers. The economics of custom IC's for commercial vehicles are still sound because, although the quantity required is smaller, commercial vehicle users are becoming more and more conscious of reliability in design and are prepared to pay for it.

TACHOMETERS

The Smiths Industries MIC2 tachometer chip (marketed by Texas Instruments as SN 76810P) is an example of a custom-designed product specifically for the motor industry.

Some four years ago, when the probable impact on the motor industry of mass-produced IC's at low cost became evident, a design was

started to produce an IC for use in tachometers. A block diagram of the final chip is shown in Fig. 1.

An input pulse, which may be a very narrow capacitively-coupled signal from the EHT, or a wide-voltage waveform from the contact-breaker, or a current pulse coupled by transformer action from the coil current, is filtered and fed to a squaring circuit. In this part of the circuit — consisting of a Schmitt trigger with low hysteresis — the input signal waveform is shaped to provide uniform switching edges to operate the monostable.

The monostable has been designed to have good linearity, quick recovery from overload, and a low temperature coefficient. The pulse width remains constant, regardless of whether the input pulse is wider or narrower than

the defined width. This allows quarter percent linearity from a very low duty ratio to a high ratio, such as 80 percent on and 20 percent off.

For the whole period of the monostable an output current source is switched on and fed to a moving coil meter. The particular advantage of current feeding a meter is that the overall temperature coefficient is greatly reduced. Most moving coil meters are voltage-fed and their coil resistance affects the current passing through the coil. Thus the temperature coefficient of the coil winding, usually copper, is important. Current feeding removes this problem and reduces the drift down to a value usually defined by the magnet material.

The current source technique is carried out by passing the required current through an external fixed resistor. The voltage so developed is compared with a reference and the error fed to an amplifier. The amplifier output sets the current level.

The supply voltage to the tachometer IC is defined by a shunt regulator. The relatively inefficient shunt regulator has been chosen, over the series regulator, for several minor reasons and one major. This major reason is associated with reliability under transient conditions. A shunt regulator, for example a zener diode, will turn all voltage transients into current transients. The potentially lethal high voltage spikes on a vehicle positive supply only appear at the supply end of a series resistor. Current surges on a well-designed chip cause only a momentary temperature rise.

The whole IC, with a complexity of 20 transistors, is packaged in an 8-lead dual-in-line format and is normally mounted on a thick film substrate (Fig. 2).

SPEEDOMETERS

A second integrated circuit has since been designed for commercial vehicle speedometers. Apart from minor differences, the speed indication is provided by a moving coil meter and the circuit is similar to the tachometer IC described. The input stage differs in that the signal can be obtained from (nominally) a sine wave generator and need not cope with the peculiar signals of an ignition system. Included on this IC, for the purpose of operating an odometer, is a five-stage divider with logic gates, enabling a division ratio of either 22 or 30 to be obtained.

The division ratio is adjusted by the connection or disconnection of one of the IC pins to ground. The reason for this change is that certain commercial vehicles have a back axle containing dual ratio gearing, selected by a solenoid or motor and controlled by the driver. This gear ratio is 1.36:1, which approximates to 30:22. The

inclusion of this feature inside the IC saves the cost of an extra solenoid-operated gearbox specifically for the speedometer.

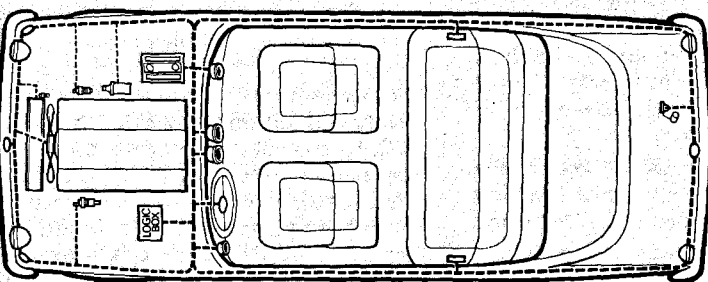
Also included on this particular IC is a trip circuit which can be adjusted externally to give an output when the speed passes through a particular level. For example, an audible warning can be obtained at 83 mph to comply with proposed U.S. regulations, or an inhibit can be obtained to prevent the driver of a public service vehicle opening the passenger doors above 3 mph. This latter feature is being used on the new Leyland "National", bus.

This integrated circuit measures approximately 0.070" x 0.070" and has about 80 transistors. It has an output capability of 40mA peak into a meter and two outputs of 100mA to drive a stepping motor for the odometer. A rear view of the full speedometer showing this IC can be seen in Fig. 3, alongside a tachometer incorporating the other IC described.

THE FUTURE

This then is the position regarding production items available to vehicles now. For the future it is obvious that larger IC's, with the consequent increase in possible complexity, will allow more functions to be accommodated at a reasonable price level. Experience has shown that expensive integrated circuits, designed for aviation or space use, fall in price to a level acceptable to the consumer and automotive regions in only a few years. Complexities of 6,000 transistors on a metal oxide silicon chip having a size of 0.15" x 0.15" are available even now at modest prices.

With this complexity in mind it is possible to envisage automotive sub-systems with the long-term aim of one overall system. Examples of sub-systems which will use integrated circuits are: fuel injection; anti-lock braking, speed control; overall display systems; one-wire control systems; warning and safety systems. For all these systems reliability is extremely important. The few actual components used, usually an IC, one or two capacitors, a thick or thin film, and perhaps a power semiconductor, make this degree of reliability attainable.



ECSTASY SYSTEM

As one example of such a system, Smiths Industries have produced a one-wire vehicle control system with the code name ECSTASY. This stands for electronic control for switching and telemetering automobile systems and is illustrated in Fig. 4.

All wiring on a conventional vehicle is replaced by a ring main system consisting of a power lead and a control wire passing around the perimeter of the vehicle; all electrical accessories are connected to this ring at the nearest point via an electronic module. A control unit situated at the dashboard is also connected to the same ring.

A switch, operated on the dashboard control, alters a particular code in a main sequence, transmitted down the control wire every millisecond. The appropriate accessory electronic module detects that code and stores the information. When the correct code is received four sequential times, nominally after four milliseconds, the accessory is operated. If the accessory fails to operate, a fail signal is returned to the control module and a warning indicator is illuminated.

A particular feature of this system is the ability to accept analogue (or changing level) signals. As an example, a tachometer sensor connected to the ring at the engine has a code location. This is detected, again at the control unit, decoded and displayed in the conventional way on an instrument.

Further locations can be made available for other instrumentation — i.e. temperature, fuel and pressure gauges.

Fig. 5. The ECSTASY ring main system.

Fig. 4. This ring-main wiring system uses digital signals to actuate particular functions.

The electronic modules built so far contain discrete electronic components and as such are much larger, and costlier, than is envisaged for vehicle use. The actual modules, which are of necessity cheap, would have a size of about 1 cu. in. They would be completely encapsulated and coded by their channel numbers.

CONCLUSION

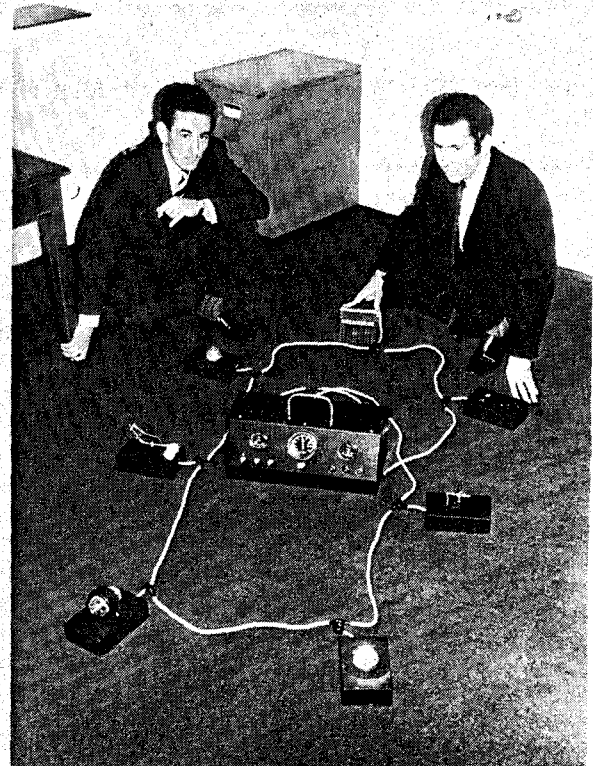
When using these new design techniques, it is necessary that the designer fully understand them if he is to obtain the best from the technology.

An anti-lock braking system has been deliberately designed on a semi-digital principle such that it is more amenable to IC design. Also, more accurate detection of incipient wheel locking is possible, and the digital approach allows the use of a simplified pulse generator at the wheel.

Integrated circuits have, then, arrived in motor vehicles. It is, however, only the tip of an iceberg.

The penetration of electronics has been delayed by cost, and reliability problems consequent upon low cost, for too long. Integrated circuits are changing this. Designs are available, in various parts of the world, which use IC's in fuel injection, anti-lock braking, tachometers, speedometers, automatic transmissions, anti-pollution circuits, safety systems and warning systems.

In a few years, looking world-wide, a much larger piece of that iceberg will be visible. ●



PEAK MODEL TRM-50 AMPLIFIER

electronics
TODAY
INTERNATIONAL
product test



Latest amplifier from Peak features modular IC construction.

The Peak TRM 50 amplifier is the newest stereo amplifier to be released under the Japanese Peak (or NK) brand. The unit has a rated continuous power output of 17 watts per channel — sufficient for the requirements of most homes.

Externally the amplifier is particularly smart and very pleasing. The well constructed metal case has two solid wooden ends and a crinkle-finished plastic-coated metal cover.

The front panel is divided into two distinct horizontal sections, the top half consisting of a black escutcheon plate with clear white engraving of the functions, while the bottom half has a recessed brushed aluminium panel with four large piano key switches, a headphone jack and a power bezel light. Six control knobs, located in the top half of the front panel, have black

ends with a narrow silver strip around the edge. These knobs provide the following controls, from left to right:—

a) The first knob is for speaker selection. This unusual but very worthwhile feature enables two sets, each of two speakers, to be selected as required. The switch has four positions; an "off" position (for headphone use only), a position for speakers 'A' only, one for speakers 'A & B', and one for speakers 'B' only.

b) The second knob is the bass control. This control has a dual function, for when pushed in it activates the rumble filter.

c) The third knob is the treble control. This also has a dual function and activates the scratch filter when pressed in.

d) The fourth knob is the balance control.

e & f) The last two knobs are slightly larger in diameter than the rest, and are a volume control and a function selector knob. The function selector knob has five positions; for ceramic phono input, magnetic phono input, tuner input, tape input and auxiliary input.

The four piano key switches provide the following functions:

- i) Stereo or mono input.
- ii) Tape monitor.
- iii) Loudness control.
- iv) Mains power switch.

The input and outputs sockets are neatly laid out on the back of the unit. R.C.A. coaxial sockets are provided for phono input, tuner input, tape input, auxiliary input, tape record output and tape monitor input. A combination DIN socket is provided for record or playback connections to a stereo tape recorder. Speaker

connections are made via two sets of colour coded spring-loaded terminals; one set for the 'A' speakers and the other for the 'B' speakers.

Instead of the customary fuses in the mains and power transistor circuits, Peak have used miniature circuit breakers mounted inside the rear panel, with the reset buttons projecting through. One switched and one unswitched two-pin American or Japanese type, power sockets are located at the righthand end of the rear panel for energizing auxiliary equipment.

Integrated circuits are now being used in a number of consumer electronic goods and before long such use may be the norm rather than the exception.

In this respect the Peak TRM 50 is completely up to date as it uses a number of IC's to replace discrete components.

The phono input has its own integrated-circuit preamplifier complete with feedback equalisation circuit. When the phono-input is not in use, this amplifier is grounded. The preamplifier integrated circuit contains two transistors and six resistors. The other three inputs are taken direct to the attenuator of the volume control which in turn is followed by the second stage of preamplification. This second IC preamplifier again contains two transistors and eight resistors. Treble and bass boost and cut circuitry are provided externally.

The next stage is the output driver. This drives two 2SD154 npn silicon power transistors in a single-ended push-pull stage. This push-pull stage has two npn transistors as voltage amplifiers, followed by one npn and one pnp transistor as a phase splitter.

Internal bias stability for the drivers is provided by diodes glued to each power transistor heat sink, so that, in theory at least, the bias can be controlled by the output stage.

In the amplifier that we tested, the rigidity of the diode leads caused the glue bonding these diodes to the heat sink to break, so the contact was no longer integral.

The major sections of the amplifier are assembled from a number of interconnected printed circuit boards. One worthwhile feature of these boards is the pins used for interconnecting wiring. These pins project through both sides of the boards and are handy for connecting test probes for fault finding.

Much of the circuit has been built from what appears to be either medium scale integrated (or hybrid) circuits, or discrete components have been used and encapsulated to provide a series of modules which replicate the function of the respective stages of conventional transistor amplifiers.

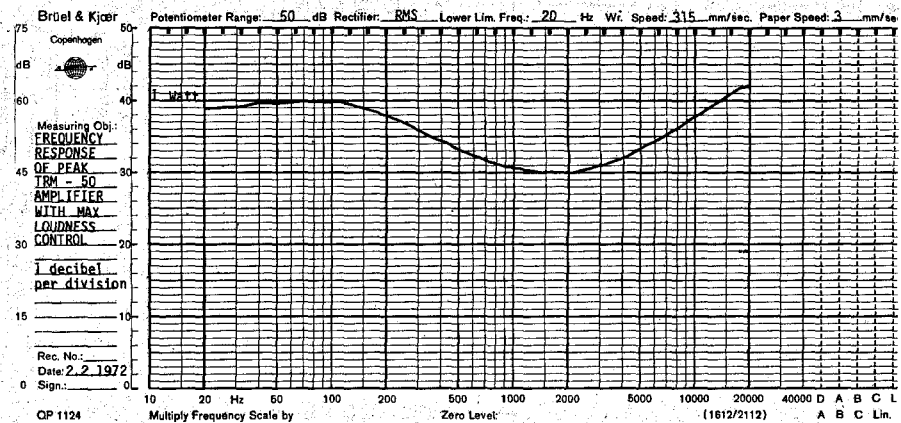
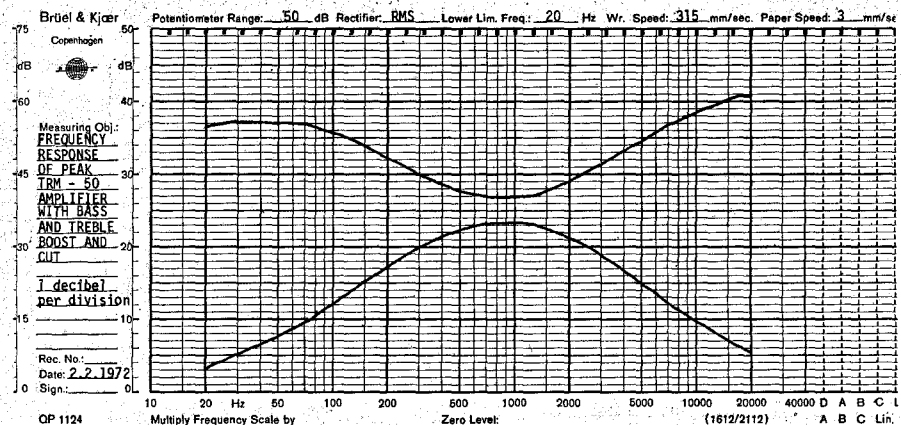
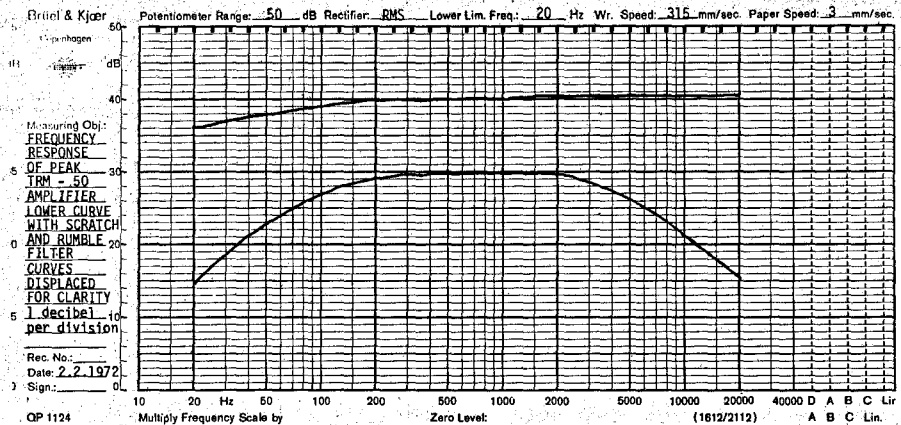
Certainly the construction of the amplifier is simplified somewhat, but it cannot be truly said that a dramatic breakthrough has been effected, nor that the resultant wiring or interconnections have become either simpler or neater.

The owner's manual is rather brief — containing only six pages. The first page gives a comprehensive performance specification, the next page provides explicit details on the functions of each control on the front panel, the middle two pages give an explanation of the rear panel connections and how to connect and operate the amplifier, and the last page

provides a schematic wiring diagram showing all component values.

Objective tests showed that the performance of the amplifier was good. Only one measured parameter failed to match the manufacturer's specification — whilst the manufacturer claimed a frequency response of 10 Hertz to 70kHz \pm 1 dB for the auxiliary input, we found that for the low frequency performance was -4dB at 20 Hertz. The frequency response to the phono input was -0.5dB at 20 Hertz and -1dB at 15kHz.

The overload circuit breakers are really effective and operate smartly as



PEAK MODEL TRM-50 AMPLIFIER

soon as the current exceeds a nominal 1.25 amps in either dc supply lead. A similar circuit breaker is utilized in the mains lead. This should only operate under gross overload, or if a component fails in the power supply.

The Peak TRM 50 stereo amplifier reflects some of the latest trends in amplifier design, particularly with regard to the provision of switching facilities. Its power output is adequate for most domestic applications and it would readily harmonize with most modern decor.

It is well made and performs adequately. The provision for switching two sets of speakers is very worthwhile, and the built-in overload protection is both ingenious and effective.

In view of the Peak TRM 50's many good points it is rather unfortunate that — at the recommended selling price of \$210 — it is not really competitive with several other amplifiers with many (but not all) of this unit's features.

Since this report was written — the recommended selling price of the Peak TRM 50 Amplifier has been reduced to \$195.

MEASURED PERFORMANCE OF PEAK MODEL TRM-50 AMPLIFIER SERIAL NO 3404473

FREQUENCY RESPONSE (AT RATED OUTPUT — 17W)

Auxiliary input	20Hz — 20kHz	+½dB —4dB
Phono input	20Hz — 15kHz	+0dB —1dB

POWER OUTPUT INTO 8 OHMS (BOTH CHANNELS DRIVEN)

18 Watts

HUM & NOISE — UNWEIGHTED (RE RATED OUTPUT — 17W)

Auxiliary input	—79dB
Phono input	—55dB

INPUT SENSITIVITY (FOR RATED OUTPUT — 17W)

INPUT	SENSITIVITY (mV)	IMPEDANCE
Phono (Mag)	2	50k Ω
Auxiliary	250	100k Ω
Tape Monitor	250	100k Ω
Tuner	250	100k Ω
Tape Record	250	10k Ω

TOTAL HARMONIC DISTORTION (AT RATED OUTPUT)

100Hz	— 0.55%
1kHz	— 0.55%
6.3kHz	— 0.50%

INTERMODULATION DISTORTION (1kHz and 960Hz)

0.55%

TONE CONTROLS

Bass 12dB Boost at 50Hz
18dB Cut at 50Hz

Treble 13dB Boost at 10kHz
15dB Cut at 10kHz

Loudness Control 14dB Boost at 50Hz
7dB Boost at 10kHz

Rumble Filter 7dB Cut at 50Hz
Scratch Filter 9dB Cut at 10kHz

DIMENSIONS

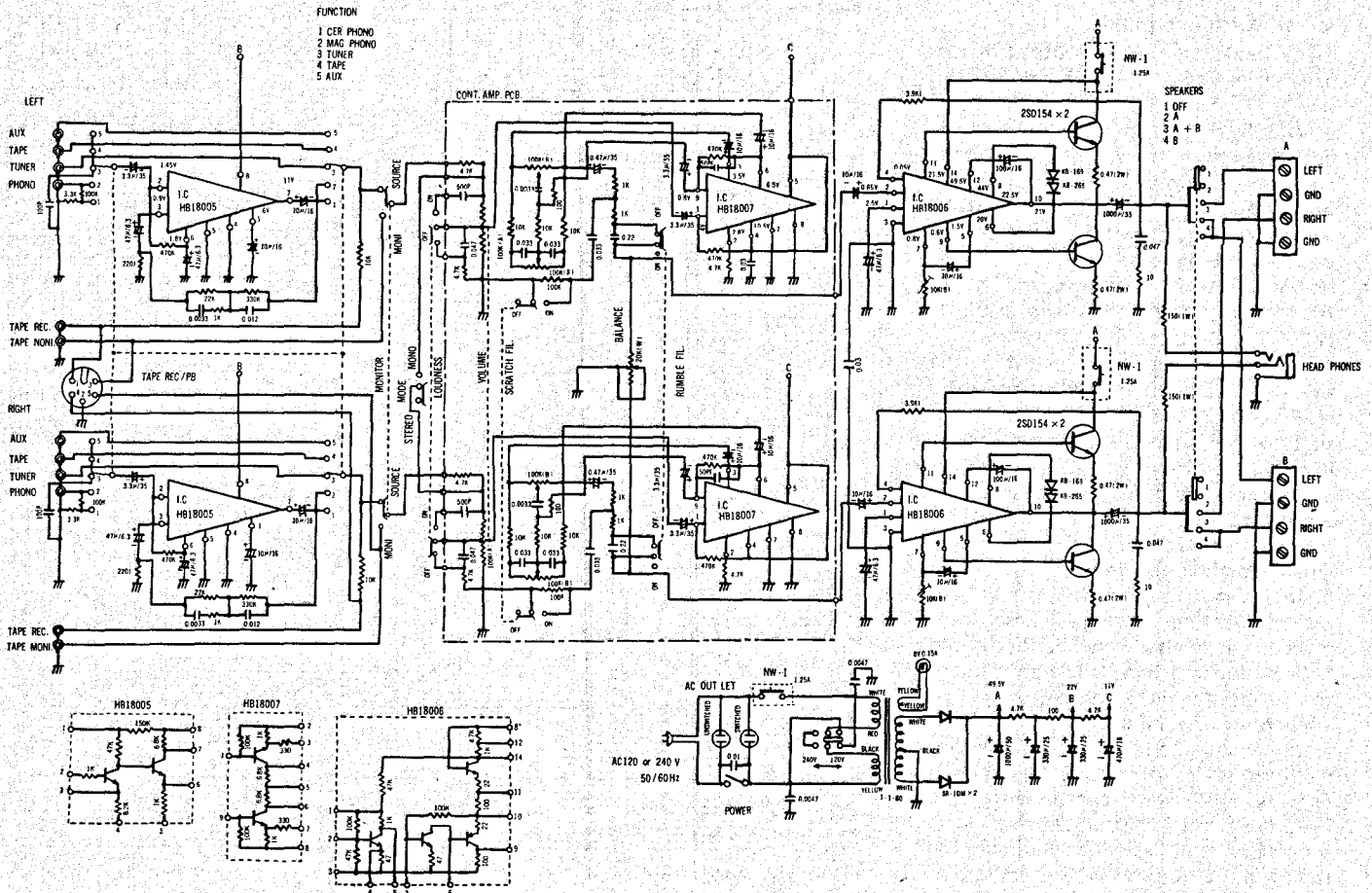
13" Wide x 9½" Deep x 3¾" High

WEIGHT

11.4 lbs.

Price

Recommended retail price \$195



NOW AVAILABLE: JVC CD-4 DISCRETE 4-CHANNEL RECORDS

World's first discrete 4-channel records now at all JVC dealers

Hear Bizet's fiery Carmen Suite and your favourite themes from the movies like you've never heard them before at your nearest JVC/NIVICO dealer. These are the first in many planned JVC/NIVICO discrete 4-channel record releases. Your dealer has all the facts on the records and on the equipment you'll need to enjoy them. See your favourite JVC/NIVICO dealer or write to the JVC/NIVICO distributor listed below for your dealer's name and address, and for detailed information.

The missing link in 4-channel sound

Until now the only discrete 4-channel sources available were tapes and cartridges. The discrete 4-channel disc — the biggest 4-channel source of all — was missing. Today, thanks to JVC/NIVICO this is no longer true.

Big breakthrough in recording

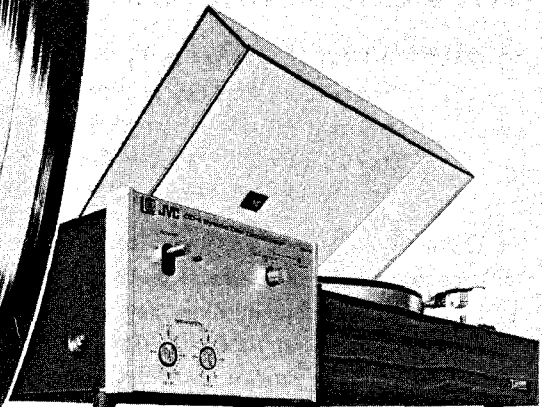
How to put four separate signals on the walls of the standard v-shaped record groove while maintaining the same tonal quality and price factor of existing 2-channel records was a major obstacle to the development of the 4-channel record. JVC/NIVICO solved it by major breakthroughs in the record cutting process. So far, some ninety patents have been applied for in the JVC/NIVICO CD-4 system. Some of the breakthroughs include a modulated recording system, low speed cutting, carrier level control, Neutrex Discrete 4-channel sound.

Discrete 4-channel sound

Discrete, by definition, means that where a plurality of sound transmission systems is present, each transmission channel is recorded and played back independently. This is the JVC/NIVICO CD-4 system. It gives the kind of separation which makes it possible to reproduce the original musical properties recorded for you to enjoy the sound, nearest to concert hall true fidelity. Matrix-type or encoded 4-channel systems do *not* have this complete separation, which means that no matter how sophisticated, they just can't qualify as real high fidelity 4-channel systems.

Equipment needed

Other than a 4-channel amplifier (e.g. MCA-V5) or an add amplifier (e.g. 5100) to your existing stereo amplifier and a quality stereo turntable (e.g. SRP-473) the only equipment you need to hear JVC/NIVICO discrete 4-channel records are the JVC/NIVICO 4-channel/2-channel playback cartridge (4MD-10X) and JVC/NIVICO disc demodulator (4DD-10)



JVC
NIVICO



Hagemyer (Australasia) N.V., SYDNEY — 59 Anzac Parade, Kensington. 2033. Tel. 663-4402, 663-4553, 663-5335.
MELBOURNE — 40-48 Park Street, South Melbourne. 3204. Tel. 699-1633
ADELAIDE — 15-17 Kingston Avenue, Richmond. 5033. Tel. 52-1687
BRISBANE — 52 Costin Street, Fortitude Valley. 4006. Tel. 51-5722.
PERTH — 228 Oxford Street, Leederville. 6007. Tel. 24-7755.



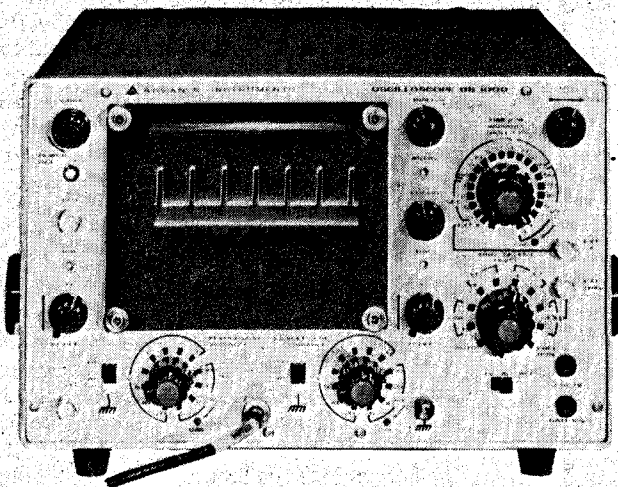
Two new instruments from

ADVANCE

which offer

UP -to-the-minute performance and
latest 'state of the art' technology

DOWN -to-earth prices



OS1000 oscilloscope

- OUTSTANDING FEATURES**
- DC to 15 MHz bandwidth
 - 5mV/cm dual trace
 - Signal delay
 - Comprehensive trigger facilities, incl. TV sync.
 - Bright line auto free-run
 - Switched X-Y operation

The ADVANCE OS1000 is a portable, dual trace oscilloscope, combining small size and light weight with a specification providing the ability to make precise waveform measurements. Wide time base ranges and comprehensive trigger control combined with broad bandwidth and calibrated deflection factor make this instrument suitable for many general purpose and laboratory and TV applications. Use of solid state circuitry throughout makes the OS1000 particularly suitable for servicing or laboratory use. Full specifications available on request.

DMM2 digital m/meter

- OUTSTANDING FEATURES**
- 17 ranges for measurement of AC or DC voltage, current and resistance
 - Maximum stability
 - LSI reliability

The DMM2 Digital Multimeter provides in 17 ranges a clear digital reading of AC or DC voltage, AC and DC current and resistance. Push button selection of functions and ranges. The display has a max. reading of 1999 with automatically positioned decimal point. Overrange and reverse polarity indications are provided. The DMM2 weighs only 3½ lb and can be operated from AC supply, external 12V DC, or an optional rechargeable battery pack. Design ensures maximum stability for all measurements, ease of operation allowing use by non-technical operators and high reliability with all counting and storage functions performed by an LSI package (Large Scale Integrated Circuit). Full specifications available on request.



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JM/57/70

A PRACTICAL GUIDE TO SCR'S

PART II

In the second part of this series Collyn Rivers describes how SCR's are used in switching, timing, and logic circuits.

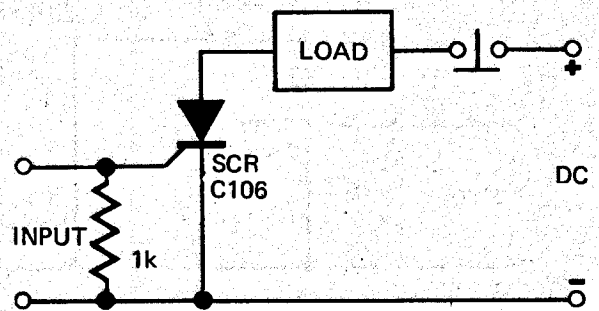


FIG. 1

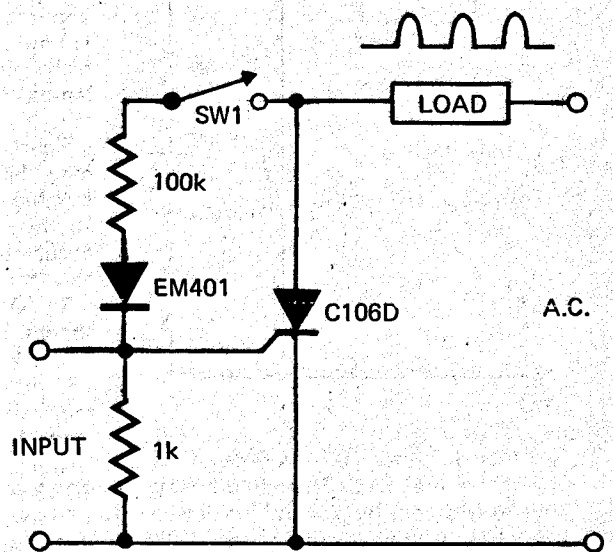


FIG. 2

SCR's may be used to simulate common relay configurations, Figs. 1 through 5 show how this can be done.

Figure 1 shows how an SCR can simulate a single pole single throw latching contact. A positive input to the gate of the SCR activates the load. The circuit is deactivated by the 'reset' switch.

An ac energized version of this circuit is shown in Fig. 2. Here, a positive input (or closure of SW1) will cause the load to be energized with half-wave rectified dc. Reset is automatic when the triggering signal is removed (or SW1 is opened).

The circuit shown in Fig. 3 is a 'normally closed' version of that shown in Fig. 2. Here a positive input to the gate of SCR1 shorts out the triggering of SCR2, thus preventing it from triggering. When the input signal is removed, SCR1 switches off and SCR2

A PRACTICAL GUIDE TO SCR'S

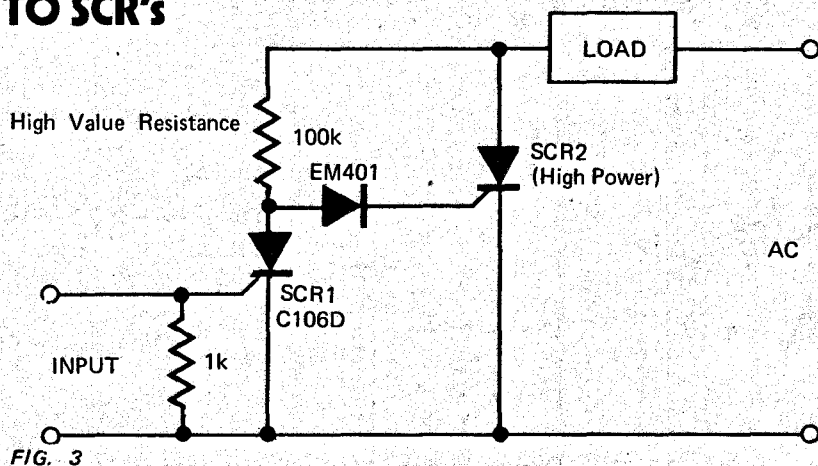


FIG. 3

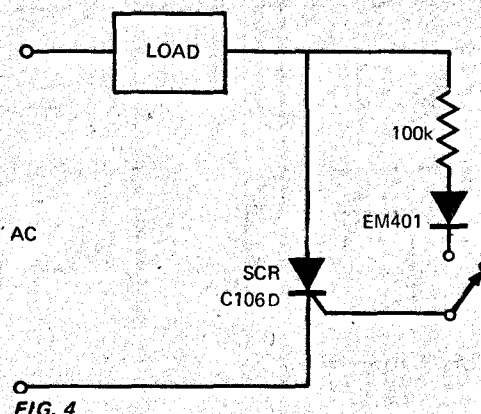


FIG. 4

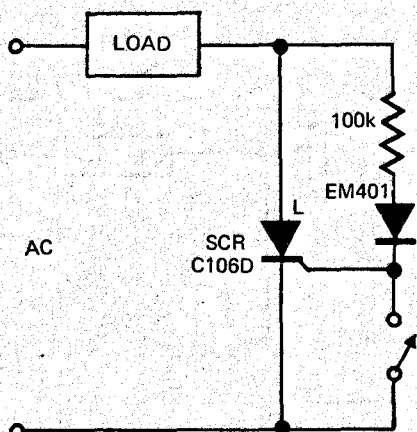


FIG. 5

is biased into conduction thus energizing the load. This circuit may also be triggered by a switching device — simply by the addition of the 100k resistor and EM401 diode shown in Fig. 2.

Figure 4 shows how an SCR may be triggered (via a switch) by energy derived from the ac supply. The circuit shown in Fig. 5 is a variation of Fig. 4, the difference being that the switch shown in Fig. 5 causes the SCR to switch 'off' when closed.

It is important to appreciate that the circuits shown in Figs. 2, 3, 4 and 5 will cause half-wave rectified dc to be supplied to the load.

Full-wave operation may be obtained by connecting the SCR's within a full-wave rectifier bridge as shown in Fig. 6. Both ac and dc loads may be switched using this type of circuit, but unless the circuit is being used to take advantage of the low gate current triggering capabilities of small SCR's, it is generally more satisfactory to use Triacs if full-wave switching is required.

LOGIC OPERATIONS

The 'on-off' (or binary) nature of the

SCR makes it an ideal device for low-speed logic circuitry in applications where large power output is required. They may be used to drive high current relays, incandescent lamps, fractional horse-power motors etc.

Figure 7 shows how a pair of C106s may be used as an 'AND' circuit capable of switching up to four amps. In this circuit, unless inputs 1 and 2 occur simultaneously, no voltage can exist across the load.

An 'OR' gate, again using C106s, is shown in Fig. 8. Here, an input to either 1 or 2 will energize the load.

Figure 9 shows a triggered multivibrator — an input to 1 energizes load 1. A subsequent input to 2 energizes load 2, thus turning off SCR1 and de-energizing load 1.

The circuit shown in Fig. 10 is a 'one shot' or pulse generator. Here an incoming signal triggers the SCR and energizes the load. The load voltage energizes the UJT timing circuit. After a time determined by R1/C1, the UJT fires, and a pulse generated across R2 is coupled to the cathode of the SCR through D1 and C2. The SCR's cathode is momentarily lifted above the anode voltage and the SCR turns off.

A pulse generating circuit, suitable for use as a car, boat or warning flasher, is shown in Fig. 11.

This circuit will operate reliably from noisy or fluctuating power supplies — and unlike many multivibrator circuits — is inherently self-starting when power is applied. In this circuit unijunction transistor Q1 is used as a relaxation oscillator supplying a continuous train of pulses to the gates of the SCR's. Assume that SCR2 has been triggered into conduction and that lamp 2 is energized. The next trigger pulse from Q1 triggers SCR1, this discharges C2 and the resultant commutation pulse turns off SCR2. The resistor R2 in the anode of SCR1 is of a value high enough to prevent SCR1 from latching on. SCR2 is retriggered by the next triggering pulse from Q1. Using the component values shown, the flash rate of this circuit is adjustable — by R2 — from 35 to 150 flashes a minute.

TIMING CIRCUITS

The precision time delay circuit shown in Fig. 12 will provide accurate and repeatable time delays adjustable from a few milliseconds to a minute or two. This is a very flexible circuit in which the operating current and voltage depends only on the choice of SCR.

The timing sequence may be initiated either by applying power to the circuit — or by opening a shorting switch

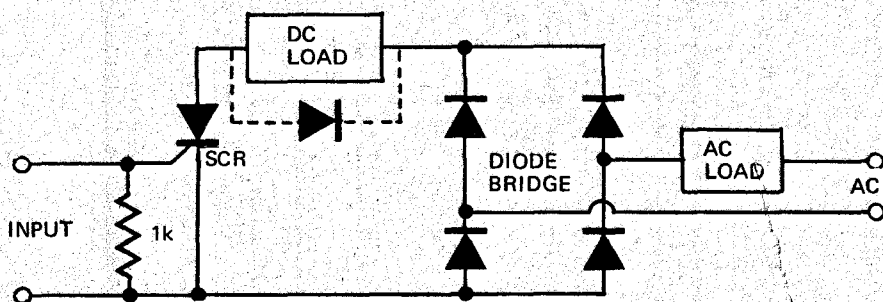


FIG. 6

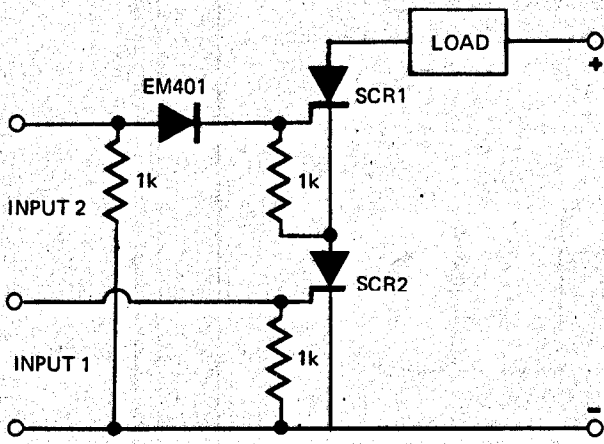


FIG. 7

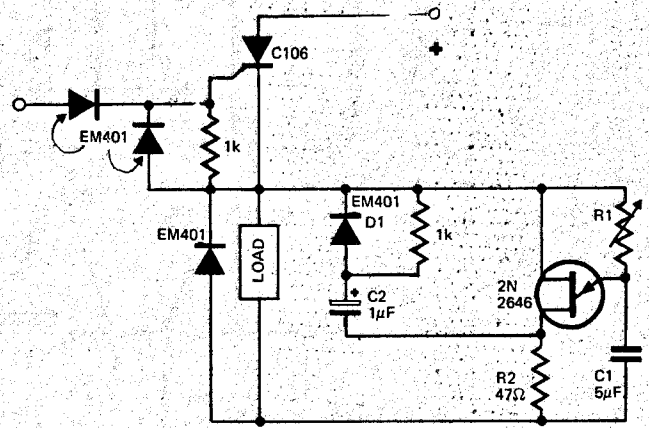


FIG. 10

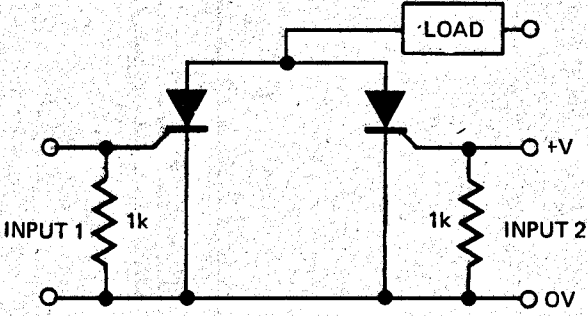


FIG. 8

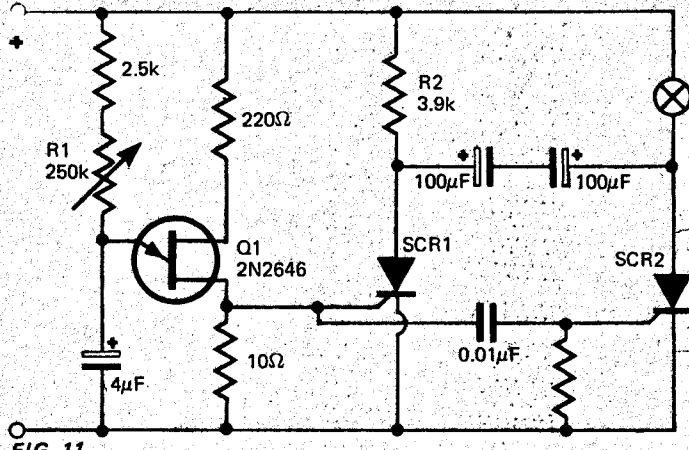


FIG. 11

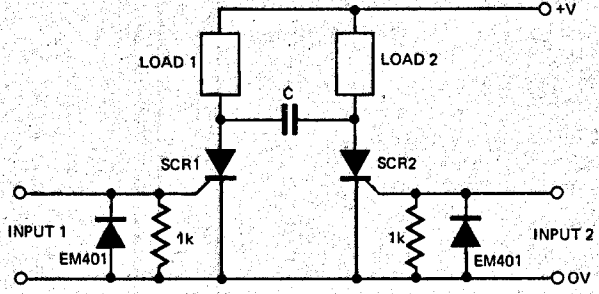


FIG. 9

wired across C1. Timing capacitor C1 is charged via R1 and R2 until the voltage across C1 reaches the peak point voltage of the UJT Q1. When this occurs, Q1 fires, generating a pulse across R4, triggering the SCR, and applying power to the load. Holding current for the SCR is provided via R5 and D1.

The circuit is reset by momentarily removing the supply voltage.

If the circuit is to be used in an application where both rapid cycling and accurate, repeatable timing is required - some provision must be made to ensure that C1 is discharged to zero before each timing sequence. This can most easily be done by interconnecting a pair of switch contacts with the reset system so as to momentarily short out C1 whenever the circuit is reset.

Temperature compensation for this circuit is provided by R3. Increasing

*TIMER
250µS.*

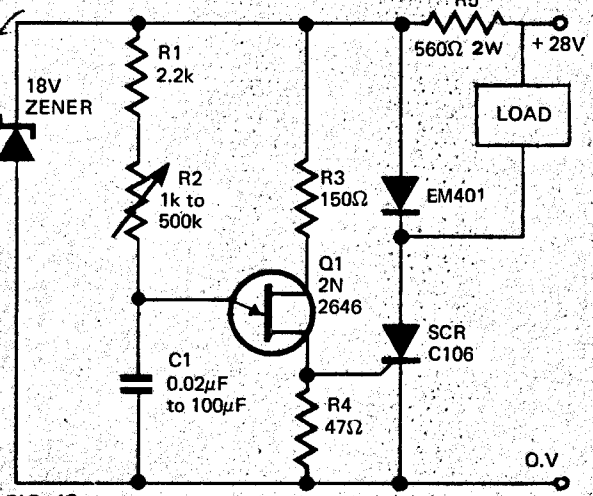


FIG. 12

the value of this resistor causes the circuit to have a positive temperature coefficient. It is possible to obtain zero coefficient over a small range of ambient temperatures by optimizing R3.

A simpler version of this time delay circuit is shown in Fig. 13. The supply voltage to the timing circuit is not Zener stabilized in this latter version, and because of this, repeatability is not as good.

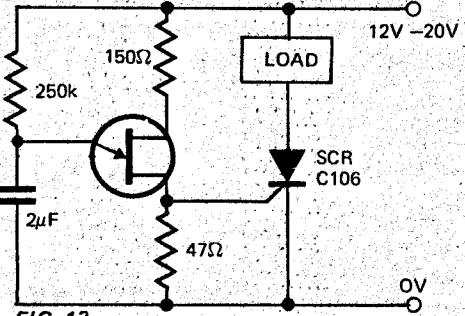
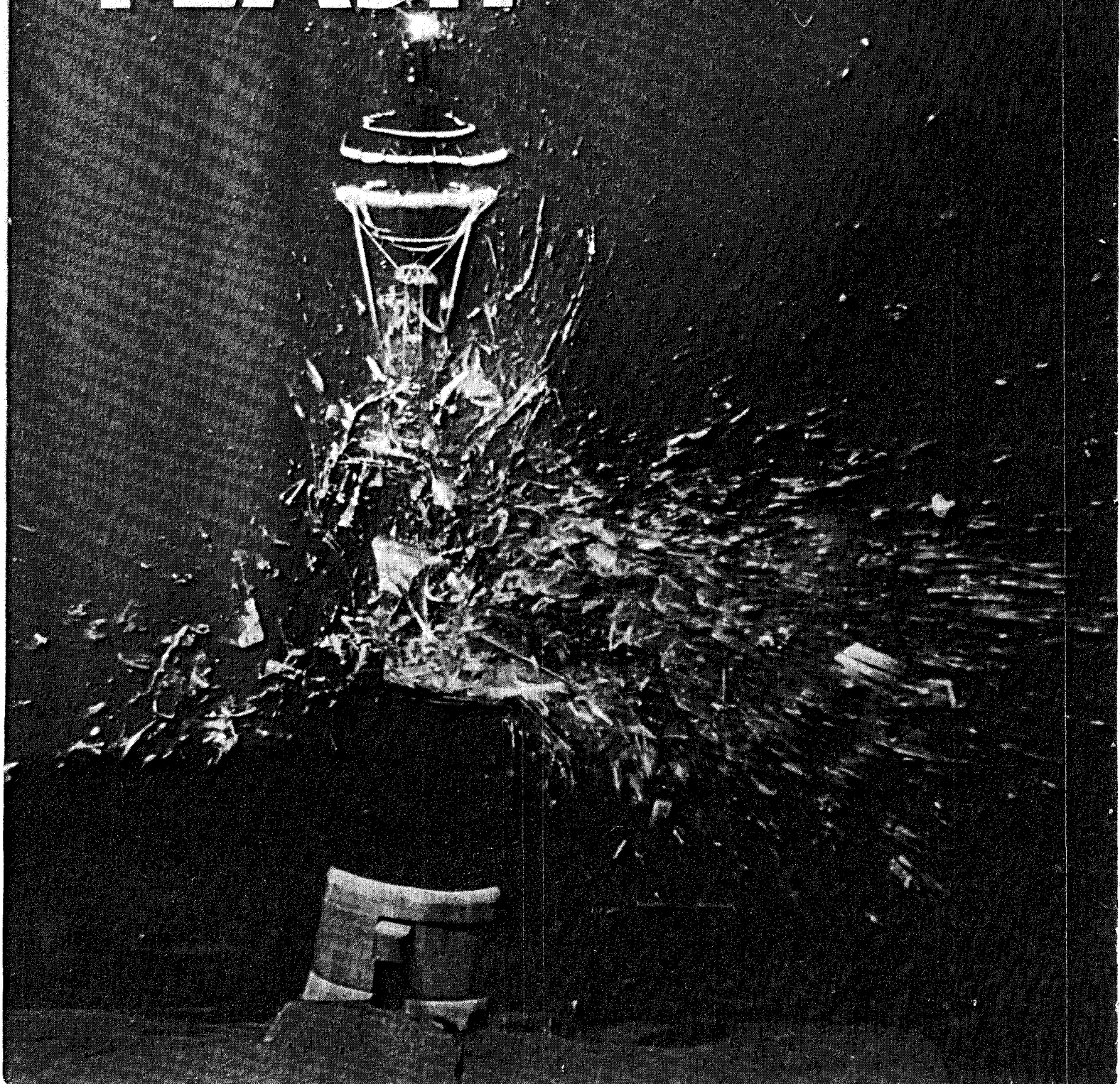


FIG. 13

SOUND- OPERATED FLASH



SOUND-OPERATED FLASH

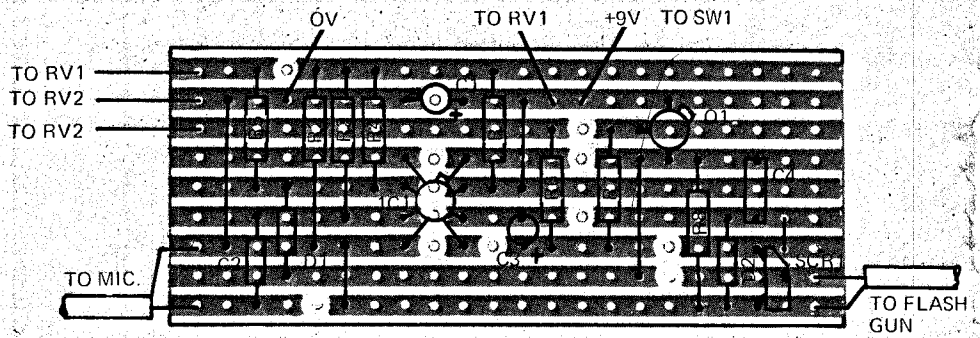


Fig. 3. How the components are located on the Veroboard.

PARTS LIST ETI514

- R1 - resistor 1k ohm ½ Watt 10%
- R2 - " 1k " " "
- R3 - " 100k " " "
- R4 - " 10k " " "
- R5 - " 10k " " "
- R6 - " 3.3k " " "
- R7 - " 4.7k " " "
- R8 - " 1k " " "
- RV1 potentiometer 5M log
- RV2 " 50k "
- C1 Capacitor 33 uF 10V electrolytic
- C2 " 0.0047 uF 100V
- C3 " 10 uF 16V
- C4 " 0.1 uF 100V
- Q1 Transistor BC178 or similar
- D1, D2 diode 1N914 or similar
- IC1 Integrated circuit uA 741C
(metal can type only)
- SCR1 C106D1
- SW1 Switch single pole single throw
- 9V battery
- Plug for flash and or an extension cord
- Microphone jack
- Microphone - High output crystal Veroboard (0.15").

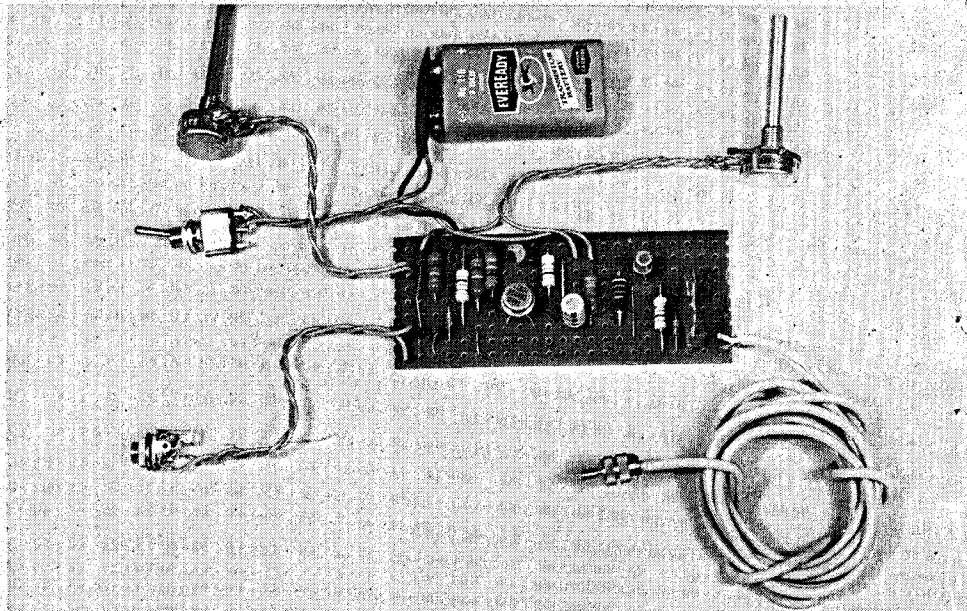
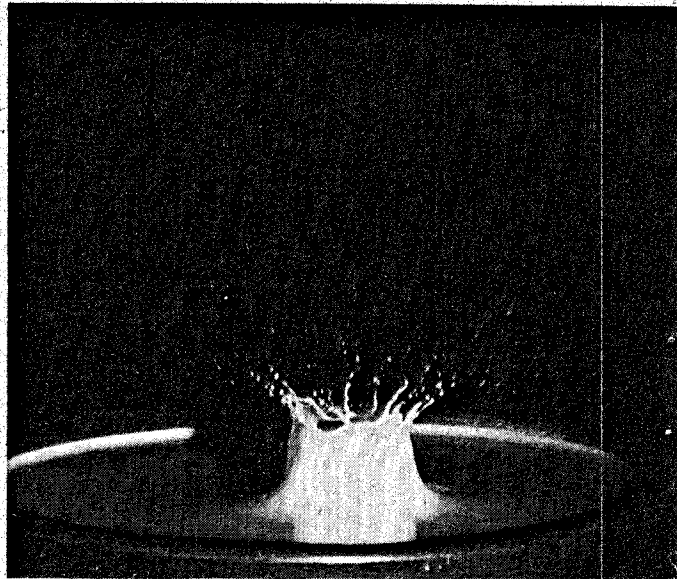
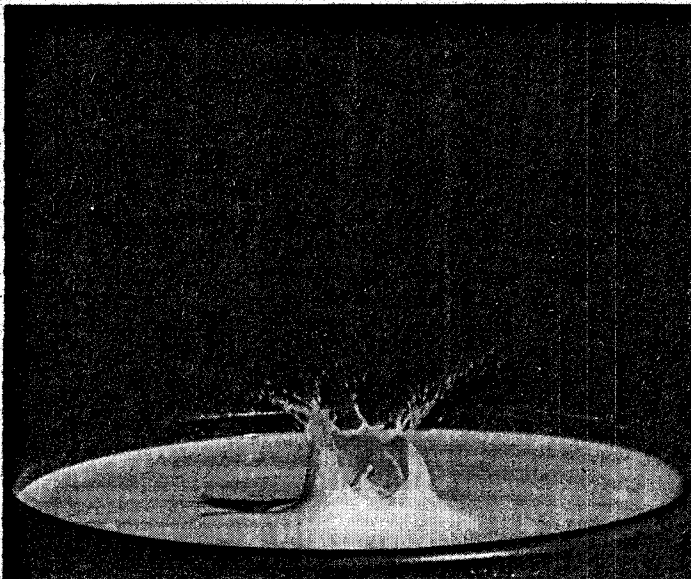


Fig. 4.

These pictures show how the variable time delay facility can be used to capture the effect of a ball bouncing in a container of fluid. The pictures were taken with the sound operated flash unit set at time delays between 50 milliseconds and 200 milliseconds.



crystal microphone (these are cheap and readily obtainable) into the mic. input socket on the unit, and plug the unit's flash lead into the flash gun.

Switch on SW1 and adjust RV1 so that the flash is not triggered by ambient noise, but will be triggered by the event to be recorded — i.e., a gun firing, hands clapping, glass breaking, etc.

In most circumstances the stop-action photography must be done in a dark room with the camera shutter open, or if only black and white film is used — using a red photographic safe-light. Assume for example, that we wish to photograph a bottle at the instant of being broken by a stone from a catapult. The equipment, catapult and bottle are set up initially in the light and tested to confirm correct function and sequence.

A test run is then performed, using an arbitrary setting of the delay, in the now darkened room. This is done by opening the shutter, firing the catapult and then closing the shutter before turning on the lights. (Although shooting a bottle in the dark may seem very difficult — with a little practise it is surprisingly easy — our front cover picture was taken just this way. It is of course potentially dangerous and it is essential to wear eye protection.)

Subsequent development of the film will show whether the chosen delay was correct. If too short, the bottle will be photographed before actually

breaking up — if too late the action will have progressed further than required. Further pictures should then be taken varying the time delay to 'bracket' the actual delay that is now estimated as correct. With a little experience the user will be able to

estimate the required delay within close limits.

As the flash duration is typically of the order of one or two thousandths of a second, quite high-speed activity can be frozen — as our own pictures show. ●

HOW IT WORKS

Basically the microphone triggers the IC monostable circuit which subsequently triggers an SCR, and hence the flash, after a time delay. This delay is adjustable — by varying a monostable on-time — from 5 milliseconds to 200 milliseconds.

Integrated circuit IC is an $\mu A741C$. This is a dc differential amplifier with a high gain — typically 25,000. The output swing of the IC with a 9 volt dc supply is of the order of 6 volts, and this is obtained with an input swing of only 240 microvolts. This makes the IC ideally suited for use as a comparator and is the mode of operation utilised in our circuit.

Due to the very high gain and the relatively large input signals normally encountered, the IC is almost always either fully cut off or fully saturated. The linear region is very narrow and is not utilized in this circuit.

The two inputs of the IC (pins 2 and 3) would be at the same potential were it not for the bias current supplied through RV1. This raises the voltage at pin 2 of the IC by 10mV or more above pin 3 depending on the setting of RV1.

The IC will therefore normally be fully saturated and the output voltage will be low.

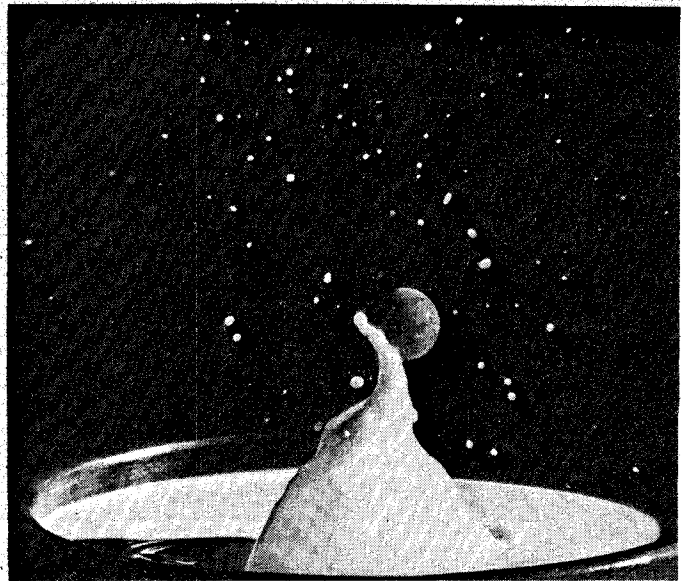
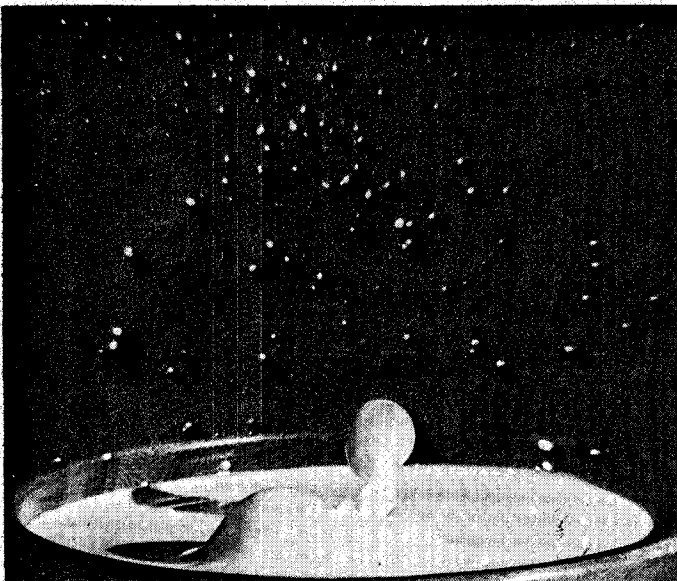
Transistor Q1 is normally held on by the current through RV2, and its collector is high, reverse biasing diode D1.

When an audio signal from the microphone produces at pin 3 a level exceeding that set on pin 2 by RV1, the IC will rapidly change state and its output will go high.

The front edge of this transition turns off Q1 via C3. The collector of Q1 will fall, D1 becomes forward biased and pulls down pin 2 to about one volt — the IC output is maintained in its high state.

After a time — determined by the time constant of C3 and RV2 — Q1 turns on again allowing the IC to revert to its normal low output.

The output signal from Q1 is differentiated by C4 and the negative pulses (which occur first) are clipped off by diode D2. The positive pulse which occurs at the end of the delay period, triggers the SCR and fires the flash.



Slave-flash unit

ET1 PROJECT 515

This simple slave flash unit uses only five basic components.

PHOTOGRAPHS taken with a single photographic flash are often harsh, with unnaturally sharp shadows.

This problem may be overcome by using a slave flash — triggered by the light from the main flash — for filling in and/or background illumination. The unit described in this project is very simple and easy to build, and will provide vastly improved results for a very moderate outlay.

Figure 1 shows the circuit of the slave unit. Any phototransistor may be

used for Q1. We used a BPX25 — this is an npn device. If a pnp phototransistor is chosen (such as an OCP71), the device must be assembled into the circuit with the emitter and collector reversed, rather than as shown in Figs. 1 and 2.

The unit is powered by a small nine volt battery (such as Eveready type 216).

CONSTRUCTION

Our prototype was made on a small piece of Veroboard — the component overlay for this is shown in Fig. 2. Note that one track of the Veroboard must be cut beneath C1. If a battery switch is required it should be connected in series with the nine-volt battery; otherwise the battery can simply be unplugged when the unit is not in use.

The containers of the unit may be any small metal or plastic box large enough to hold the components. We found that a plastic SCOTCH sticky tape dispenser was ideal. If a transparent box is used, the phototransistor may be mounted directly onto the Veroboard, if not it must be mounted externally.

OPERATION

Usually there is no need to locate the slave flash close to the master unit. The lights of the main flash unit is nearly always sufficient to trigger the slave flash anywhere inside a room. If

the unit is used externally it may be necessary to orientate the slave flash so that the phototransistor is looking into the light from the main unit.

Before an exposure is made, the master flash unit should be set off once or twice to ensure that enough light is reaching the slave flash to ensure reliable triggering.

Make sure that all flash units are fully charged before taking photographs.

Calculate the F stop required for the main flash and stop down the camera accordingly. The slave flash must now be positioned such that an adequate exposure will be given to the background with the previously determined camera stop.

If the slave is used as fill, some adjustment to the exposure may be necessary and this is best found by trial and error.

HOW IT WORKS

Normally the phototransistor Q1 has high resistance — the actual value depending upon the level of ambient light. When the sudden light from the main flash illuminates Q1, its resistance suddenly falls and the resultant positive going pulse is impressed — via C1 — onto the gate of the SCR. The SCR immediately triggers thus setting off the flash.

PARTS LIST ET1 515

- R1 — resistor 10k ½ watt 5%
- R2 — resistor 33k ½ watt 5%
- C1 — capacitor 0.1μF 100 volt polyester
- SCR1 — thyristor type C106D1
- Q1 — phototransistor — any type
 - typical BPX25 NPN
 - OCP71 PNP
 - MEL12 NPN

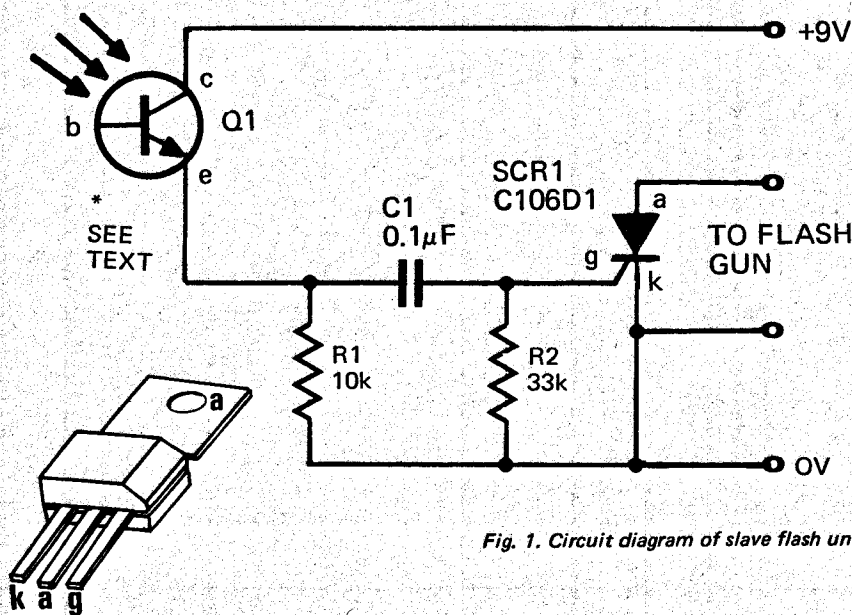


Fig. 1. Circuit diagram of slave flash unit.

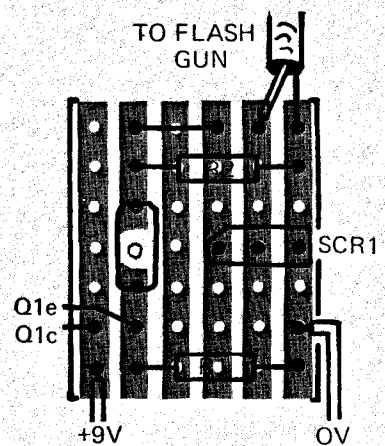
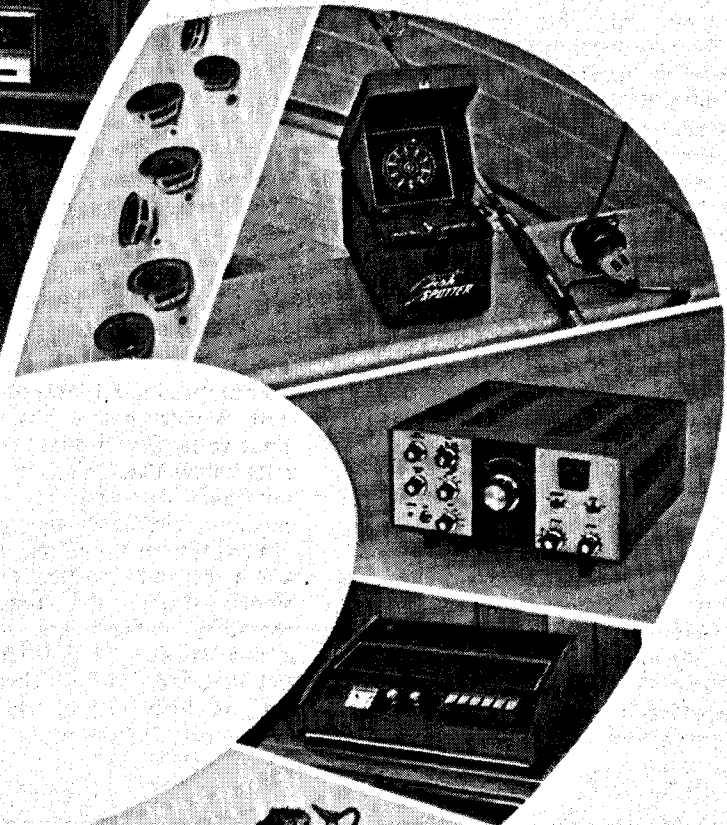
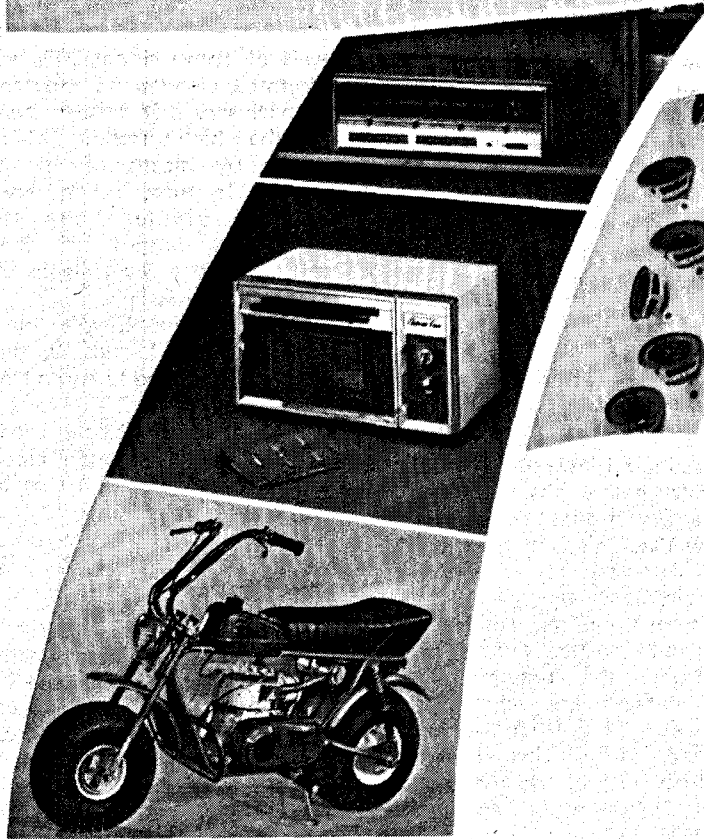
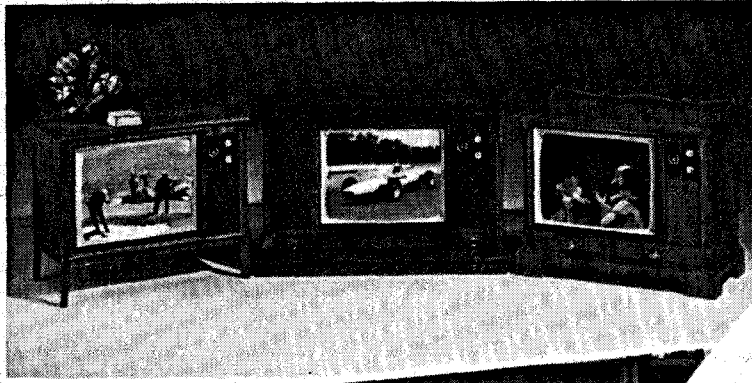


Fig. 2. How the components are located on the Veroboard; note that a break is made in one track of the Veroboard underneath C1.

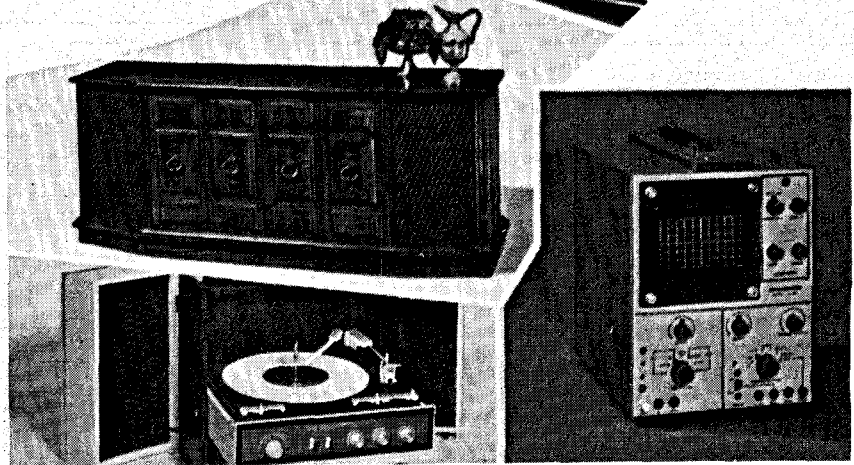
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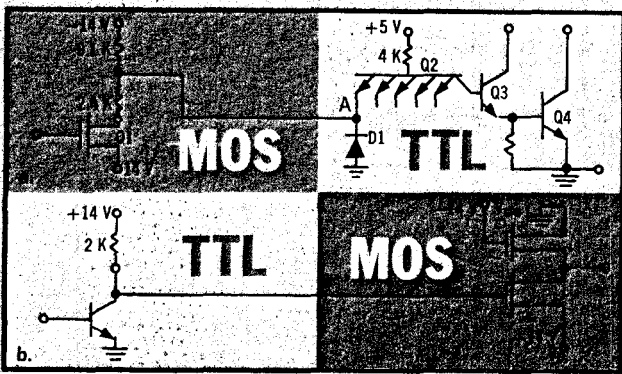
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The best features of differing logic technologies may be utilised in hybrid systems. This article explains how MOS and TTL are interfaced.

INTERFACING

MOS usage is mushrooming, and the long run usefulness of the various MOS technologies depends strongly on their abilities to interface with each other and with bipolar circuitry. In some cases complete systems will be built exclusively with MOS techniques. More typically, MOS devices will be used for those portions of a system where low power and/or high density are required. In very large systems particularly, the predominant high-speed portions are likely to be implemented with faster MECL or TTL logic, with lower speed storage functions being assigned to MOS memory devices. Interface problems, therefore, take on considerable importance.

Interfacing between different MOS and bipolar circuits varies in complexity. Some low-threshold MOS processing permits MOS and bipolar devices to coexist without any special supplementary circuits. With others (as with some dynamic shift registers) a combination of clock drivers and voltage-level translators is the price of effecting a compatible union.

Two following device discussions represent the extremes of MOS-bipolar circuitry interface requirements. The high threshold, metal-gate, static register demands level translation at the input and output, as well as clock generation. Comparatively, the low-threshold silicon-gate dynamic circuit requires only clock generation. Somewhere between lie most of the possible interfacing combinations.

INTERFACING WITH HIGH-THRESHOLD MOS

The MC1160G dual 100-bit shift register is a high-threshold device with the negative logic 1 level specified as at least 9 volts below V_{SS} . The clock input voltage is specified as at least 25 volts below V_{SS} . This high clock pulse amplitude is used to achieve the maximum circuit speed.

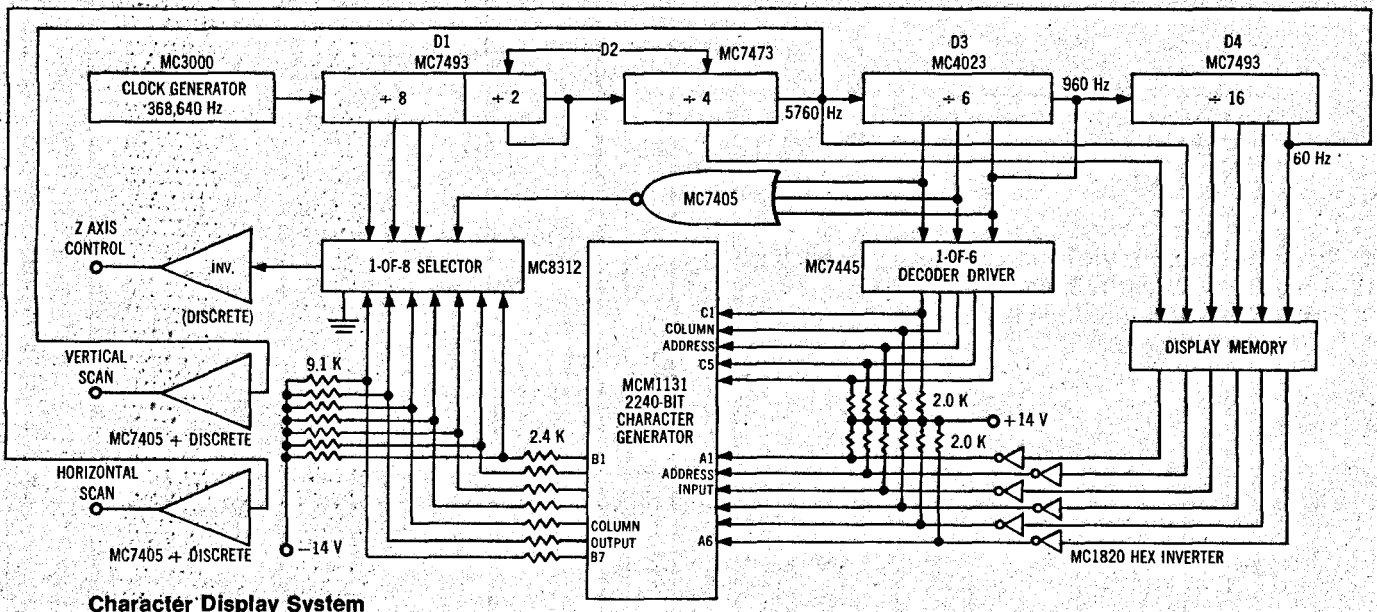
In a typical interface application, where the shift register is driven with bipolar logic, the required high operating voltages are achieved by setting V_{SS} at +14 V, V_{DD} at ground, and V_{GG} at -14 V. This allows the use of high-voltage, open-collector DTL or TTL gates as input

voltage-level translators. In a typical system of this type, the 5-volt signal levels of conventional DTL and TTL integrated circuits are converted into the necessary high-voltage drive signal for the high-threshold MOS shift register by means of an interface inverter. In turn, a line receiver or resistor divider converts the high-voltage output of the shift register to the 5-volt logic range of DTL and TTL designs.

To obtain the 25-volt (or higher) clock signals, $\phi 1$ and $\phi 2$, the clock drivers are required to swing from +14 volts to -14 volts. Any non-overlapping clock generation scheme which assures a clock OFF time of greater than 10 ns but less than 10 μs is suitable.

INTERFACING WITH LOW-THRESHOLD MOS

The MC2380 is a "bipolar compatible" silicon gate dynamic shift register similar in size to the MC1160. The threshold voltage is low enough so that the same operating and signal levels can be used as with bipolar saturating logic. A pull-up resistor should be used with the TTL driving



Character Display System

the shift register input to insure that the totem pole output of the TTL circuit will be pulled above the MOS threshold level.

The output transistor of the MC2380 shift register is an open drain device, tied to V_{ss} , with sufficient drive capability to interface directly with one TTL load.

MOS MEMORIES

The unique attributes of the MOS technology lend themselves ideally to semiconductor memories. One of the first major uses of MOS in this category has been in read-only memories (ROMS), which have become available as off-the-shelf products in impressive numbers. Interesting examples of these are the standard Motorola MCM1131 column-select and the MCM1121 row-select 5 x 7 USASCII character generators.

A character generator generates the voltage patterns (of "1's" and "0's") needed to form numbers, letters and symbols to be displayed in a 5 x 7 dot matrix on cathode-ray tubes or 5 x 7 LED arrays. Each of the specific patterns for 64 different characters is stored at specific addresses in a 2240-bit ROM with each character occupying a 35-bit matrix in the memory. When the 6-bit address code

associated with a particular character is applied to the six address lines (the 6 bits define 64 USASCII characters) it is decoded by an address decoder that selects the associated 5 x 7 matrix in the memory. Then, when one of the five columns of that matrix (in the "column select" version) is energized, a "word" of seven parallel bits corresponding to that particular column appears at the output. The five columns of the matrix are sequentially energized to provide a five-word sequence of seven parallel bits per word for each character selected by the address inputs.

THE INTERFACING

Of the various circuits used in the illustrated display system, only the character generator itself is an MOS device. All the others are either TTL or DTL circuits. Voltage-level translation is required at the interface points.

In this system, the first interface requirement is between the character generator, with its zero-to-14 volt output swing, and the 1-of-8 selector with its zero-to-5 volt input requirement. To simplify interfacing, the generator outputs are open-drain FETs that permit the use of external pull-down (load) resistors. The

pull-down resistor at each output is a pair of series-connected resistors going to the -14 V supply. The inputs of the TTL 1-of-8 selector are connected to the junctions of these series resistors.

The simplified schematic of this arrangement is shown for both MOS to TTL and TTL to MOS interface. In operation, when Q1 is cut off, a negative voltage appears at point A. This causes diode D1 to conduct and clamps the voltage applied to the emitter of the TTL input circuit to one diode drop, or -0.7 V. This is recognized by the TTL gate as a "zero" which defines a space, or "no dot." If the input to Q1 is negative, the FET is turned on. The voltage at A, therefore, increases to a positive (+) value between 2.5 volts and 4 volts, above the TTL input threshold.

The point is, however, that the high-voltage signal at the output of the FET has been translated to the reduced voltage swing needed at the input of the TTL circuit. The COLUMN SELECT inputs to the character generator likewise need level translation - from the low TTL output voltages to the relatively high drive voltages needed by the MOS circuit. This is achieved by the high voltage open collector DTL and TTL circuits mentioned earlier. ●

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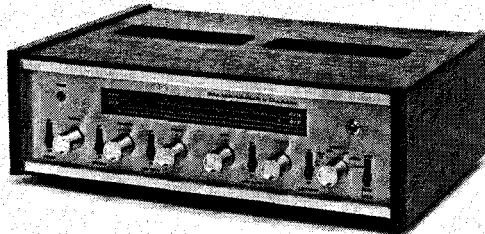
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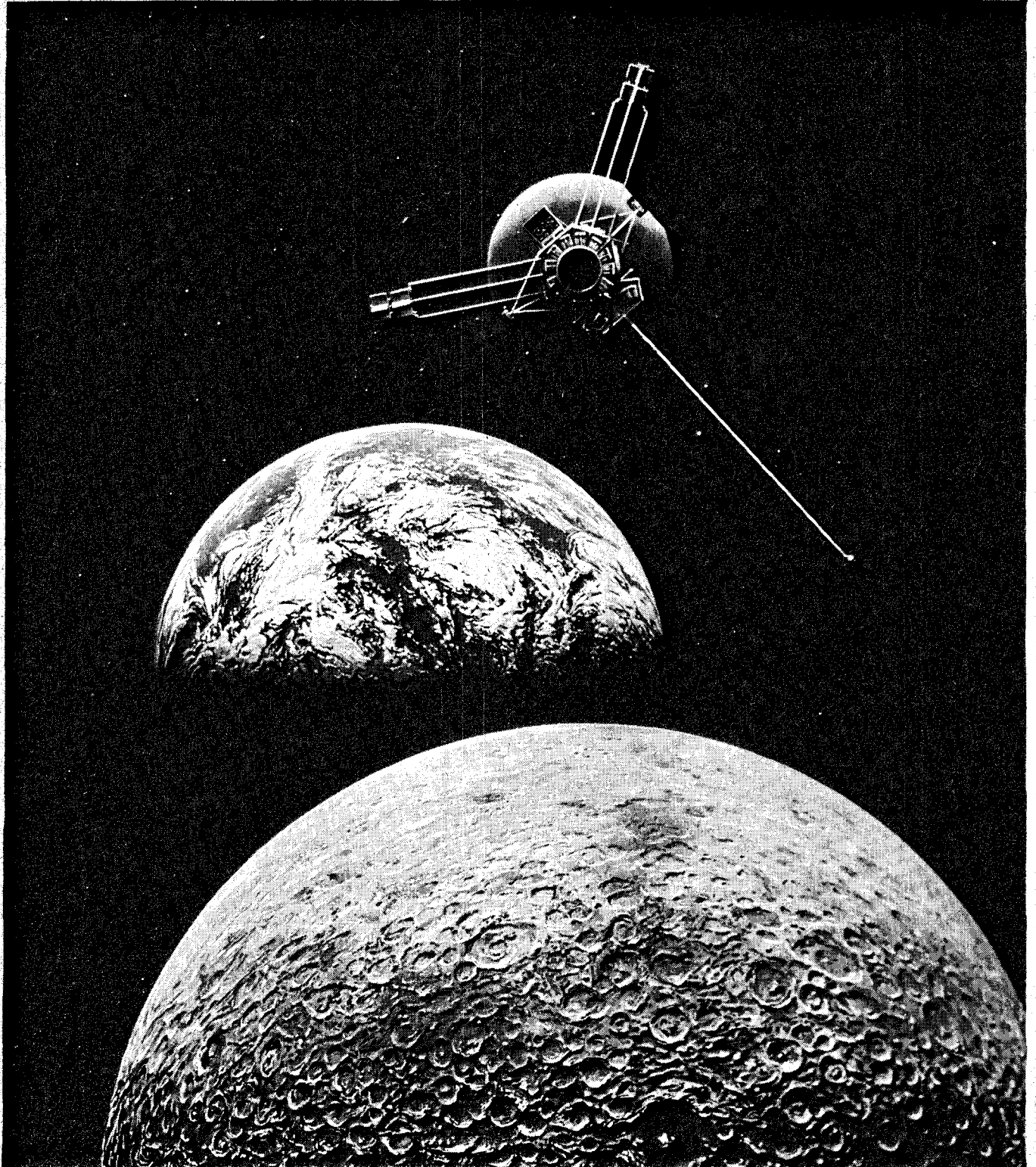
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SPACE SPECTACULAR

NASA



The first man-made object to travel into outer space, Pioneer F is now well on its way towards planet Jupiter.

Successfully launched by NASA last month, the Pioneer spacecraft is now well on its two year voyage to Jupiter.

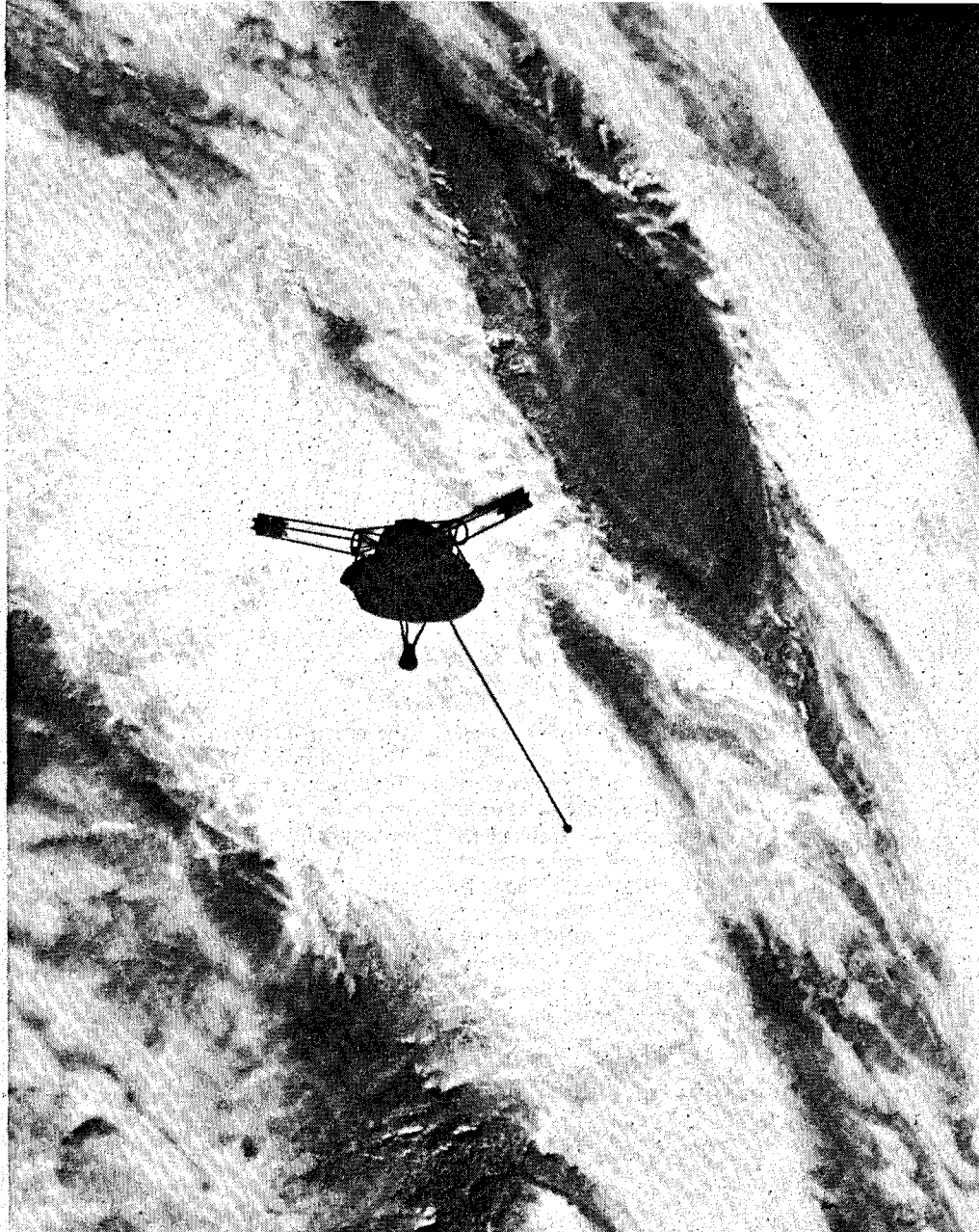
Our stylized picture shows the spacecraft passing the Moon on the first stage of its journey.

Jupiter is a spectacular planet, it appears to have its own internal energy source and is so massive that it is almost a small star. It may have the necessary ingredients to produce life. Its volume is 1000 times that of Earth, and it has more than twice the mass of all the other planets combined. Striped in glowing orange-yellow and blue-gray; it floats in space like a bright-coloured rubber ball. It has a huge red 'eye' in its southern hemisphere and spins more than twice as fast as the earth.

PIONEER F PLAQUE

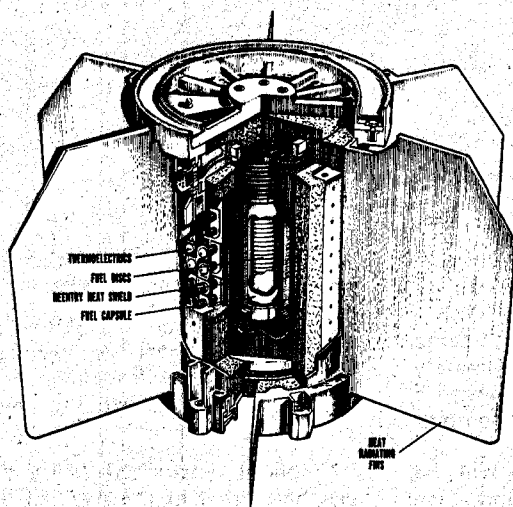
The Pioneer spacecraft is the first man-made object to escape from the solar system into interstellar space. It carries this pictorial plaque intended to show scientifically educated inhabitants of some other star system — who might intercept it — perhaps millions of years from now — when Pioneer was launched, from where, and by what kind of beings.

The design is etched into a gold-anodized aluminium plate, approx 6" by 9" attached to the spacecraft's antenna support struts in a



Artist's conception of Pioneer over Jupiter's red spot.

NASA

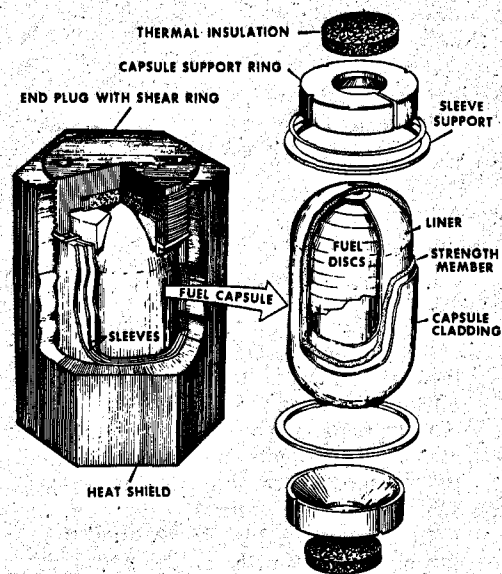


SNAP 19/PIONEER RADIOISOTOPE THERMOELECTRIC GENERATOR



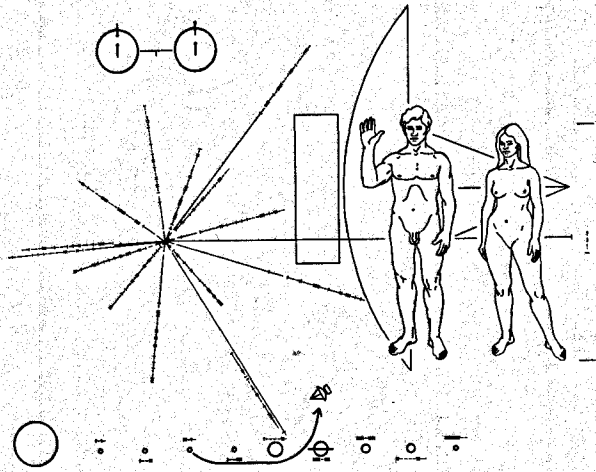
This cutaway drawing illustrates one of the four radioisotope thermoelectric generators — providing a total of 120 Watts — used in the Pioneer spacecraft. These generators — developed by the US Atomic Energy Commission — are the first ever to use nuclear energy power on an interplanetary spacecraft.

The drawing on the right shows the construction of one of the plutonium 238 fuel capsules used in the thermoelectric generator.



SNAP 19 / PIONEER HEAT SOURCE

SPACE SPECTACULAR



NASA

position to help shield it from erosion by interstellar dust.

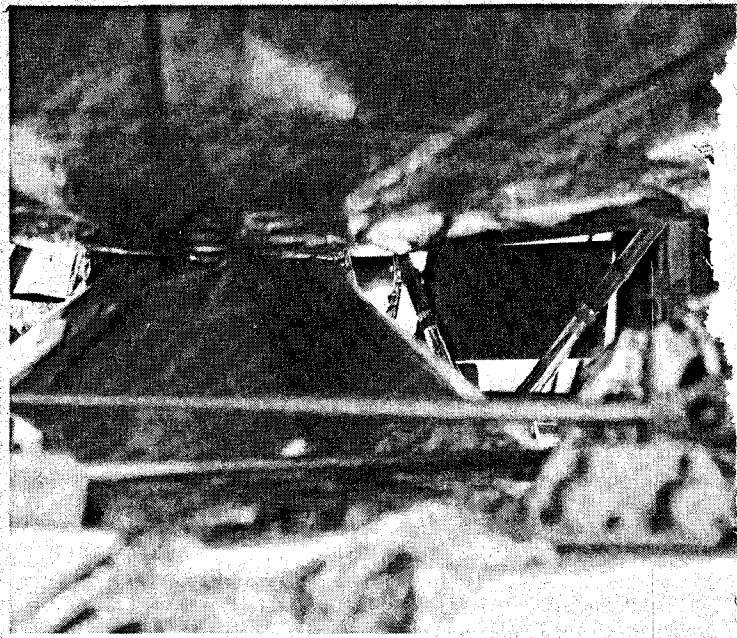
The radiating lines at left represent the positions of 14 pulsars — cosmic sources of radio energy — arranged to indicate our Sun as the home star of the launching civilization. The '1' symbols at the ends of the lines are binary numbers that represent the frequencies of these pulsars at the time of the launch of Pioneer F relative to that of the hydrogen atom, shown at

the upper left with a '1' unity symbol. The hydrogen atom is thus used as a 'universal clock', and the regular decrease in the frequencies of the pulsars will enable another civilization to determine the time that has elapsed since Pioneer F was launched.

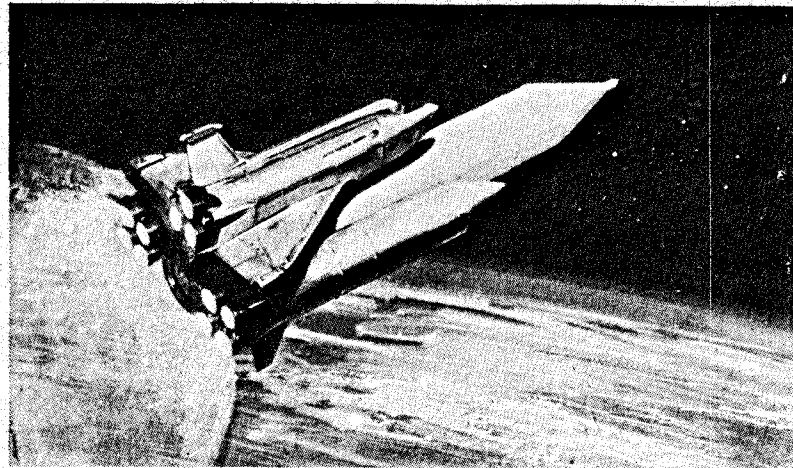
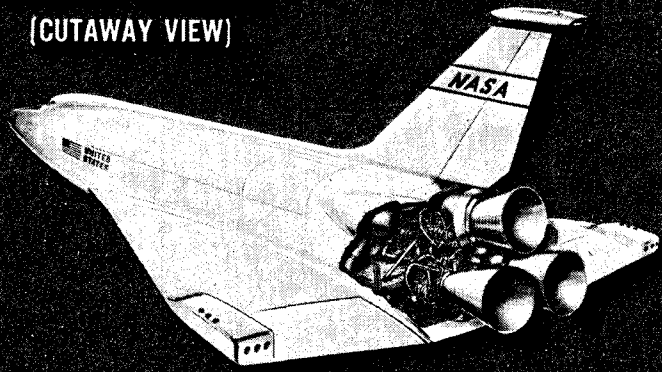
The hydrogen atom is also used as a 'universal yardstick' for sizing the human figures and outline of the spacecraft shown on the right of the plaque. The hydrogen wavelength —

about 8 inches — multiplied by the binary number representing '8' — shown next to the woman, gives her height — 64 inches. The figures represent the type of creature that created Pioneer. The man's hand is raised in a gesture of good will.

Across the bottom are the planets, ranging outward from the Sun, with the spacecraft's trajectory arcing away from Earth, passing Mars, and swinging by Jupiter. ●



ORBITER ENGINES (CUTAWAY VIEW)



Here, the orbiter is seen before the external fuel tanks have been jettisoned.

As reported in our news columns last month, US President Nixon has announced that work is to commence at once with the development of a space shuttle to enable components and personnel to be transported to and from orbiting space vessels and stations.

It is proposed by NASA that the manned space shuttle will be powered by three high pressure engines each

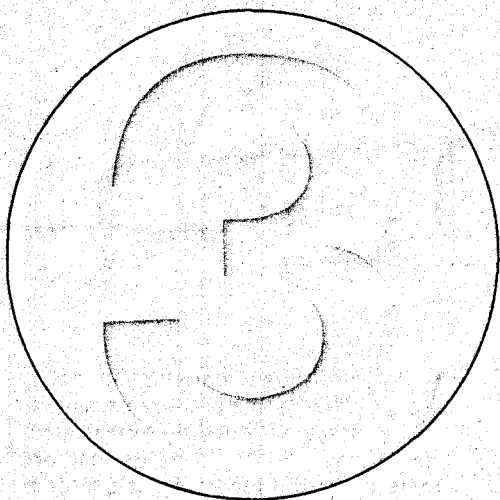
developing 470,000 lbs of thrust (in space). The orbiter will be approximately 120 feet long, with a wing span of 75 feet. The cargo compartment will be approximately 15 feet in diameter and between 45 and 60 feet long. Payload will be up to 65,000 lbs.

External propellant tanks will be attached to the orbiter and then jettisoned in orbit. The tanks will be

'de-orbited' by retro-rockets and landed in remote ocean areas.

The crew will consist of two pilots and two flight engineers. The engineers' duties will include checking out the unmanned satellite payloads and deploying them in space.

A special pressurized sortie module can be carried in the payload bay to accommodate up to 12 persons. ●



SIMPLE STEPS TO RECORD PLAYING SUCCESS.

1. INVEST IN THE BEST TURNTABLE AVAILABLE. THORENS

Choose from the Model TD-125 or the TD-150 Mk. II. Then you can share the opinions of leading overseas reviewers: "the best three-speed manual we've ever tested" — ("High Fidelity"), "wow and flutter were as low as we've ever measured" — ("Stereo Review"), "a favourite contender in the best turntable category" — ("Audio"), "it would be hard to imagine a unit that performs better" — ("Electronics World").

Examine Thorens specifications closely and critically. The new Model TD-125 features: ● Transistor governed 16-pole synchronous motor ● $\pm 2\%$ speed control on all speeds ● Belt drive ● 7½ lb. 12" turntable ● Wow and flutter $\pm 0.08\%$ ● Rumble —68dB. ● Fine Swiss craftsmanship.

The lower priced Thorens TD-150 Mk. II offers: ● 16-pole synchronous motor ● Belt drive ● 7 lb. 12" diameter turntable ● Two speeds — 33⅓ and 45 rpm ● Wow and flutter $\pm 0.09\%$ ● Rumble —65 dB.

When you've purchased your Thorens turntable . . .

2. ADD AN ORTOFON M15 STEREO CARTRIDGE.

After many years research, Ortofon have designed a new stereo cartridge which maintains the proud traditions of the Ortofon name. Featuring new principles, the high performance standards which have made Ortofon world famous have been preserved in the new Series M15 and MF15. Over 80% of professional users such as the radio and television stations (and recording studios) specify Ortofon equipment.

BASIC SPECIFICATIONS:

Weight of cartridge: 5 grams.
Frequency response: 20 Hz. to 10 kHz.
 ± 1 dB.
20 Hz. to 20 kHz.
 ± 2 dB.

Recommended load: 47 k ohms.
Channel separation at 1 kHz. Greater than 30 dB.

Having equipped yourself with a fine player and cartridge . . .

3. KEEP YOUR RECORDS CLEAN WITH WATTS EQUIPMENT.

Airborne dust and dirt are the greatest enemies of your records and cause untold amounts of noisy interference.

We recommend:

THE WATTS "DUST BUG" . . . which cleans the record, removing dust and static charges as the record plays. Surface noise is reduced considerably.

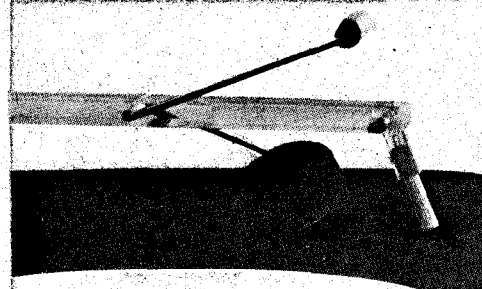
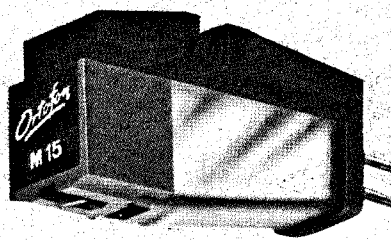
THE WATTS "DISC PREENER" . . . designed expressly for records which have not had previous anti-static treatment. The "Disc Preener" keeps new records like new.

THE WATTS "MANUAL PARASTAT", Model Mk. IIA. . . is a dual purpose record cleaner designed to maintain new records as new and to restore fidelity to older discs.

Ask for a copy of the Watts Guide to Record Cleanliness when you visit your record store.

*It's easy to follow the Three Steps to Success. Call at your nearest franchised Simon Gray dealer's showroom. He'll be delighted to tell you all about Thorens turntables, Ortofon stereo cartridges and Watts record cleaning equipment!

SG TOW 3/71



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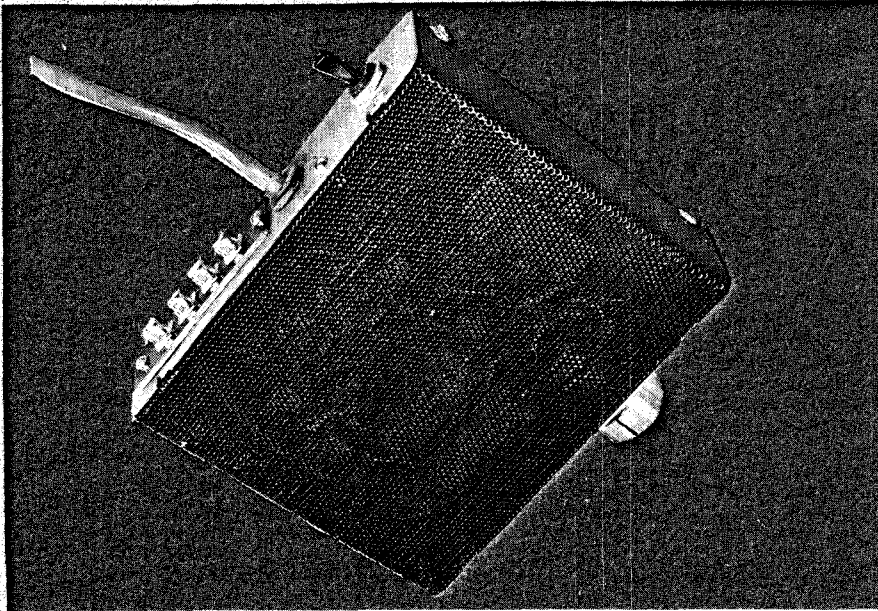
Please send me all the facts about: (a) Thorens turntables; (b) Ortofon cartridges; (c) Watts record cleaning equipment . . . and the name of my nearest franchised Simon Gray dealer.

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SUPER-



When stereo reproduction was a novelty, many recordings were made with grossly exaggerated stereo 'image'. So much so that on some orchestral recordings the second violins appeared to be playing somewhere to the left of the gentlemen's toilet.

Now, some record companies have swung the other way, and music lovers complain that a number of recordings — especially of symphonic music — have *insufficient* spread, and the apparent stage is restricted to a small area either side of the centre line of the speaker enclosures.

To some extent this can be remedied by increasing the spacing between speakers — but only if room dimensions permit.

This is a problem that has attracted the attention of Mullard Ltd, and they have developed a 'sound-source width control' that enables the stereo 'image' to be adjusted so that at one extreme both stereo channels are spatially combined so that the sound apparently emanates from a point half way between the two speakers, whilst at the other extreme, the effective

ETL PROJECT 410

SELECT THE WIDTH OF YOUR STEREO'S EFFECTIVE IMAGE — FROM A POINT SOURCE TO A SPREAD MUCH GREATER THAN NORMAL.

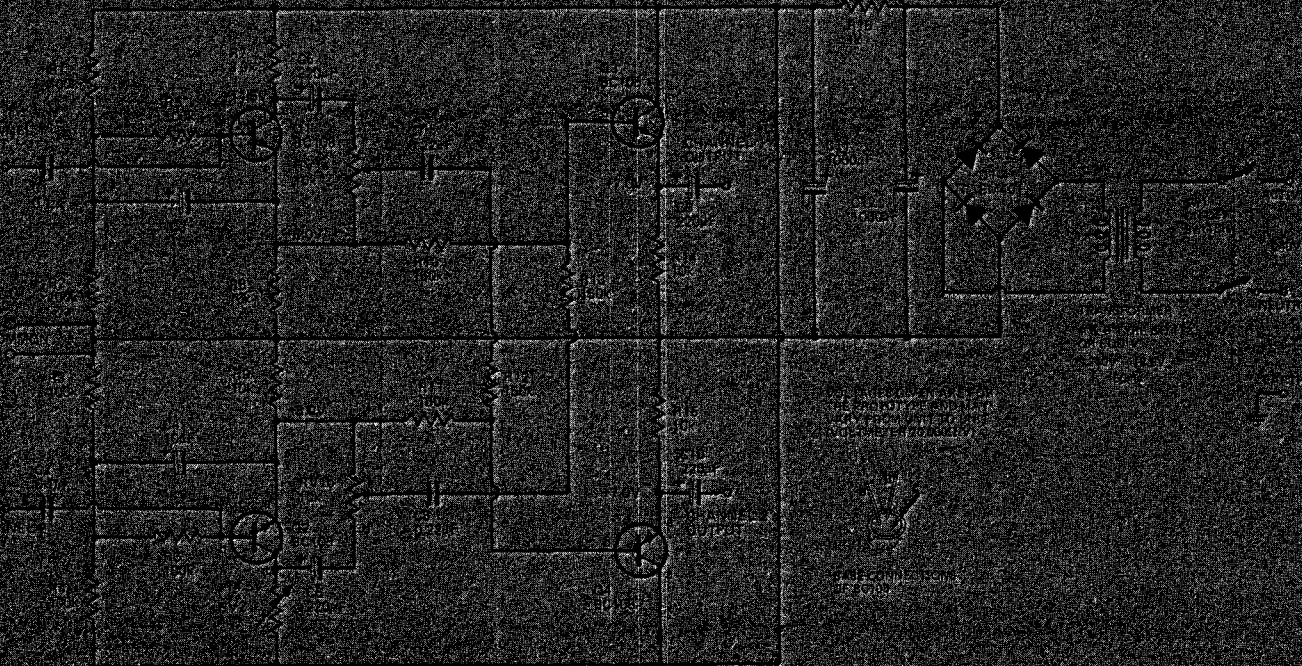


Fig. 1. Circuit diagram of supply unit.

Warré Pat. EATS 85117

STEREO

stereo image is increased quite considerably.

The circuit operates by adding part of the signal in one channel to the signal in the second channel. This is done with both signals in phase (to produce mono effects), or with the signals out of phase (to produce stereo-width enhancement).

Care has been taken to ensure that the unit does not introduce hum or distortion.

When we first assembled the unit we found that the range of adjustment provided by the width control was not really sufficient to cater for all programme material and the circuit described here has been modified to provide continuous adjustment, from mono, through the normal stereo image, to an apparent stereo spread approximately 40% greater than normal.

INTER-UNIT CONNECTIONS

This unit is designed to accept high level signals — exceeding 100 mV, and is intended for connection between a pre-amplifier and main amplifier.

It is not suitable for handling signals directly from a low level (less than 100 mV) magnetic pick-up. This is because internal noise generated by the unit will degrade the low level signals.

Crystal or ceramic pick-ups have sufficient output successfully to drive the unit and it may of course also be used between a pre-amplifier and tape recorder, tape recorder (reel-to-reel or cassette) and amplifier, or between two tape recorders.

Many modern amplifiers are of course built with the pre-amplifier and main amplifier combined. With these it is generally possible to connect the unit's input to the 'tape-out' connections and the unit's output to the 'tape-input' sockets on the stereo amplifier. (This approach is also used by the Bose company — their active equaliser is interconnected in the same way).

TESTING

At this stage connect input 1 and output 2 only, input 2 and output 1

Fig. 3. How the components are located on the printed circuit board.

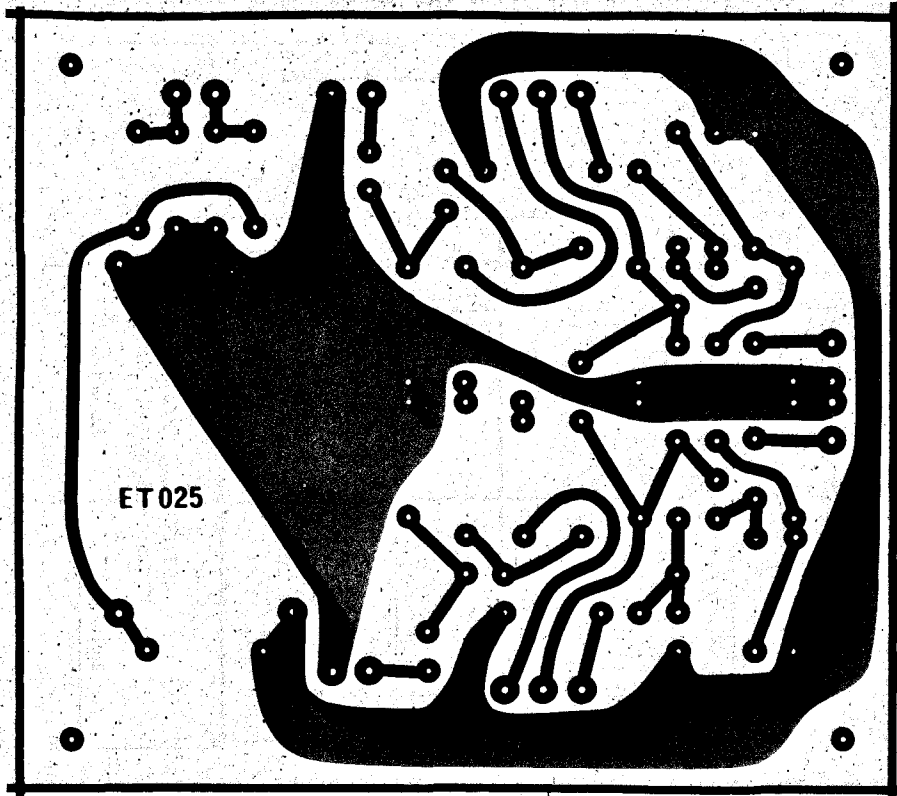
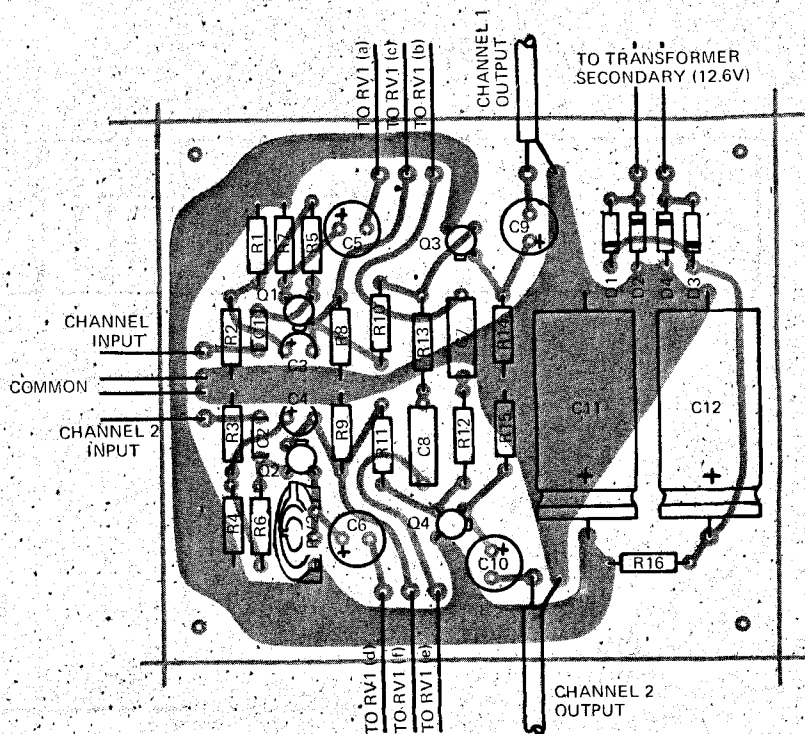
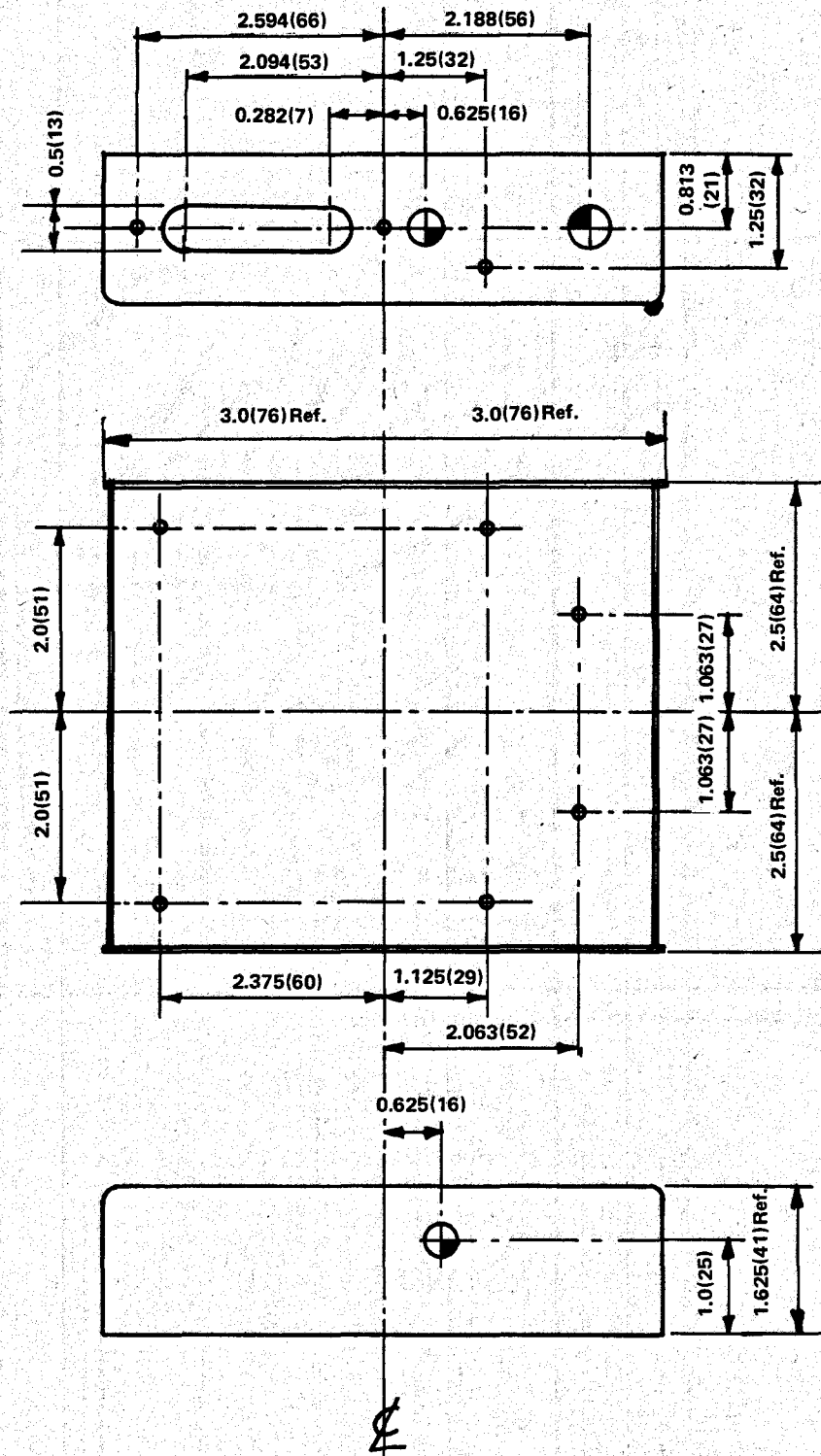


Fig. 2. Foil pattern of printed circuit board — full size.



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- 9 HOLES $5/32$ (4) DIA.
- ◐ 2 HOLES $13/32$ (10) DIA.
- ◑ 1 HOLE $1/2$ (13) DIA.

DIMENSIONS IN BRACKETS
ARE IN MILLIMETERS

Fig. 4. Constructional and drilling details of metal case.

PARTS LIST ET410

R1	— resistor	100k	$1/2$ W	5%
R2	— "	100k	"	"
R3	— "	100k	"	"
R4	— "	100k	"	"
R5	— "	100k	"	"
R6	— "	100k	"	"
R7	— "	3.9k	"	"
R8	— "	10k	"	"
R9	— "	10k	"	"
R10	— "	150k	"	"
R11	— "	150k	"	"
R12	— "	150k	"	"
R13	— "	150k	"	"
R14	— "	10k	"	"
R15	— "	10k	"	"
R16	— "	1k	"	"
RV1	— 2 gang	10k Lin. Pot		

RV2 — Trimpot 4.7k (Large Type)

C1	capacitor	0.1 μ F	100V	
C2	"	0.1 μ F	100V	
C3	"	10 μ F	25V electrolytic	
C4	"	10 μ F	25V	"
C5	"	220 μ F	16V	"
C6	"	220 μ F	16V	"
C7	"	0.22 μ F	100V	
C8	"	0.22 μ F	100V	
C9	"	220 μ F	16V electrolytic	
C10	"	220 μ F	16V	"
C11	"	1000 μ F	25V	"
C12	"	1000 μ F	25V	"

Q1	Transistor	BC108 or equivalent	
Q2	"	BC108	"
Q3	"	BC108	"
Q4	"	BC108	"

D1-D4 Diode EM401 or equivalent
Transformer 240/12.6V 150mA
A&R 6474 or equivalent.

PC board ET025.

Metal box (Warburton Franki type 200D)

4 way RCA sockets.

Double pole 240V switch MSP 625 or similar.

Rubber grometer.

3 core flex and plug.

Cable clamp (for mains cord).

Knob for pot.

Nuts and bolts.

4 spacers $1/4$ " long for PC board.

Coaxial cable wire etc.

must be left disconnected.

Switch on all units; and play a stereo recording through the system. Adjust RV1 (front panel control) for minimum output in speaker channel 2. Leave RV1 in this position for the time being. Mark this position on the case — it represents the normal stereo setting.

Now connect input 2 and output 1, and disconnect input 1 and output 2. Again play the record through the system but this time adjust RV1 to give minimum output in speaker channel 1.

Reconnect input 1 and output 2. The unit is now ready for use.

It should be noted that the volume level will drop as RV1 is turned towards the 'super-stereo' position, this should be corrected by adjusting the volume control.

CONSTRUCTION

The circuit diagram of the complete device is shown in Fig. 1.

The simplest way to build the unit is to assemble the components on the printed circuit board — the foil pattern of which is shown full-size in Fig. 2.

Figure 3 shows how the components are assembled on the printed circuit board. Ensure that transistors, diodes and electrolytic capacitors are correctly orientated. Trimming potentiometer RV2 should be bent over slightly to allow ease of adjustment.

The assembled printed circuit board, together with the mains transformer and potentiometer RV1, should then be fitted into the metal case.

For our prototype unit, we used the Type 200D box (available from Warburton Franki). Drilling details are provided in Fig. 4. This drawing shows sufficient details for those who wish to construct their own case.

Leads carrying audio signals must be screened if they are longer than an inch or so. However if the unit is assembled as shown in Fig. 5, only the output leads require screening. Co-axial cable or standard screened lead is suitable for this purpose.

When wiring up the power supply note that the transformer centre tap is not used.

It is of course perfectly feasible to build the circuit and controls within an existing stereo amplifier — in which case the power supply would not be required. (The unit draws only a few milliamps and within the range of 12 to 18 volts, voltage is not overly critical).

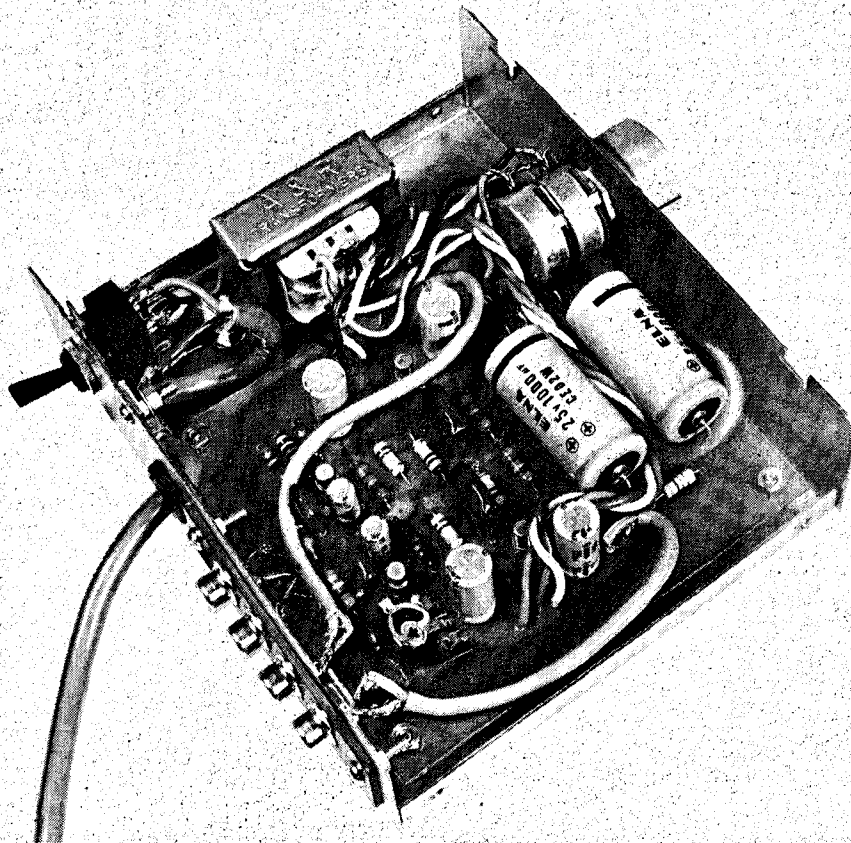
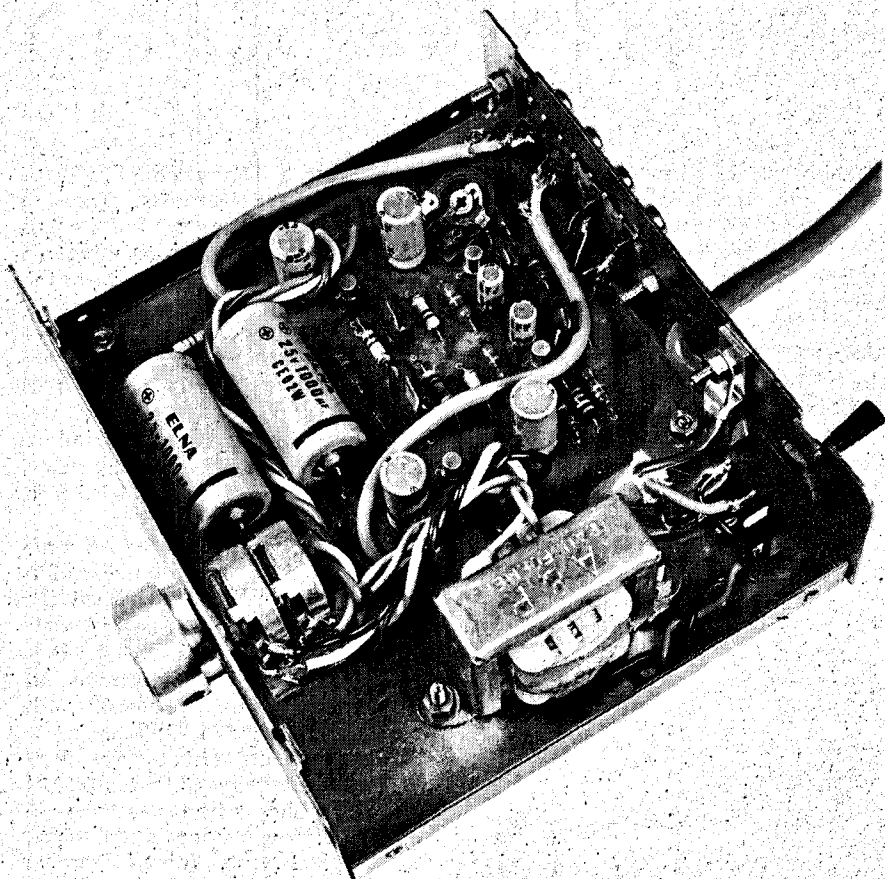


Fig. 5. Note how very short leads are used to connect the output sockets to the printed circuit board. Screened leads have been used only for the longer input connections.



HOW IT WORKS

Basically the circuit consists of two practically identical channels. This text describes the operation of channel 1.

The circuit consists of a buffer stage that provides both a unity gain 'in-phase' output, and an attenuated (39%) 'out-of-phase' output. Potentiometer RV1 enables the output of the buffer stage to be varied between either the 'in-phase' or 'out-of-phase' condition. This output is fed to mixer transistor Q3.

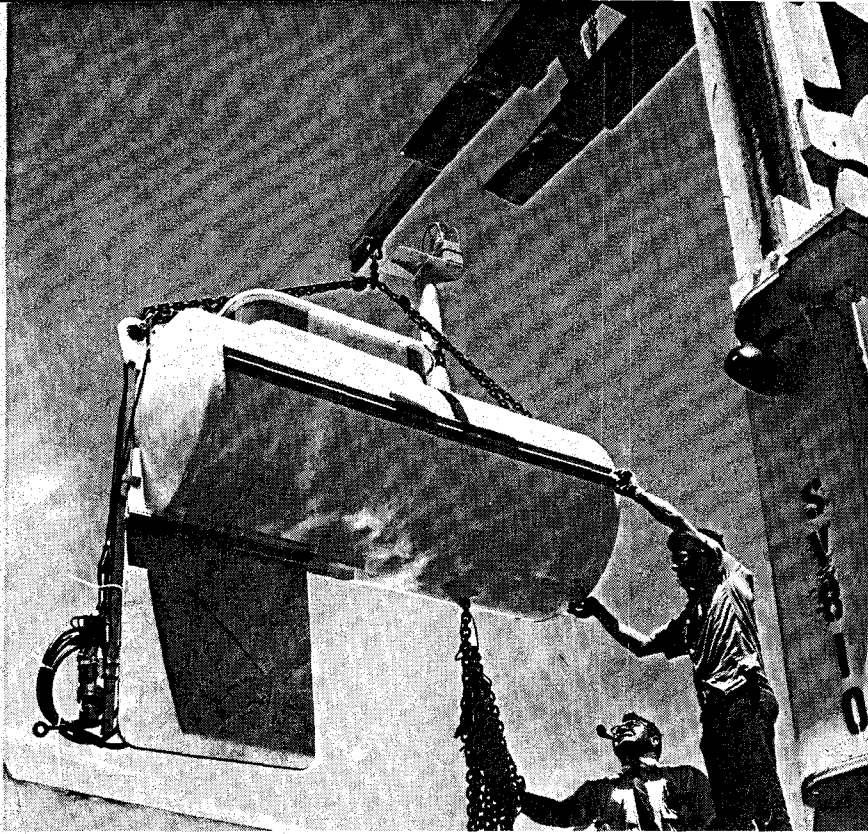
The output of Q3 consists of the channel 1 input plus a proportion of channel 2. The amount of channel 2 signal that is mixed with channel 1 depends upon the setting of RV1 and can vary from the full 'in-phase' channel 2 signal (mono) through zero input from channel 2 (normal stereo), through to 39% 'out-of-phase' (super-stereo).

The operation of channel 2 is similar to that described above.

The mixing process either amplifies signals common to both channels — or attenuates the common signal (super stereo).

Buffer transistor Q1 is biased by R1, R2 and R3. Capacitor C3 provides some positive feedback to increase the input impedance (bootstrapping). Q1 has unity gain as the emitter (in-phase), and an inverted signal of 39% of the input voltage at its collector. RV1 provides the variable output. The bias for mixer Q3 is derived from the output of Q1 via R16.

The power supply consists of a 12.6V transformer, a bridge rectifier, and filter capacitor C12. Further filtering is provided by R16 and C11. Due to the large amount of filtering capacitance — and the low current drawn by the unit — the unit will continue to operate for about 45 seconds after it is switched off.



The forerunner of a buoy system which would maintain a continuous watch on water pollution levels is being tested in San Francisco Bay by Lockheed Missiles & Space Co.

If experiments with the Ecology-Data Buoy are successful, Lockheed will propose the design of an Eco-Buoy system to State and Federal agencies charged with pollution control in U.S. waters.

For a month, Lockheed's cylindrical pollution sentinel will take hourly measurements of the bay's water temperature, electrical conductivity and dissolved oxygen content — three important indicators of water pollution.

Water measurements taken by the buoy will automatically be telemetered to Lockheed's data processing center. When the information has been processed and plotted, it will be provided to the California Regional Water Quality Control Board in Oakland.

George H. Farmer, Lockheed project leader, explained that prior to the Eco Buoy tests, water pollution measurements have been taken by hand from small boats.

The time and money needed to take manual measurements and process the results is considerable. A network of relatively simple, unsophisticated buoys can automatically do the job 24 hours a day with better results and little difference in cost.

The four weeks of testing will enable the manufacturers to evaluate the buoy, its sensors and the data transmission and processing system.

The tests will also give Lockheed's Ocean Systems personnel experience in handling the buoy shape and working with a newly designed shallow water mooring system.

New Technologies

Electronic equipment claimed to measure the brain's physical ability to learn has been developed by Dr. John Ertl, director of the Center of Cybernetic Studies at Ottawa University, Canada. Dr. Ertl reported at a press conference that the "neural efficiency analyzer" is available now and may be leased for educational, governmental and private use.

Until now, intelligence measurements

were subject to such prejudices as social and economic background, language barriers, reading and writing problems and deafness.

This equipment measures the brain's biological efficiency within minutes, and is said to be uninfluenced by environmental, emotional and cultural factors. The testing technique utilizes an electroencephelograph, a flashing light to stimulate the brain and a computer. The subject being tested is

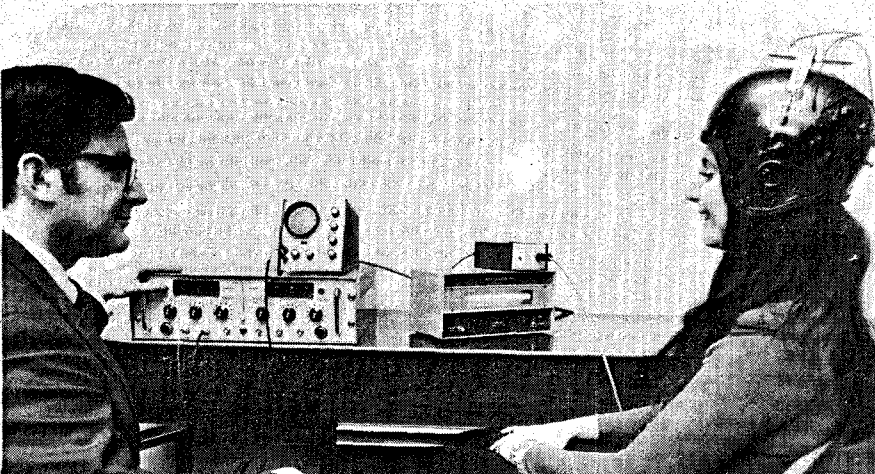
fitted with a lightweight headpiece equipped with electrodes. Then, a strobe light flashes in front of his eyes for about two minutes — resulting in a change of the electrical activity of the brain.

These brain waves are fed into a mini-computer where they are analyzed and the result displayed in numerical form.

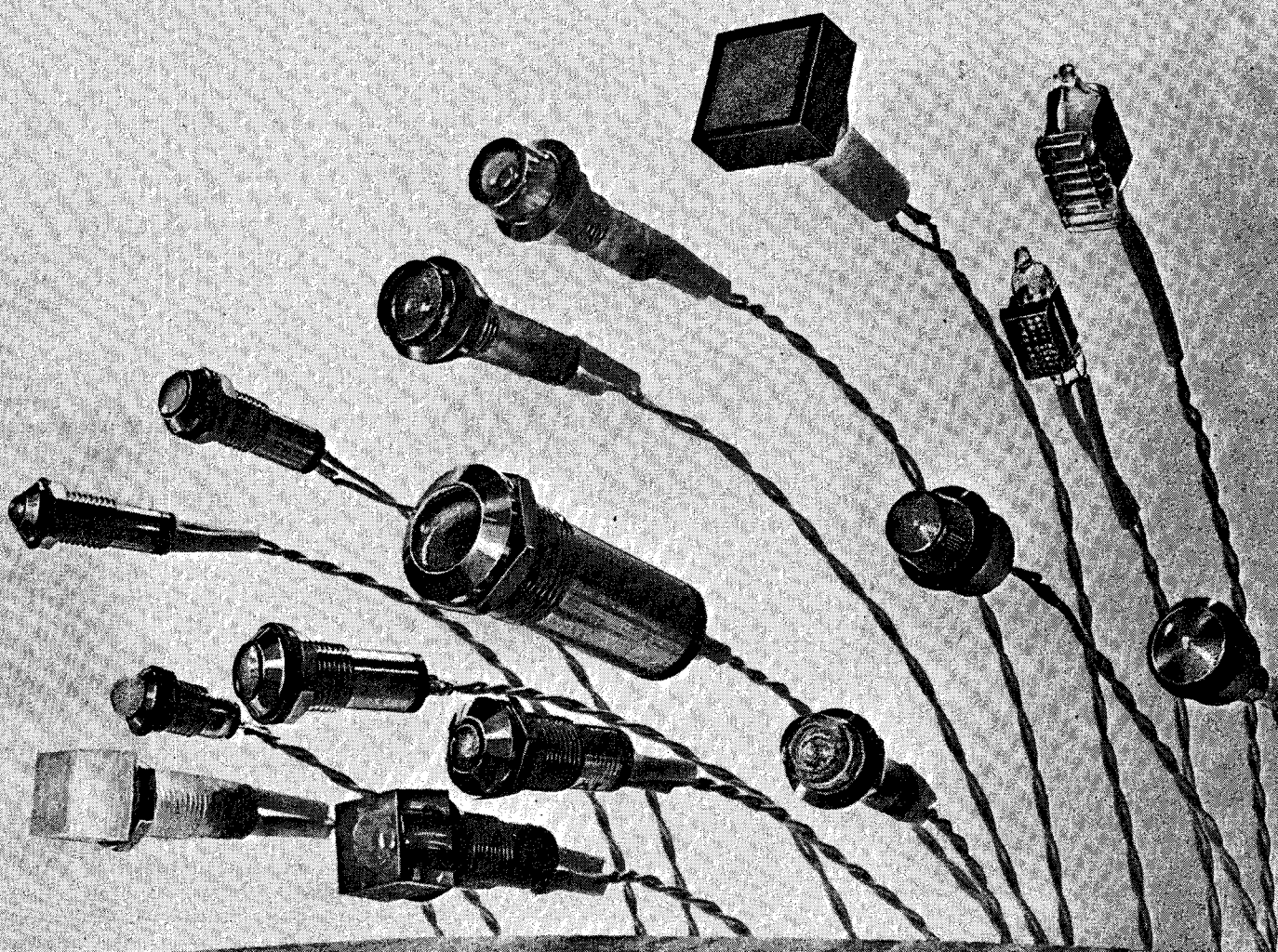
Results are correlated with standard IQ tests and research indicates that a short response is correlated with high IQ.

The system has been tested on some 6,500 subjects in this country and in Canada since Dr. Ertl developed the technique in 1959. Large scale research, financed in part by the U.S. Department of Health, Education and Welfare and the Ontario Mental Health Foundation, started in 1965.

Among subjects tested have been classes of retarded children, students in the public school systems in Louisiana, New Mexico and Canada, and children with known learning disabilities.



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AD34

TRANSDUCERS IN MEASUREMENT AND CONTROL

In this article Peter Sydenham M.E., Ph.D, M. Inst. M.C. describes industrial and surveying length transducers.

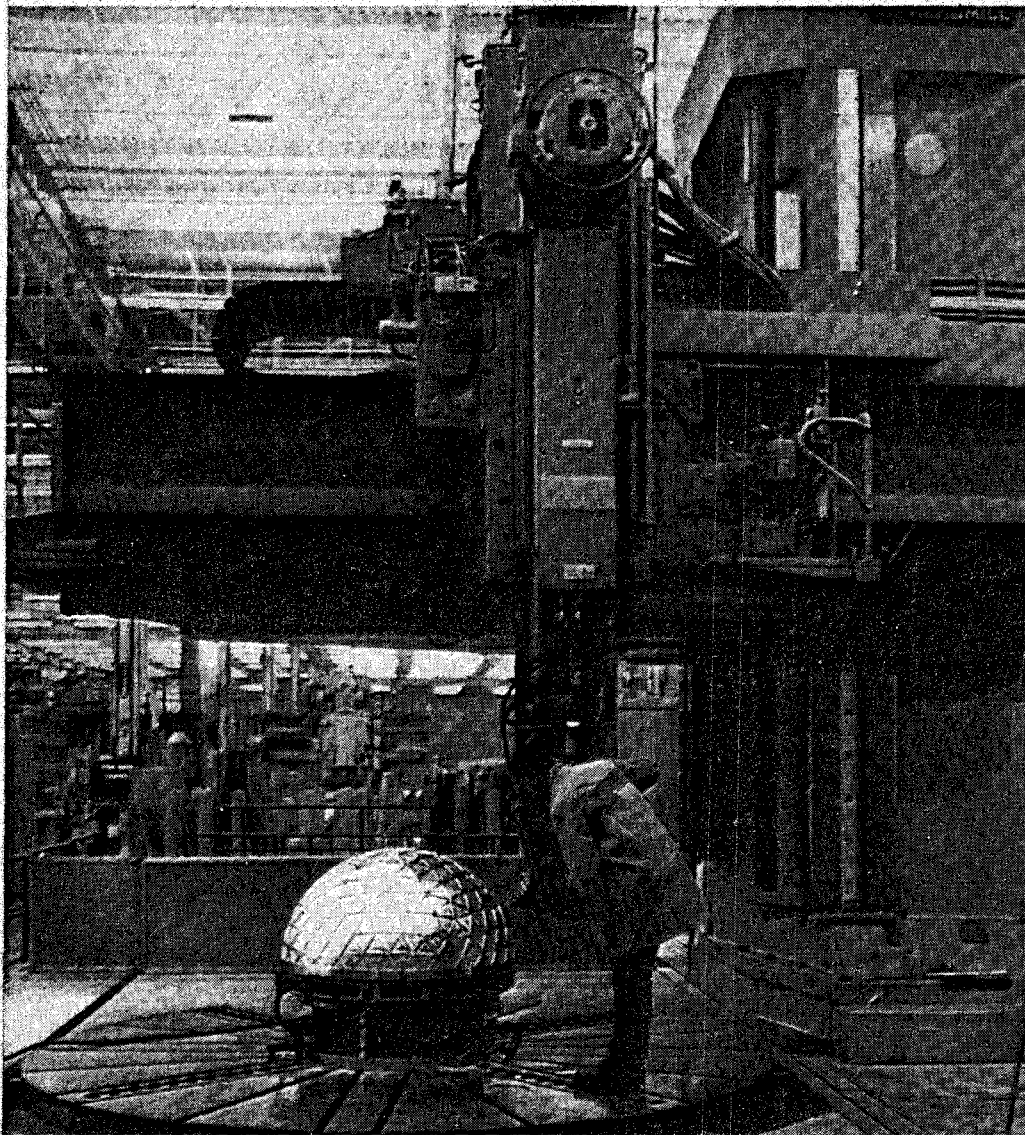


Fig. 1. A Froriep five axis numerically-controlled mill machining a fuel tank for a Saturn V Moon rocket. The finished thickness of the steel is between 0.5 and 0.8 mm.

INDUSTRIAL AND SURVEYING RANGE LENGTH TRANSDUCERS

THE first article in this series dealt with methods for converting small displacements into electrical signals. This time, longer length transducers are discussed. With only a few exceptions, the previously considered methods are unsuited to ranges greater than millimetres, so other ways have been devised.

The majority of precision length measurement of distances ranging from millimetres to several metres is performed in industry, so we use the term industrial range to assist classification.

Distances greater than 100 m or so are grouped in what could be called the surveying range, as it is mainly for land survey purposes that long distance measuring instruments have been developed.

INDUSTRIAL RANGE DISPLACEMENT TRANSDUCERS

Prior to 1950 electrical length-transducers were not often used in general industrial practice. Instead measurements were made with manually operated instruments, many having been devised to cope with specific measurement tasks. Examples are gear testing machines, projection microscopes, travelling microscopes and gauge interferometers.

Then came the change. Groups in the United States of America and in Britain foresaw the potential of an automatic machine tool that could produce a variety of different components at the command of taped digital signals. Numerical control (N.C. for short), was the subsequent development that has been accepted throughout the world.

One of the larger numerically controlled mills is shown in Figure 1.

Control techniques were reasonably well understood due to war time development of gun positioning and radar tracking, but at that time no transducer had been developed that could provide an electrical indication of a machine tool's slide position. Such a transducer needed to have a range of around a metre and a precision and accuracy close to a few parts in a million.

It did not take long for the necessary technique to be developed, for by 1955 there were dozens of such transducers in existence. Other uses for these transducers were exploited as their benefits were realised.

The simplest purpose for which they can be used is to assist the machine operator by providing a readout of length. As most devices provided a digital form of readout rather than an analogue indication, the term digital readout, or D.R.O., came into use. (One commercial D.R.O. unit does, in fact, display with a rotating meter). A milling machine with a D.R.O. facility is illustrated in Figure 2.

The trend of D.R.O. and N.C. spread to other applications. Draughting machines, chart digitizers, oxy-acetylene plate cutters, frame benders, tube benders, wiring loom production machines, rolled steel joist drilling machines, locomotive door welders and even cranes in a steel yard have had transducers fitted for readout or control purposes.

It is not ideal, however, to fit the transducer on the way of a machine, for machine constructional inaccuracies exist between the slide and the cutting point of the tool.

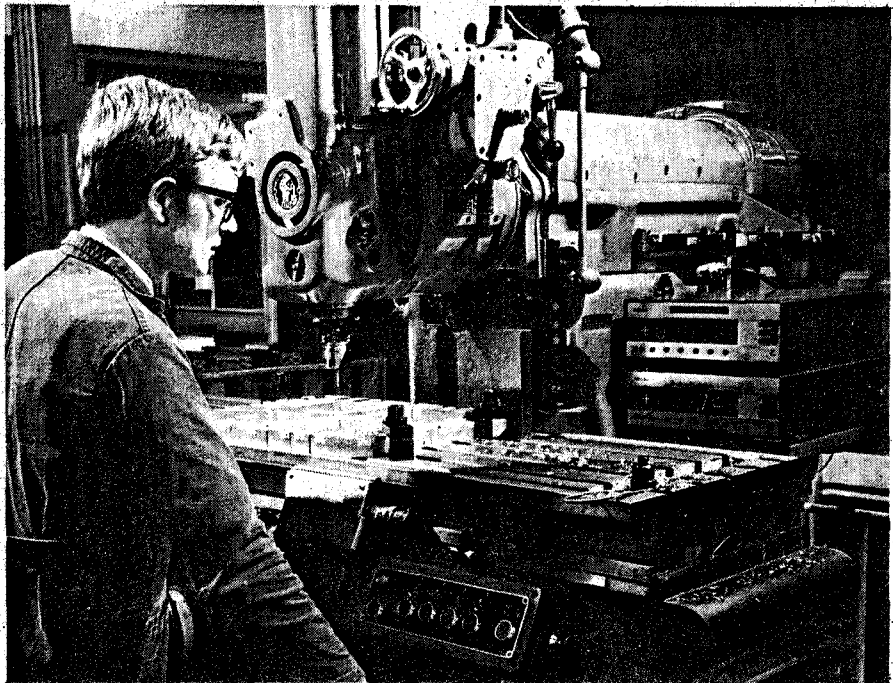


Fig. 2. This vertical milling machine has a digital readout system to assist the operator by displaying the position of both traverses.

ELECTRO-MECHANICAL
or ELECTRONIC COUNTER

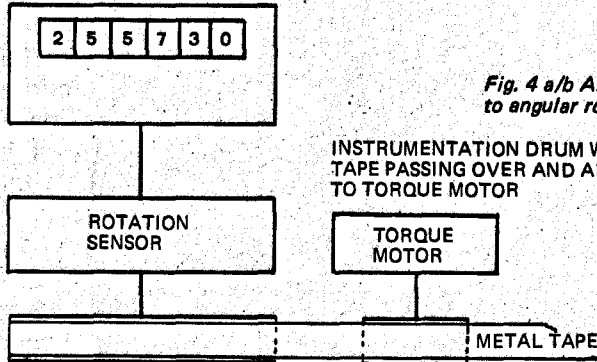


Fig. 4 a/b

Fig. 4 a/b Alternative tape/wire linear to angular rotation transducers.

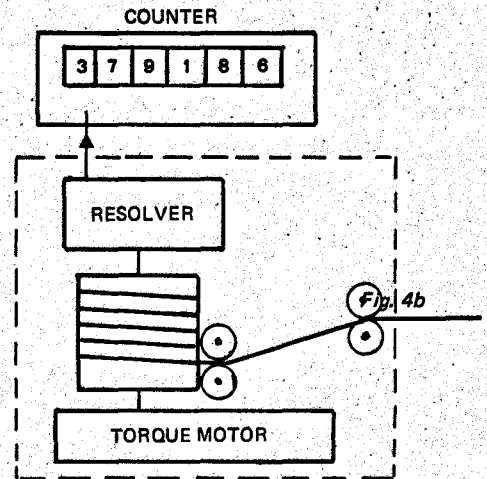
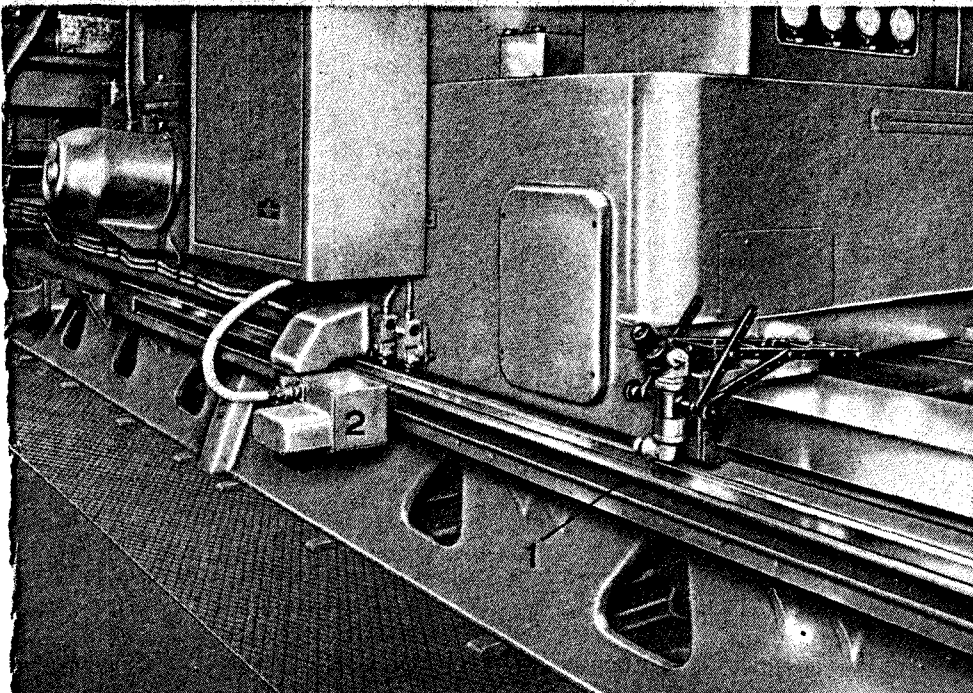
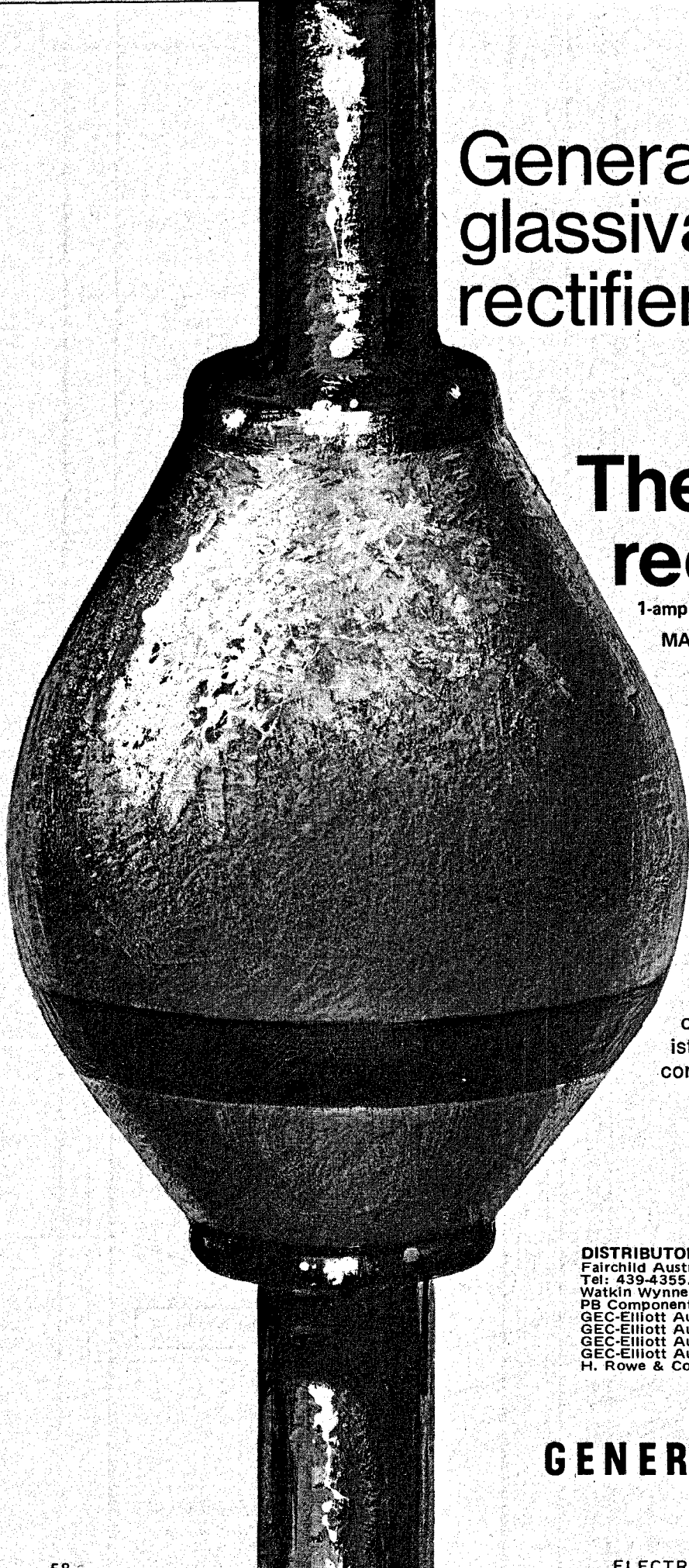


Fig. 3. Rack and pinion installation on an Innocenti boring mill.



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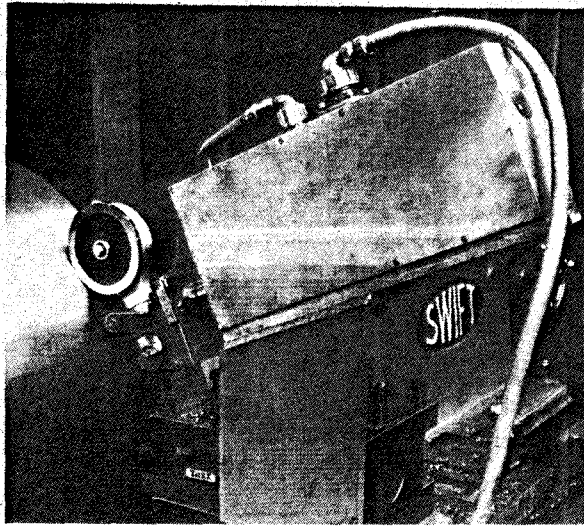


Fig. 5. Friction driven diameter measurement of a large shaft in a lathe (Rotax Ltd).

An axiom of measurement is Abbe's principle (after Professor Ernst Abbe of the famous Zeiss optical works, who lived in the 19th century). This states that a dimensional measurement made directly between the points of interest is better than one made by transferring with linkages or the like. This is illustrated by considering the measurement of length with a ruler. If the ruler is placed right on the marks, no parallax error is produced as no perpendicular transfer is needed. If the ruler is placed in line with the marks and moved from one end to the other, transferring errors are also avoided. Although this is an obvious principle, it is often impracticable to observe it as measurement is but one of the functions to be considered when designing a machine-tool.

If the size of a part is measured right at the work face, it is possible to eliminate machine structural errors. This idea has been termed the in-process technique and has found application in lathe work where a type of micrometer measures right at the tool-bit as work progresses.

Although the majority of current applications for industrial range transducers are in industry, they are not restricted to the workshop alone. In the 50's the developments in N.C. prompted many people to claim automation was around the corner. Today there are fully automatic manufacturing systems, especially in automobile production, but in the main these are not automatically controlled, but rather are preset mechanically to produce the same part many times over. Machining centres, as the fully automated systems are called, have been made and technologically, automation is possible. But social and labour pressures have prevented their greater use so far.

There are literally thousands of N.C.

tools and D.R.O. units in use throughout the world so it is only to be expected that numerous ways have been devised to transduce length into control signals. Two basic approaches to the problem are possible.

In the first, the linear motion is converted into a rotary equivalent by a mechanical method. This rotation is then transduced to give either an analogue or digital, measurement signal.

The alternative method utilises measurements taken from a directly sensed linear scale attached — where mechanically convenient — to the machine.

LINEAR TO ROTARY CONVERSION

There are four mechanical devices that can convert length to angle over long distances. These are the rack and pinion, lead screw and nut, tape or wire and drum, and a friction driven wheel running on the linear surface.

Rack and Pinion — A popular

technique, especially for long traverses on machine tools, uses a precision gear pinion meshing in a linear gear track which is mounted on the slide (as shown in Figure 3). Provided the mesh is accurate and back lash controlled, this method can provide accuracies around 10 parts in a million (which is the generally needed workshop accuracy). The design of the pinion gear and the pinion mounting is important, and usually springloaded split gears are used to minimize backlash.

Leadscrews — Early screws left much to be desired as backlash and friction were considerable. Nowadays the friction screw has been replaced in precision designs by the recirculating-ball screw in which ball bearings maintain contact between the screw and the nut. The nut is made in two pieces, one being wound on against the other to preload the balls into heavy contact in order to increase the stiffness of the joint. This results in improved dynamic performance. Ball screws are expensive but yield excellent precision. Better grades hold tolerances of $2\mu/250\text{mm}$ of screw. The length of screw is limited, however, to a metre or two by the difficulties of supporting the screw and by the amount of screw wind-up under load that can be tolerated.

Tape and Wire Driven Drums — This linear to rotary conversion makes use of a tape or wire to rotate a precision measuring drum. The tape may be pulled around the drum, using the drum as a capstan (Fig. 4a), or pulled off the drum. The latter method uses a spring or an electric motor to provide a constant torque to the storage/measurement drum (Fig. 4b). This maintains a constant tension in the wire or tape and reduces elastic errors.

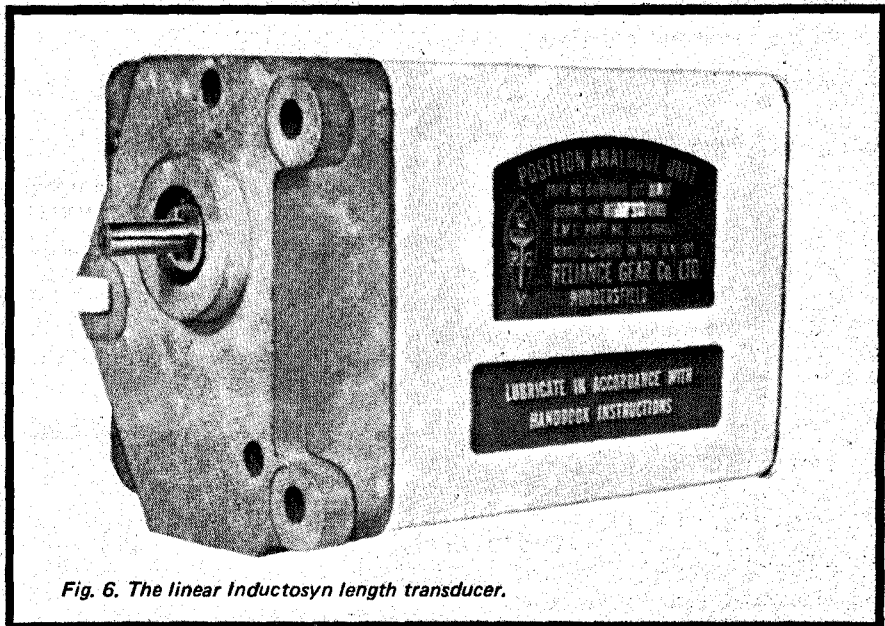
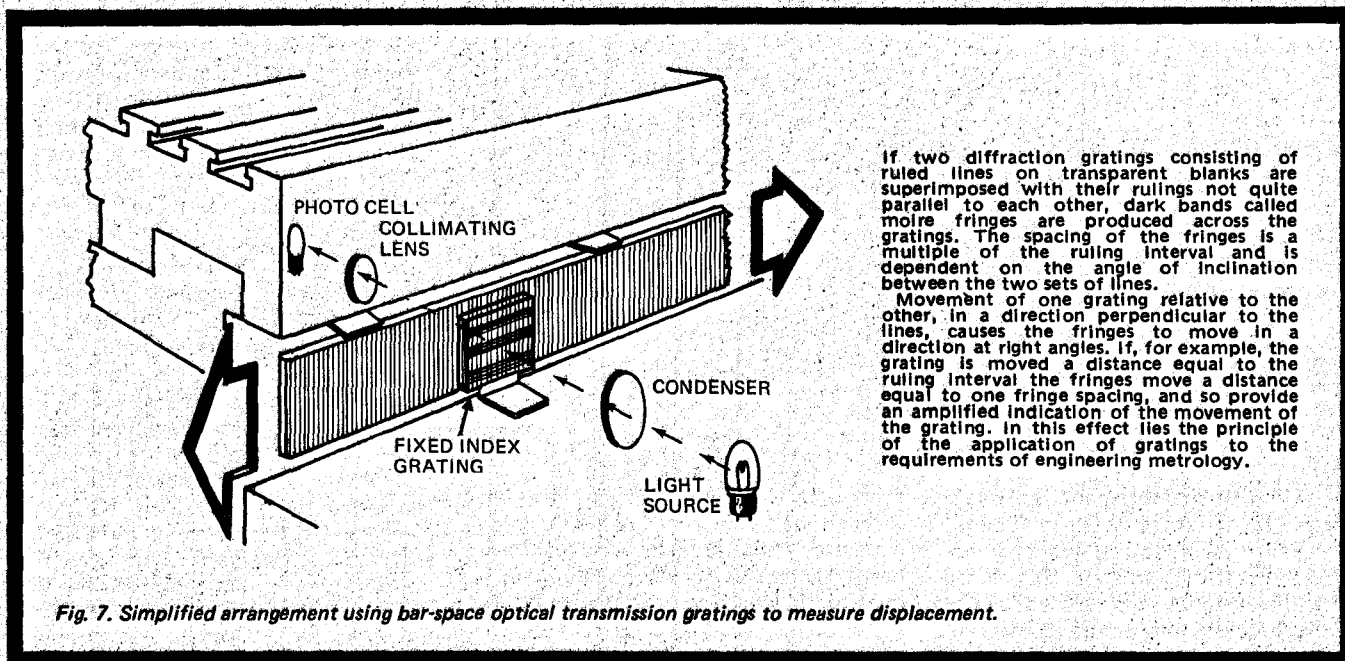


Fig. 6. The linear Inductosyn length transducer.



If two diffraction gratings consisting of ruled lines on transparent blanks are superimposed with their rulings not quite parallel to each other, dark bands called moire fringes are produced across the gratings. The spacing of the fringes is a multiple of the ruling interval and is dependent on the angle of inclination between the two sets of lines. Movement of one grating relative to the other, in a direction perpendicular to the lines, causes the fringes to move in a direction at right angles. If, for example, the grating is moved a distance equal to the ruling interval the fringes move a distance equal to one fringe spacing, and so provide an amplified indication of the movement of the grating. In this effect lies the principle of the application of gratings to the requirements of engineering metrology.

Fig. 7. Simplified arrangement using bar-space optical transmission gratings to measure displacement.

Although this method can provide accurate measurements, comparable with the rack and pinion for instance, it is not widely used except for the measurement of fluid levels in storage tanks. An automatic positioning control system has been demonstrated that uses one of these units as only two ends (the end of the wire and the tensioning drum) need to be mounted. Alignment is far less critical than with alternative methods.

Friction Rollers – It is possible to convert a linear motion into a rotary

one by using a wheel. Provided the surface is smooth and flat this method yields quite good precision. An inexpensive clock-dial output device is available for fitting to a lathe. It is also available with a digital readout device. Friction driven rollers have also been used to control shaft diameter size in in-process turning and grinding. To improve the accuracy, rotations of the roller (mounted in contact with the surface just cut) are counted and subdivided over a large number of shaft turns. Devices developed in Britain perform better than a micrometer and,

of course, have the advantage of an electrical output for inspection or control purposes. The advantage of this method is that the same basic unit can measure from small to practically unlimited sizes of shaft.

In each of the above methods the resultant shaft rotation is used to rotate a mechanical pointer or an angle transducer. (Angle transducers are discussed in the next article – dealing with multi-axial position).

Direct Methods

There is often a requirement for greater precision than indirect methods can provide.

Accuracies approaching a part in a million are attainable with directly sensed linear scales. Extreme precision is, however, often demanded by persons unaware that errors of one part in a million are hard to eliminate unless the whole machine and work-piece are temperature stable to at least 10C or better. Few machines, even precision ones, are given a special controlled environment room in which to operate.

Scales can be either a physical mechanical arrangement or a feature of a radiation beam such as in a laser interferometer.

Mechanical scales can be sensed by the primary electrical methods (resistive, inductive or capacitive) or by optical methods. In some instances the scale is simply a length with subdivision marks made along it in some way. The marks may be individually identifiable or they may all

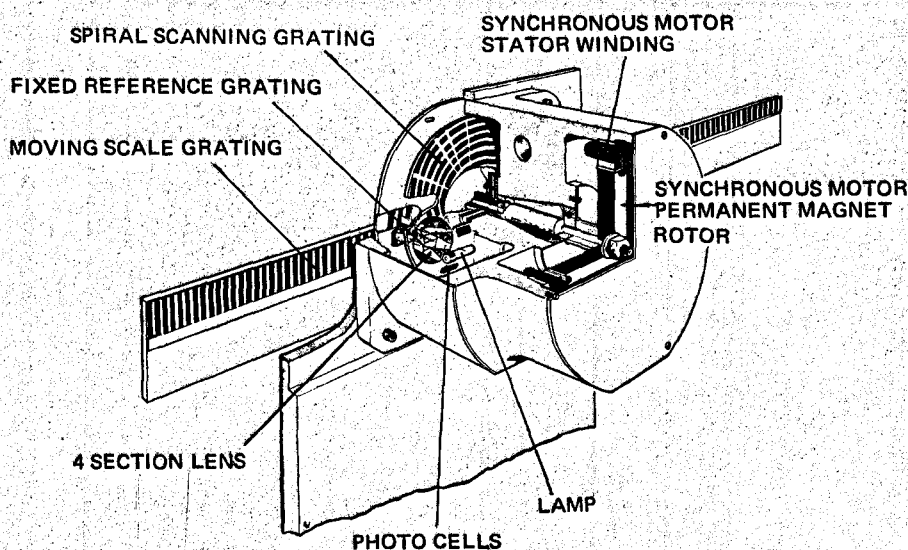


Fig. 8. Mechanical modulation of optical grating signals in the Ferranti spiral scanning head.

appear identical. These alternatives are known as absolute and incremental scales respectively, and the sensing technique depends much upon which type of scale it is. In the incremental version, the marks are progressively counted in order to ascertain the length traversed, whereas in the absolute scale, no action needs to be taken during movement between two points as the position information is available at the mark on which it stops.

Resistance potentiometers, described in the last article, can be made to any length but for applications requiring extreme precision, the resolution and stability are inadequate. Furthermore industrial applications offer extremely dirty and vibratory conditions which severely shorten the life of the contact and surface of the resistance material.

The inductive and capacitive techniques described in the last article are only suitable for quite small displacements. However, means have been developed by which a number of units can be cascaded side by side to cover the required length. Electronic circuitry is used to decide which unit is in operation at any one time, thereby giving the coarse position. Fine position is added to the measurement by using the output of the individual transducer then in use. This is a combination of both incremental (the coarse positions are identical) and absolute devices — it is known as an hybrid system.

Many variations exist on this theme. In one, which illustrates the general principle used, a photo-mechanically printed and etched conducting hairpin winding, (Figure 6) is formed on the surface of a precision glass plate some 300 mm long. This is attached to the sideway of the machine tool. Fastened to the moving saddle is a much shorter piece of glass having two similar patterns formed on it with a spatial phase separation of one quarter of the pitch of the grid. This slider, as it is called, moves along the fixed scale with an airgap of 0.25 mm. The long grid is fed with a 10 kHz electro-magnetic signal. The slider grids pick up this signal by inductive coupling across the airgap. Phase measurement between the slider elements and the reference oscillator yields direction of movement and position within one gridpitch. It is necessary to determine where the slider is upon the grid and this can be done with a rack driven encoder (which can be of lesser precision), by counting the number of full cycles traversed from a datum position, or by the use of further inductive grids as seen in Fig. 6.

This method is basically similar to many other devices — a salient feature is manufactured cyclically along the scale at precisely fixed, constant pitch

positions. Position within a cycle is decided by the subdivisive method known as the phase-analogue method, and the number of salient features passed is found by counting, or by reference to a second coarser measuring system. Small magnets, castellations, the thread of the lead screw, inserted slugs — all have been used with magnetic sensing and with the exception of the first, with capacitive sensing also.

Optically-sensed scales — It is also possible to sense marks by optical methods. Opaque lines, small prisms, screw threads and holes have been sensed by the light passing through. The most commonly used method is the first.

In 1950 the British firm of Ferranti Ltd developed a length transducer to facilitate machine-tool control. This employed long diffraction gratings. These were made inexpensively by resin replication from a master unit. The long diffraction grating was used in conjunction with a smaller piece, (called the index grating), to form Moire fringes which were then counted photo-electrically. The ruling pitch was typically .001 inch in the imperial measure scale. As time went by the diffraction grating was replaced by an easier to produce and use grid called the bar and space transmission-grating. This simply has nontransparent lines and transparent spaces at the same pitch. The Moire fringes, shown in Figure 7, are formed by placing the index grating at a small angle to the main grating. (These fringes are commonly seen by viewing through the two handrails of a bridge or by looking

at a corrugated iron wall through a vertical paling fence). The merit of the Moire fringe is that it is produced as the average of hundreds of individual lines and, therefore, reduces local errors. Furthermore, the fringe pitch is easily arranged to be much wider than the grating pitch enabling large size photo-detectors to be employed.

As with the inductive hairpin grid, two index gratings spaced in phase at 90° give two signals that enable direction to be determined.

The interpolation methods mentioned in the article on small displacement sensing were mainly devised to subdivide relatively coarse optical gratings for it is possible to place coarse lines accurately, but impracticable to put more of them closer together. With optical gratings there is no inbuilt time-modulation as with the inductive and capacitive methods. To make use of the phase-analogue method of subdivision, modulation was added by mechanically rotating a reference grating, one method being illustrated in Figure 8.

Later, solid-state methods were evolved. One uses four photocells placed at 90° intervals across the fringe. These are cyclically interrogated and their outputs processed to give phase difference with the cyclic generator. With this technique it is possible to subdivide to one hundredth of a fringe. As subdivision is an absolute measure it is preferable to use a coarse grating and subdivide down to gain the necessary resolution. This reduces errors due to pulse counting loss.

It is also possible to use this method

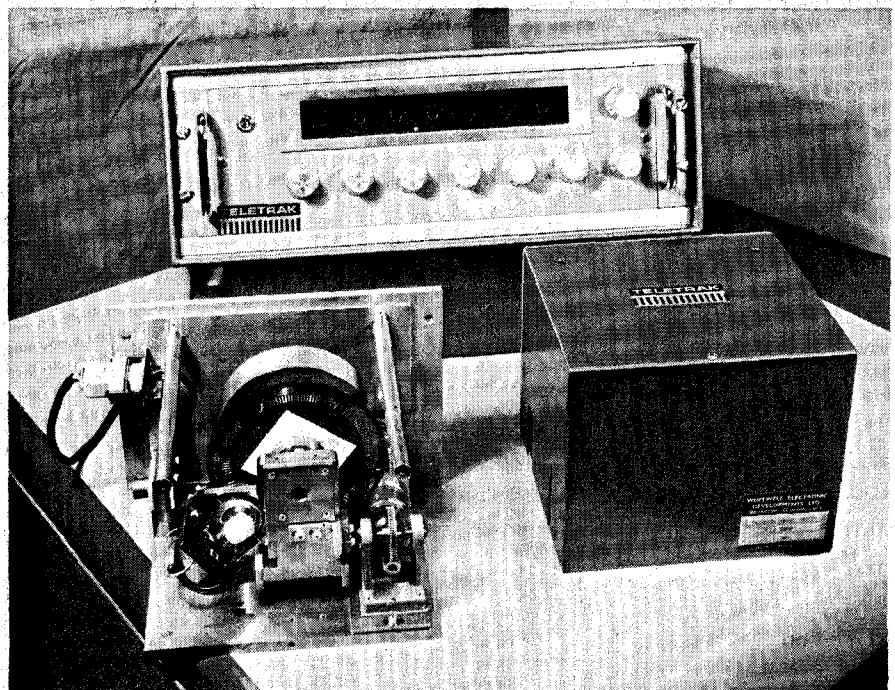


Fig. 9. A commercial version of the absolute system using incremental optical gratings.

TRANSDUCERS IN MEASUREMENT AND CONTROL

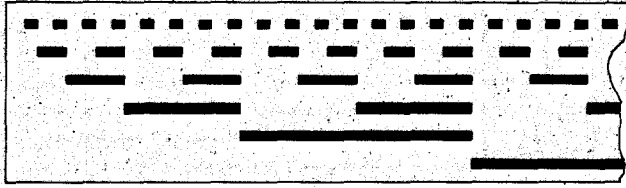


Fig. 10. Section of a 6 bit absolute digital transmission transducer scale.

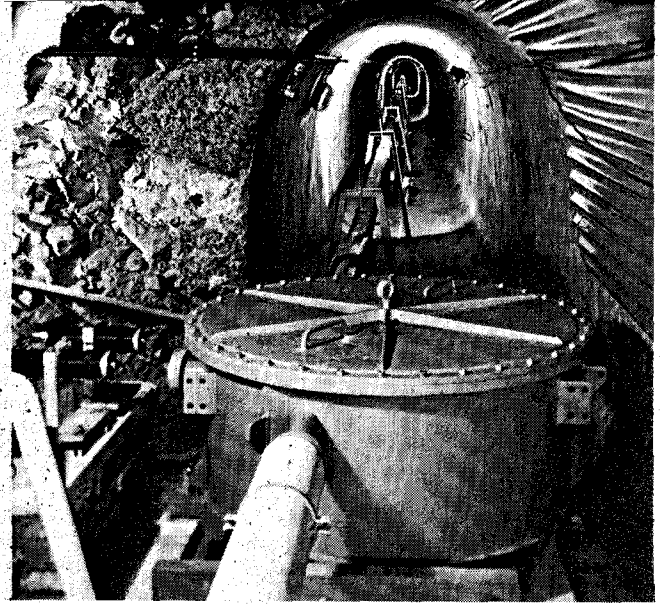


Fig. 11. The University of Trieste laser earth strain meter.

with a reflection grating that has alternate non-reflective, reflective lines etched on a narrow stainless-steel tape. In precision installations the tape is spring tensioned to maintain the same length as when it was etched.

The disadvantage of the simple bar space grating is that it is incremental. An ingenious method has been devised to use them as an absolute system. Consider starting with a coarse grating having a pitch of one millimetre. Phase analogue methods could be used to subdivide the one millimetre cycle into ten absolute parts. If alongside the first grating is one ten times finer, the finer line corresponding to the subdivided position on the coarser grid can be determined by the analogue subdivision. With a third, ten times finer again, grating we can subdivide still further. The position analogue in a millimetre space is found by absolute encoders of low cost. So with incremental gratings it is possible to measure position in an absolute manner. This technique was devised in Britain several years ago and is now marketed by several companies. These successively finer tracks are seen in the angle transducer using this concept which is shown in Figure 9.

This method is tending toward absolute digital optical scales but it needs far less tracks and this eases the manufacturing cost.

Linear digitally coded tracks are available with as many as 20 or more tracks, — one with 6 bits is shown in Figure 10, — but linear transducers of this type are difficult to use in practice. However, as we shall see in the next article they are used extensively in rotary encoders.

Radiation Scales — As mentioned previously, a laser beam (or any other coherent source of radiation, in fact) can provide a spatial scale if interferometric methods are used. The

coherence length of a source decides how far it can radiate and retain a satisfactory wavefront for interference. In the laser this length is such that distances of kilometres are in range. Thus the laser interferometer is especially versatile and is able to measure from millimetres to thousands of metres with the same apparatus.

In industry, the laser interferometer is too expensive for most routine measurement. A system costs over \$11,000 compared with \$2,000 for a grating transducer.

Interferometers are, therefore, usually reserved for vital inspection tasks and for calibrating less accurate scales. They are easily installed — only the laser and a corner cube (or cats-eye) reflector need to be mounted. As the method is by nature, incremental, it is necessary that the reflector is moved in a straight line — within tolerances of a millimetre — to ensure correct operation at all times.

One interesting application of the laser interferometer is its use to control the ruling diamond-carriage position with respect to the moving blank on the Australian C.S.I.R.O. diffraction-grating ruling machine at the Division of Chemical Physics at Clayton in Victoria. Such engines rule, on coated glass, hundreds of thousands of lines side by side and separated by only a micrometre or so. In the C.S.I.R.O. engine, mechanical gears, etc. advance the blank by roughly five fringes. Electro-optic sensing operates a servo that pulls the blank into exactly the fifth wavelength position. A line is then ruled and the process repeated.

Another scientific application of the laser interferometer is for monitoring earth strains. In these installations the path length over which variations occur, ranges from tens to hundreds of metres. It is the small variations in the length (rarely exceeding a part in a

million) that are of interest. The earth strainmeter built at the University of Trieste is shown in Figure 11. The fixed reference arm and beam splitter are enclosed in the tank. Laser radiation enters through the white tube in the foreground, passes to the far end of the tunnel in the suspended tube, then returns to produce fringes which are monitored by the two photomultipliers mounted on the brick pillar to the left of the picture.

MISCELLANEOUS INDUSTRIAL LENGTH TRANSDUCERS

So far we have been concerned with movements of machines, for this constitutes the majority of industrial range measurements. But there are times when other methods are more appropriate. Let us consider just a few.

Television Gauging — A television camera tube is able to convert an optical image size into an equivalent electrical signal by virtue of a timing process. The vidicon camera tube is the simplest of these tubes and is the most used in gauging applications. The vidicon consists of a target upon which is focussed the image of the object of interest. The intensity of the illumination on the target controls the charge distribution on its surface. At the rear of the tube is an electron gun that aims a stream of electrons at the target. This beam is electromagnetically or electrostatically deflected to scan across the target in a systematic manner. The charge on the target decides how much beam current will flow so beam current is a measure of the illumination intensity of the image. Beam current variations (the video signal) and scan position data are combined onto a common signal line and the image is reconstituted in a monitor (if needed).

(continued on page 77)

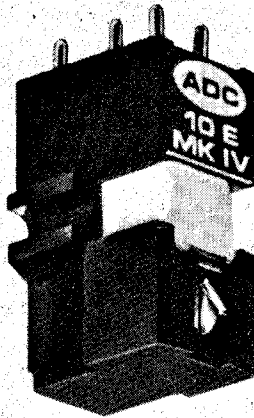
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Output: 4 mV at 5.5 cms / sec. recorded velocity
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Channel Separation: 30 dB from 50 Hz to 12kHz
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Vertical Tracking Angle: 15 degrees
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SONAB CAFE

BY any standards, Sonab speakers are unconventional.

The Sonab Company, a subsidiary of a Swedish government-owned group, was formed in 1966 to develop, manufacture, and market the speaker systems designed by Stig Carlson, a professor at the Royal Institute of Technology in Stockholm.

At present, Sonab market four speaker systems, the second largest being the OA-5 reviewed in this article. (The largest is the OA-6 which incorporates a bass speaker with its own amplifier. This amplifier has a negative reactance characteristic to compensate for the frequency characteristics of the speaker drive unit).

Stig Carlson's basic design philosophy is to produce speaker systems with omni-directional characteristics in the floor plane, thus eliminating the point source characteristics of conventional speaker systems.

When we saw the Sonab speakers for the first time, we were intrigued by their unusual external appearance. The speaker enclosure is basically a column 24" high by 9½" wide and 17" deep. The top of the column is capped with a black wire mesh cover 2" high. Removing this cover exposes four Peerless tweeters at the front of the enclosure, and a Philips twin-cone speaker — horizontally mounted at the rear. The four tweeters are mounted at the ends of two mutually perpendicular diameters of a circle, each facing towards the centre with the axis of each speaker cone pointing at an angle of approximately 15° to the horizontal.

The Philips twin-cone speaker is mounted in the top panel, facing towards the ceiling, and faced with a fine black nylon mesh to prevent dust from collecting on the speaker cones. The diaphragms of the tweeters are also protected with this fabric.

Removing the speaker mounting panel exposes a number of unique features — no doubt patented! The most interesting of these is the fibreglass lining on the rear of the Philips speaker. This lining is retained by a moulded plastic 'basket', that can be adjusted by three screws to provide



different loadings on the fibreglass — correctly to dampen the speaker for optimum bass response.

Another unusual feature of the enclosure is the positioning of the vent. This is located at the bottom of the enclosure above the mounting base. The mounting base is spaced off the bottom of the enclosure by approximately ½" to allow air movement around the perimeter from the vent opening in the bottom of the enclosure.

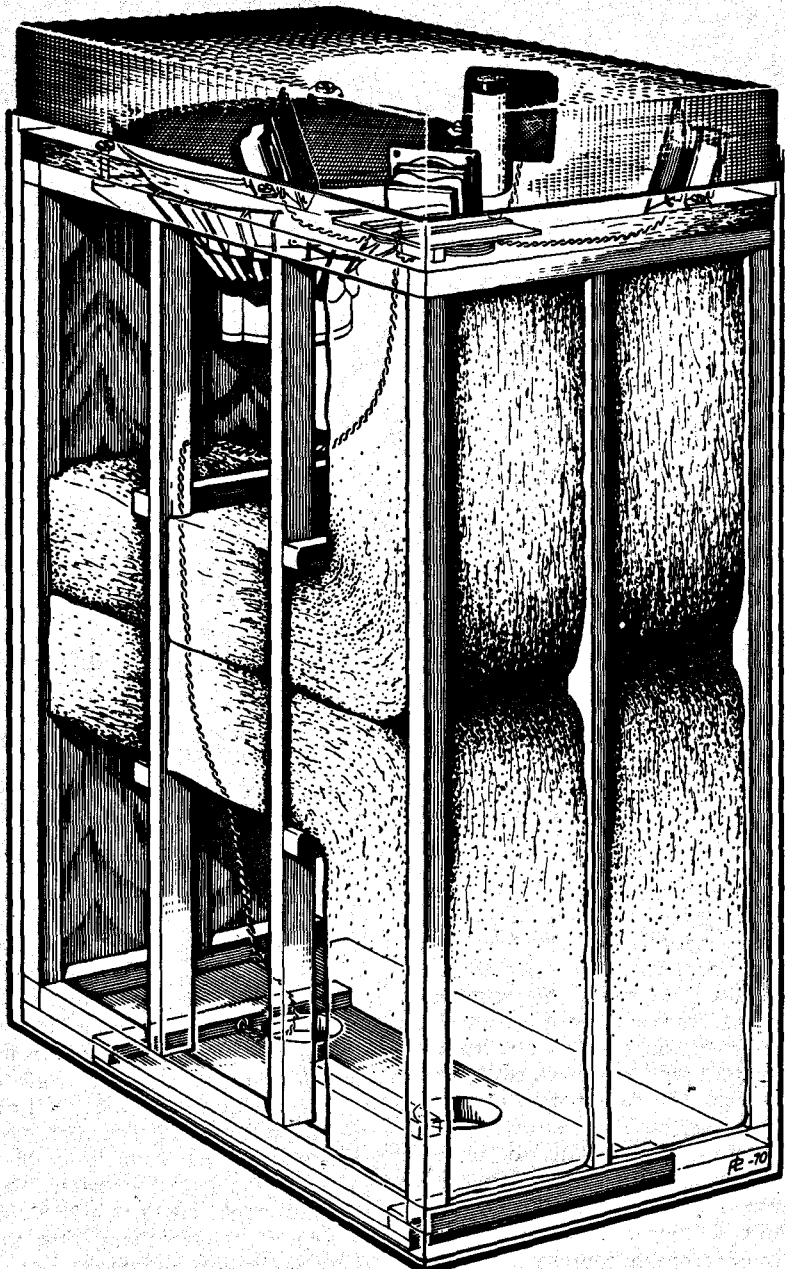
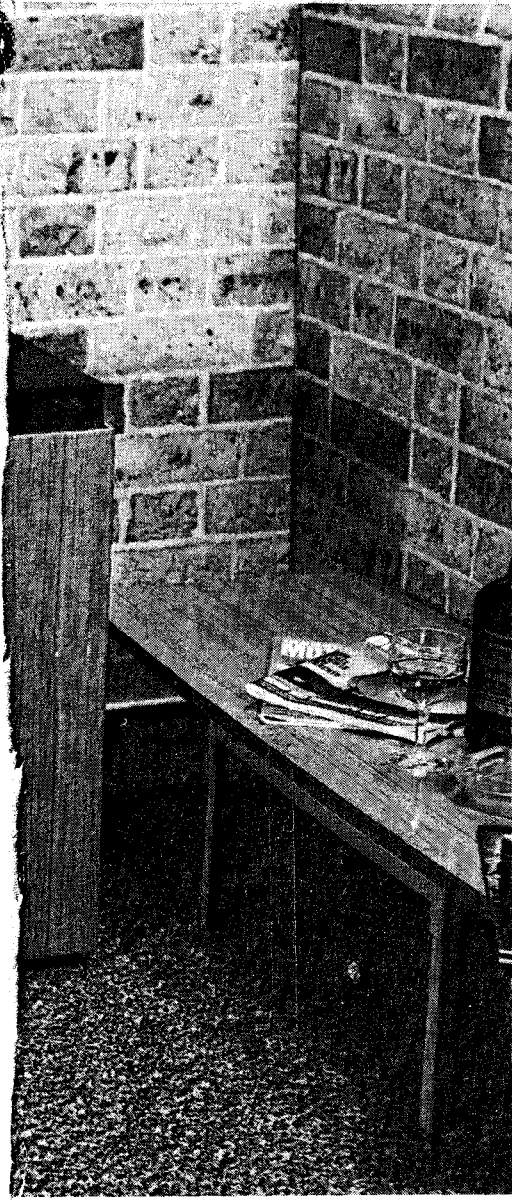
Timber stiffening ribs 1" wide by ½" thick are glued to the internal faces of the 3/8" thick oiled teak veneer particle board in order to reduce panel resonance whilst reducing weight to the minimum. The enclosure is filled with medium density fibreglass to provide additional damping.

The cross-over network, consisting of two air-cored inductors and one capacitor — all mounted on a printed circuit board — is fixed to the

TEAKER SYSTEM

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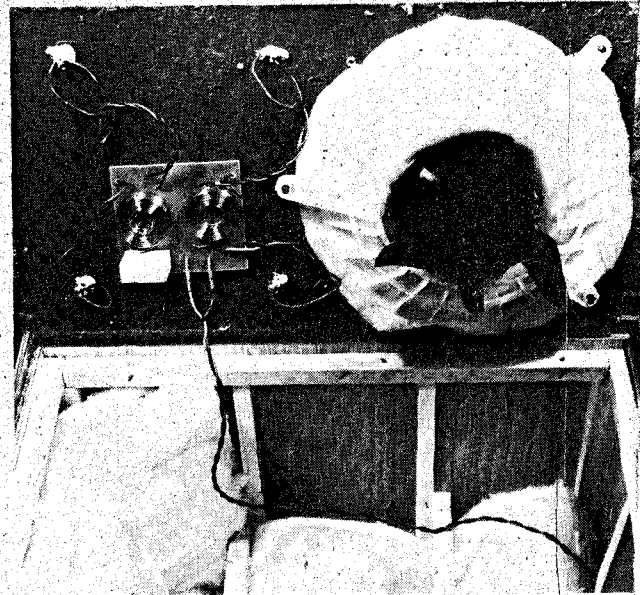
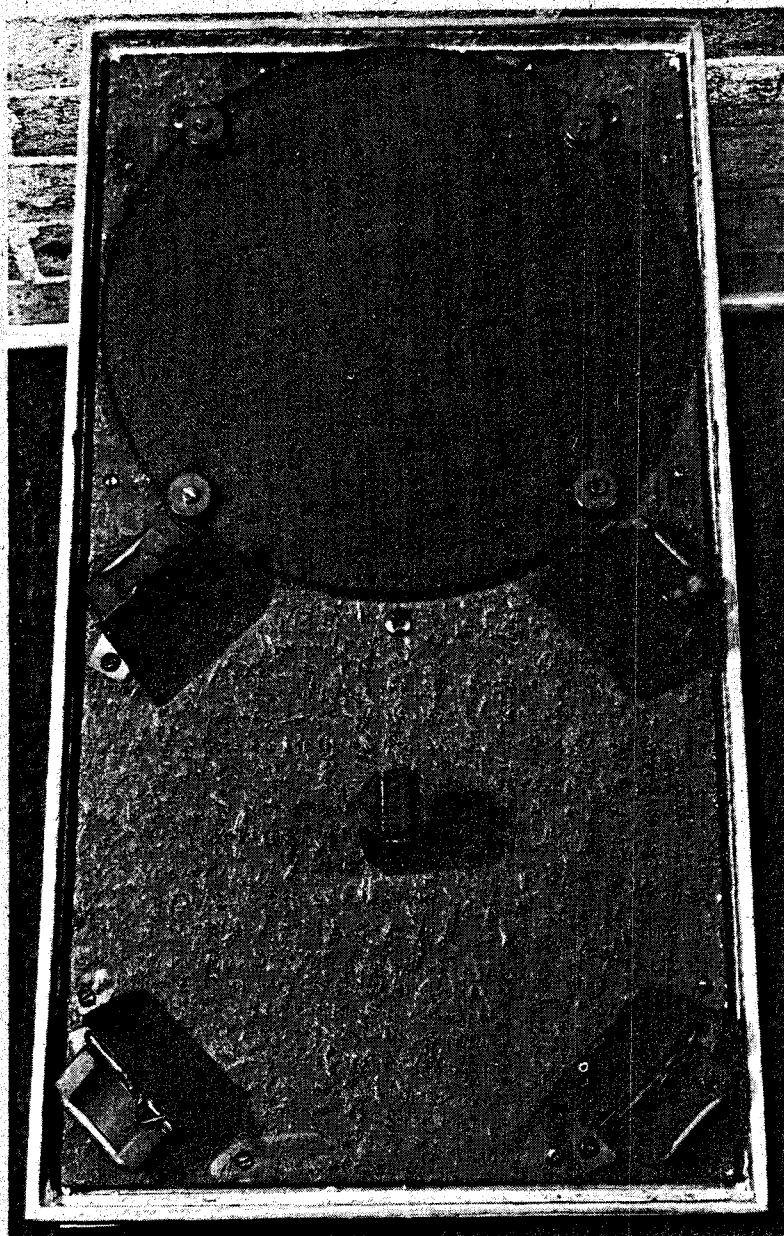


underside of the speaker mounting panel.

Although the teak veneer on the enclosure was colour matched during construction, the front and back panels of the pair that we tested had totally different grain patterns.

Preliminary subjective listening tests were unimpressive. The speakers appeared to have little bass and rather poor treble response. The lack of bass response was especially perplexing because the twin-cone speaker

SONAB OA-5 SPEAKER SYSTEM



MEASURED PERFORMANCE OF SONAB SPEAKER S/N 05225 TYPE OA-5

Frequency Response	
45Hz to 14kHz ± 6dB	
(Refer description of test set up in review)	
Cross Over Frequency	
2500Hz	
Woofer Resonance in Enclosure	
50Hz	
Total Harmonic Distortion at 5 Watts input	
100Hz	3%
1kHz	1%
6.3kHz	0.5%
Electro-Acoustic Efficiency	
0.3% at 1kHz	
Dimensions	
24" High x 9 1/2" Wide x 17" Deep	
Weight	
22lb.	
Price	
\$225 (recommended retail price)	

Top view of speaker enclosure with mesh cover removed, note the four diagonally mounted tweeters.

diaphragm appeared to be following the bass content.

Eventually we took the speakers home and arranged them about six feet apart and eight inches out from a plain cement-rendered brick wall. And this is what we should have done in the first place, for the result was good bass performance down to about 50Hz, and room modes apart, the response was consistent in all listening positions — independent of frequency. This is uncommon because the polar response of most speaker systems becomes more directional with increasing frequency, and the best

response is generally obtained on the axis of the tweeter/s.

The spacing between the speakers and the wall seems fairly critical — the wall provides an additional 'dimension' introducing short-delay reflections that result in an apparent shift of the sound source to just behind the speakers. This is particularly apparent in the mid-range frequencies. The bass response appeared to radiate from the middle of the speakers, due to the unusual position of the vent.

TESTING REFLECTIVE SPEAKERS

When a speaker system is designed to

utilize wall reflections to obtain the intended response, it is clear that anechoic testing conditions are unsuitable for determining the frequency response curve. We experienced the self-same problem when testing Bose speakers, when similarly, it was necessary to test the speakers in a room specially set up to provide the necessary environment.

The laboratory measurements were made firstly in a room with a reflective floor, and with the speaker positioned 20 cm from a reflective wall. This resulted in an unusual response with a predominant peak at 50Hz and

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Copenhagen



Measuring Obj.:

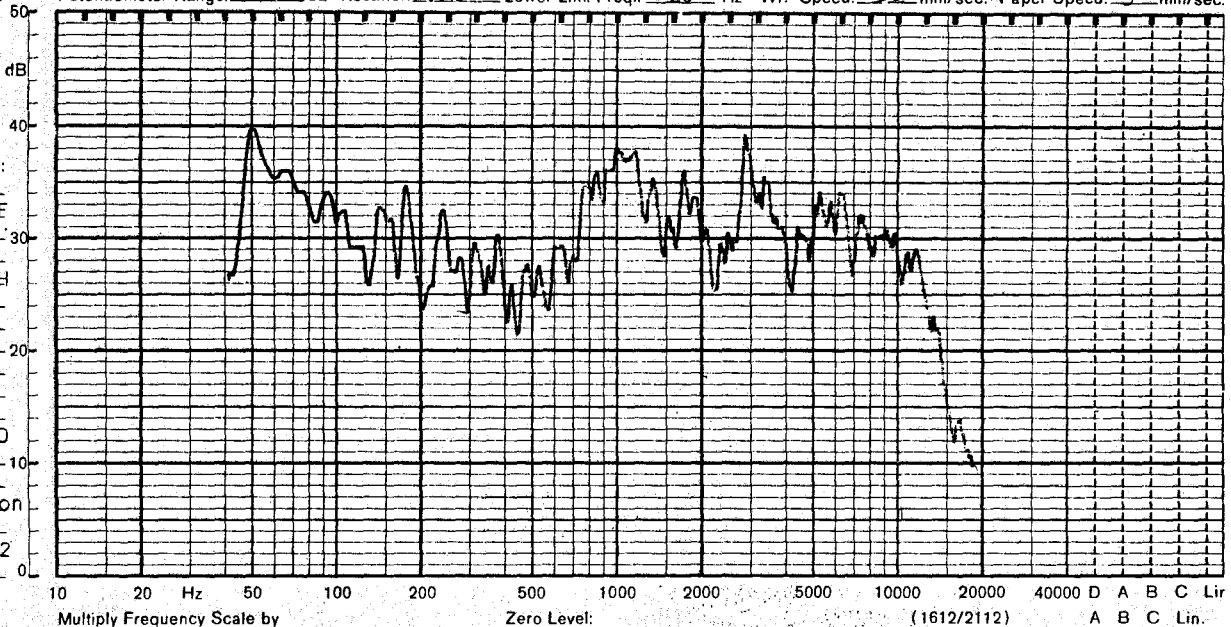
FREQUENCY
RESPONSE OF
SONAB QA-5
SPEAKER
SYSTEM WITH
SPEAKER ON
CARPETED
FLOOR AND
WITH
REFLECTING
PLANE
20cm BEHIND
THE UNIT
1 decibel
per division

Rec. No.:

Date: 25.2.72

Sign.: L.A.C.

Potentiometer Range: 50 dB Rectifier: RMS Lower Lim. Freq.: 20 Hz Wr. Speed: 50 mm/sec. Paper Speed: 3 mm/sec.



Brüel & Kjaer

Copenhagen



Measuring Obj.:

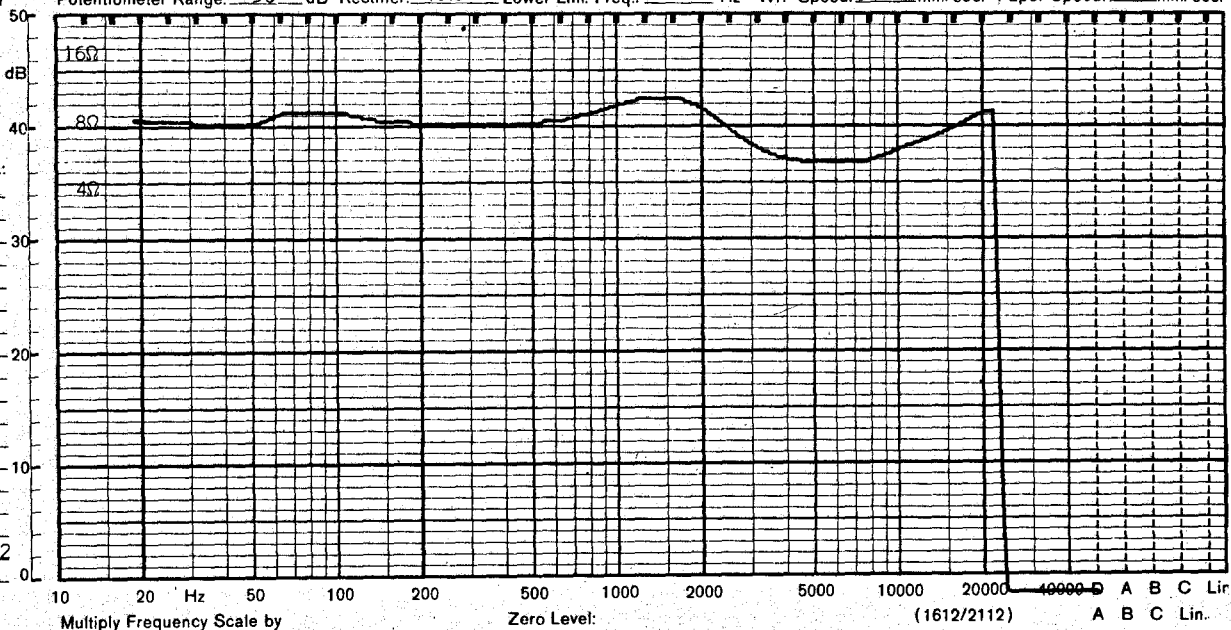
LOAD
IMPEDANCE
OF SONAB
QA-5
SPEAKER

Rec. No.:

Date: 25.2.72

Sign.: L.A.C.

Potentiometer Range: 50 dB Rectifier: RMS Lower Lim. Freq.: 20 Hz Wr. Speed: 315 mm/sec. Paper Speed: 5 mm/sec.



another at 5000Hz. The smoothest frequency response was obtained with the floor covered with 1" thick semi-rigid fibreglass. Under these conditions an unusual characteristic was observed in the form of a high level of sub-harmonic distortion generated at frequencies up to 10 times the speaker's resonance. Rather surprisingly at 500Hz the 50Hz sub-harmonic component was only 30dB down.

This resulted in a colouration of the bass end which was just detectable and is apparently a feature of the speaker mounting.

The speakers came complete with an instruction manual written in Dutch, English, German and French. This manual is the largest that we have seen supplied with any speaker system and has six quarto sized pages (in English) covering the following topics:—

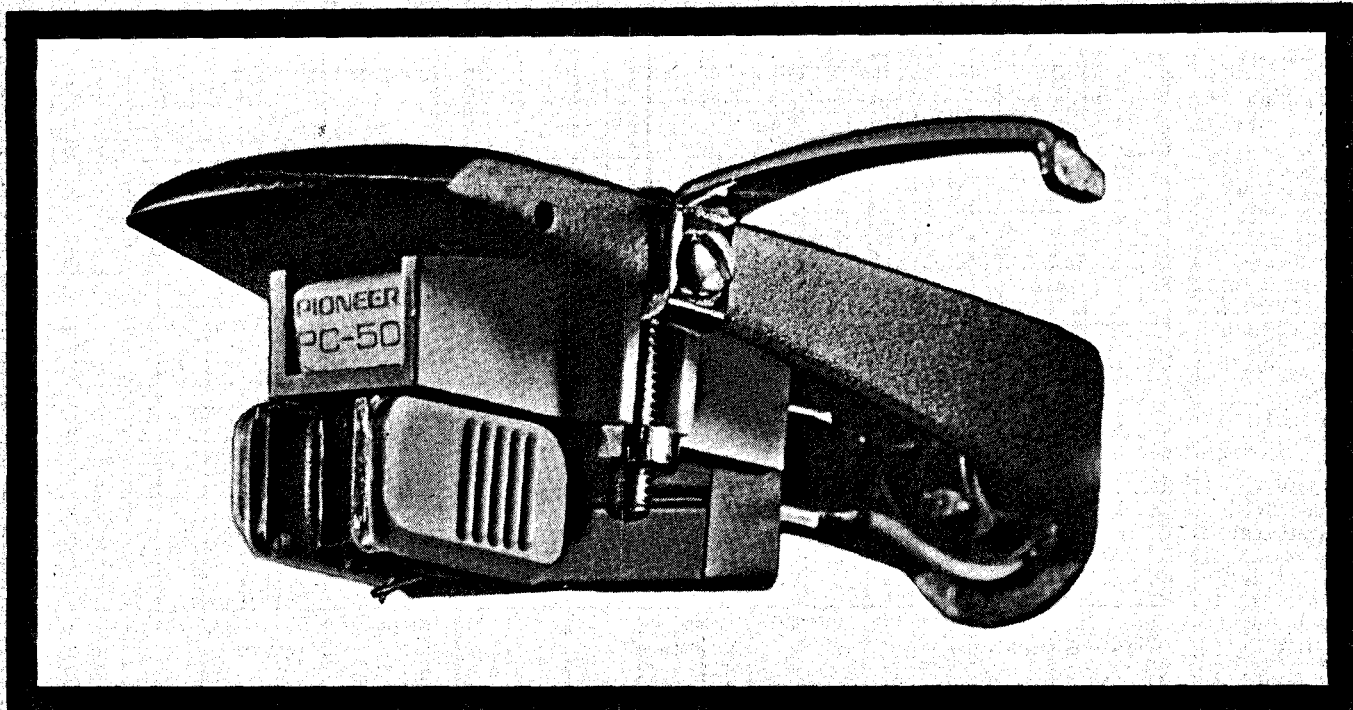
speaker location, room acoustics, amplifier selection, tone controls, making and installing speaker leads, technical details and a 5 year guarantee.

The design approach of Sonab speakers is novel and exciting. In a large room where space is not at a

premium they are more attractive and possibly more effective than most other types of speaker systems in their price range.

They have better diffusion than most, but on the other hand the frequency response may not be all that some purists would desire.

Above all else, Sonab speakers are individualistic (as much so, as in another field, was the Issoginis-designed Mini-minor). They reproduce sound as Stig Carlson believes that a speaker should. One either likes the result — or one doesn't. Either way they are interesting. ●



PIONEER PC-50 PHONO CARTRIDGE

This new induced magnet cartridge from Pioneer is very good value for money.

THE most critical elements in a record playing system are the cartridge and the speakers, for it is these devices that convert the velocity of the stylus in the record's grooves into an electrical signal, and then to audible sound at the far end of the system.

The types of cartridges available today are many and varied and, of these, crystal cartridges dominate the low-cost market whilst moving magnet and induced magnet units are more commonly used in the high fidelity field.

The performance of most good cartridges has increased steadily over the past decade, to the point where dramatic improvements are unlikely to be made — whether judged by subjective appraisal or comparison.

Whilst the measured performance of

a cartridge is of great value, most users will regard subjective impressions as being more important. And so do we. Nevertheless, whether the purpose of an evaluation is to compare two cartridges, or simply to determine a standard of quality, measurement still has a significant role.

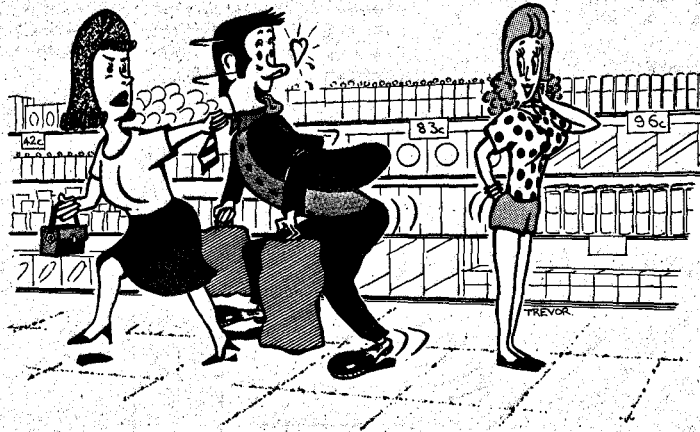
The new PC-50 cartridge constitutes a radical change for the Pioneer group, for, after many years intensively developing moving magnet cartridges, the company has produced an induced magnet type. Very few manufacturers produce induced magnet cartridges; for it is generally claimed that moving magnet cartridges are easier to make, lighter in weight and provide better performance.

Perhaps as a generalization this is correct, but this new cartridge has shown that, on two counts at least,

electronics
TODAY
INTERNATIONAL
product test

there are exceptions to the supposed rule.

The PC-50 cartridge is different in appearance from the other magnetic cartridges produced by Pioneer. Whilst its dimensions are similar, the first, and immediately apparent difference, is the light blue 'H' yoke of the stylus assembly — which comes complete with finger grip and stylus protector. The choice of an 'H' yoke is rational, and the ease with which the stylus can be removed is slightly better than we



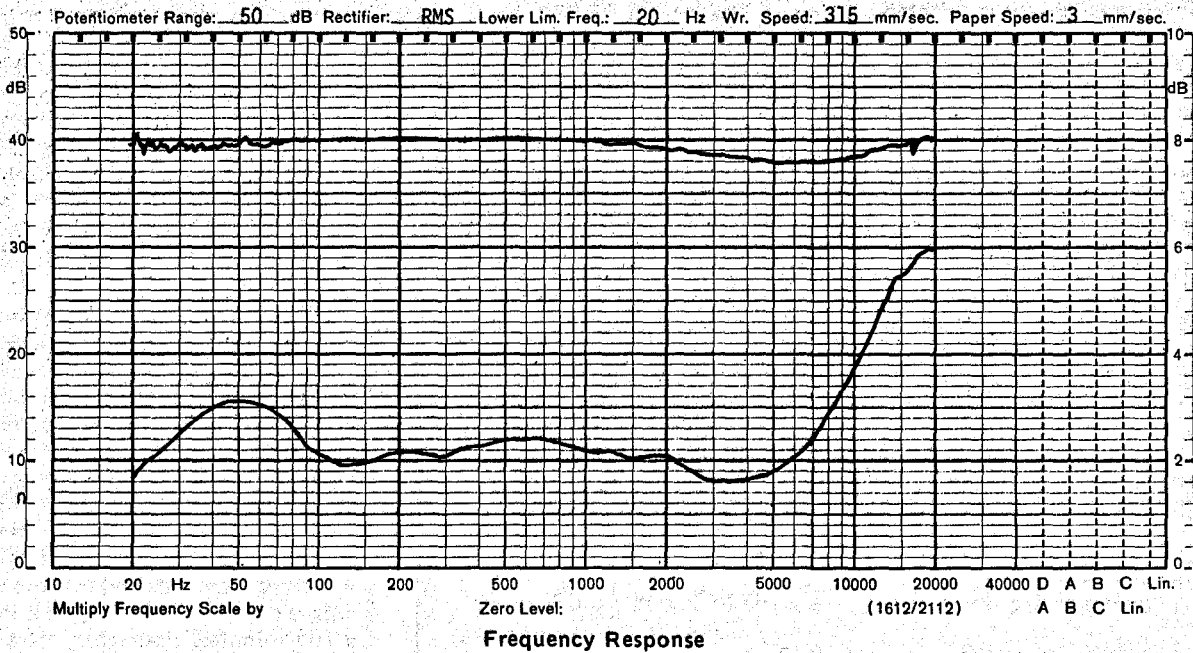
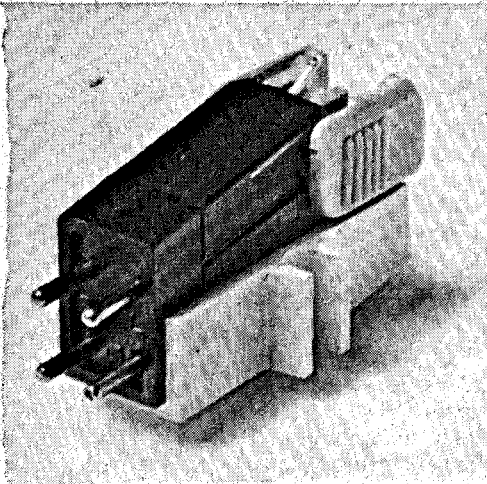
THE PICK-UP I HAD IN MIND FOR YOU WAS FOR YOUR STEREO.....

have found in some other conventional moving magnet assemblies.

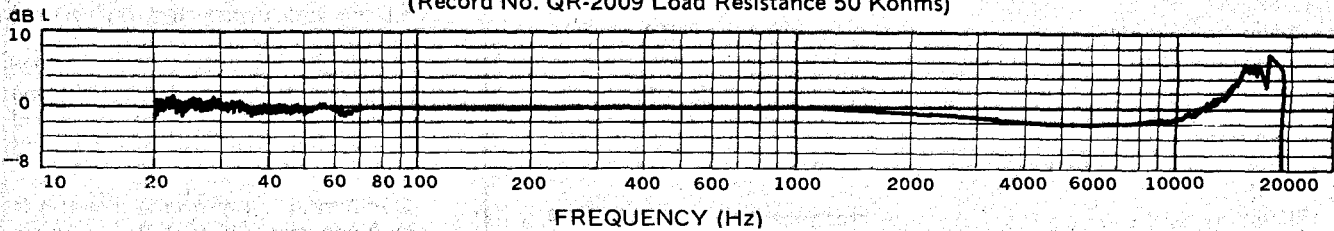
The positive location of the induced magnet assembly of the stylus is assured by two slots in the assembly as well as by two strong moulded stops. The front of the 'H' yoke acts as a holder for the stylus protector and this may be useful with manually operated arms, or on a record player which is moved often. Otherwise we doubt its practical value.

The PC 50 cartridge weighs 6.8 grams. This is only slightly higher than most moving magnet cartridges. The output signal voltage is lower than that produced by the *average* moving magnet cartridge, but higher than that produced by cartridges commonly regarded as being the best obtainable.

The performance of this cartridge, using commercial trackability records, was found to be extremely good. In fact, it was so good that we reran the



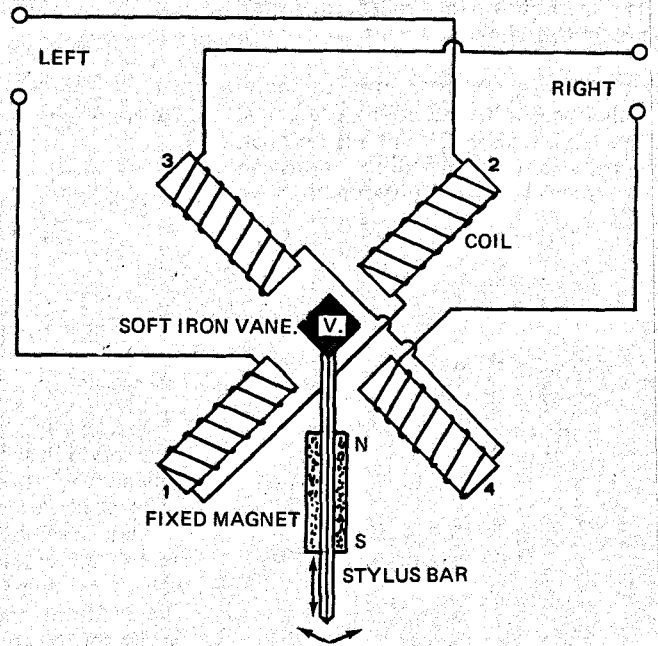
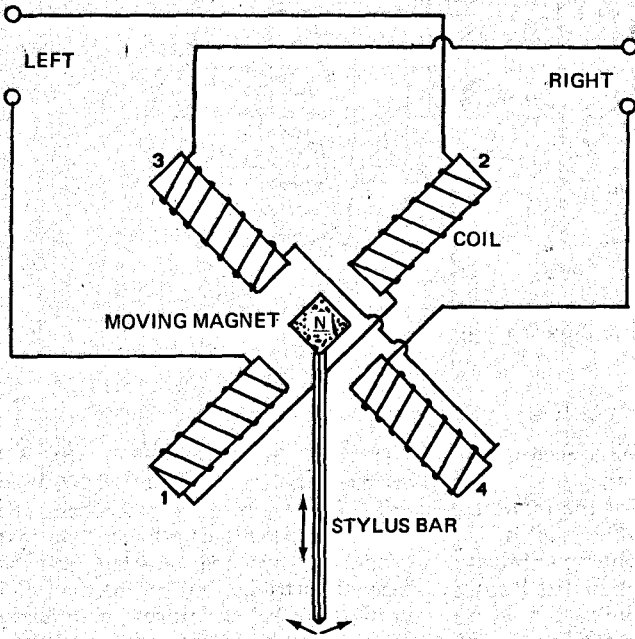
(Record No. QR-2009 Load Resistance 50 Kohms)



The measured frequency response of the Pioneer PC-50 cartridge is better than the maker's specifications. Compare these graphs. The top curves are ours — measured in a NATA registered laboratory — whilst Pioneer's graph is show below.

PIONEER PC-50 PHONO CARTRIDGE

These drawings show the basic difference between the moving magnet and the induced magnet principle. The moving magnet system is shown on the left — here the magnet is mounted directly on the end of the stylus — the induced magnet pick-up is shown on the right — in this case magnetic flux is induced into the stylus from a magnet that is located close to but not in contact with the stylus.



test to confirm the results. Had it not been for an ultrasonic resonance beyond 20kHz this cartridge would provide a trackability comparable to the very best cartridges available. The high frequency trackability is affected by this resonance and consequently there is a slight mistracking apparent at velocities in excess of 15cm/sec at frequencies over 10kHz.

The subjective impressions from this cartridge were formed using a number of new records. These included the new Cherry Pie "Just the Beginning" (NCPS1009), which is a fine demonstration record to show off a high fidelity system. Another, new record that we used was Boulez

Conducts Ravel, (SBR 235446), featuring the Cleveland Orchestra. This exhibits the extremes in levels and tempo characteristic of Ravel's work and provided an excellent trackability test for the Pioneer PC 50.

Instrumental testing confirmed our outstanding subjective impressions of this cartridge.

The frequency response was measured using our latest Bruel and Kjaer automatic recording system which records the true frequency performance and also the channel separation. This confirmed that the frequency response from both channels is within plus or minus 2 dB

from 20Hz to 20kHz. This is far better than that offered by previous Pioneer cartridges that we have tested.

The channel separation on the PC-50 cartridge is particularly good, except at the high frequency end where the 20kHz resonance results in an increased coupling between the two axes of the cartridge. The channel separation is the best we have ever recorded in the range 100Hz to 5kHz. The stylus has a 0.5 mil conical point diamond (whilst most top of the line cartridges offer an elliptical stylus as an option, Pioneer have not followed suit).

Whilst the claimed static compliance of the stylus arm is only average, the performance that we obtained on warped records was excellent. We do not usually conduct this test but we did note that this cartridge easily tracked warped records that other cartridges were simply unable to follow. The cartridge assembly conforms to the EIA 1/2" (12.7mm) mounting standards and mounts in any arm, with the screws supplied, in only a few minutes. Four gold plated pins at the back of the cartridge are coded and the stylus protector can be used with advantage in the early stages of balancing the tone arm. The cartridge is supplied with an additional backing piece to fit behind the cartridge and increase the cartridge weight should this be necessary.

Our overall impression is that this is the finest cartridge that Pioneer have yet produced. It is very good value for money.

MEASURED PERFORMANCE PIONEER PC-50 MAGNETIC CARTRIDGE

Frequency response (at 2.1 grams tracking weight)	- 20Hz to 20kHz	+0 -2 dB
Channel difference at 1kHz	1/2dB	1/2dB
Channel separation	100Hz	29dB
	1kHz	29dB
	10kHz	19dB
Output sensitivity (re 1kHz signal 5cm/sec)	3.8mV	
Price	- recommended retail price \$44.	

Give your present stereo system a \$500 sound for around \$30

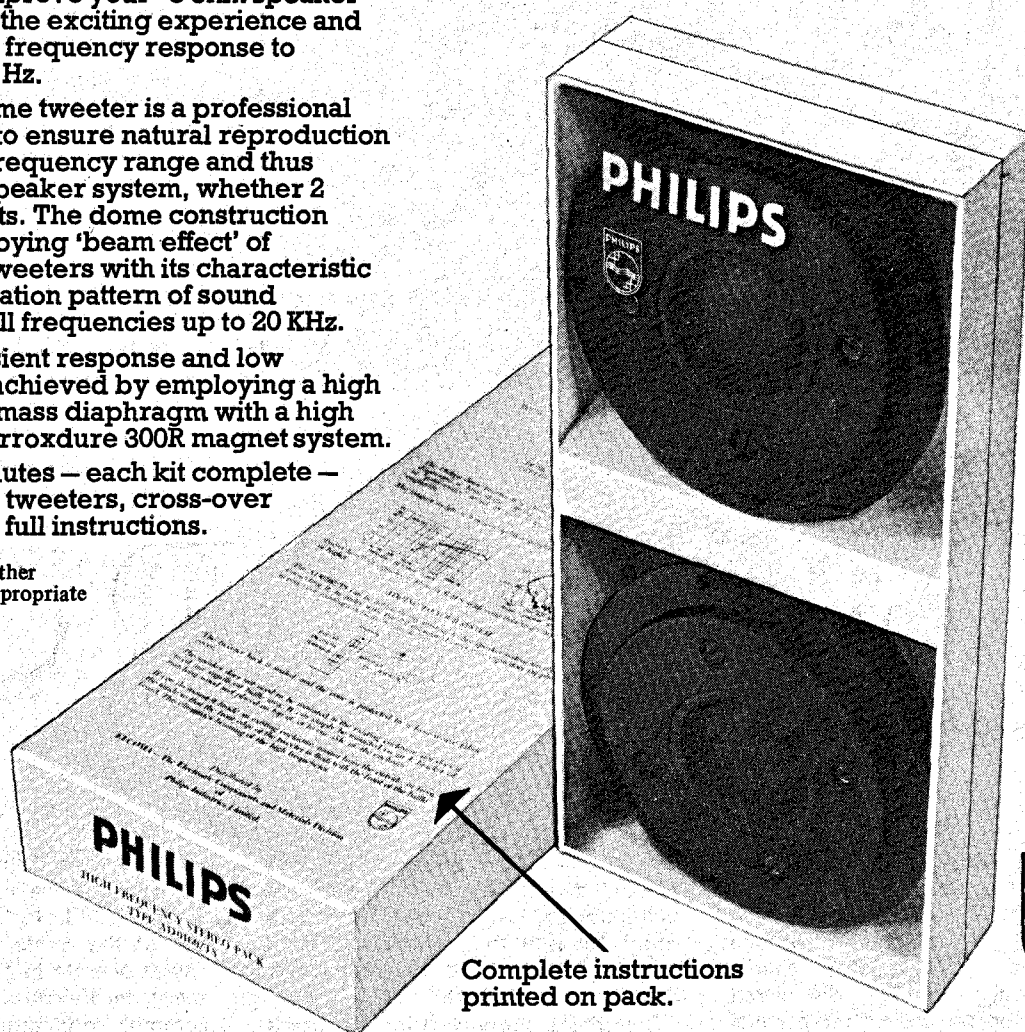
For a modest expenditure you can now significantly improve your *8 ohm speaker system to give the exciting experience and 'presence' of a frequency response to beyond 20,000 Hz.

The Philips dome tweeter is a professional unit designed to ensure natural reproduction over its wide frequency range and thus enhance any speaker system, whether 2 watts or 40 watts. The dome construction avoids the annoying 'beam effect' of conventional tweeters with its characteristic 180° polar radiation pattern of sound dispersion at all frequencies up to 20 KHz.

Excellent transient response and low distortion are achieved by employing a high efficiency low mass diaphragm with a high flux density Ferroxdure 300R magnet system.

Convert in minutes — each kit complete — 2 Philips dome tweeters, cross-over capacitors and full instructions.

*Suitable also for other impedances with appropriate cross-over values.



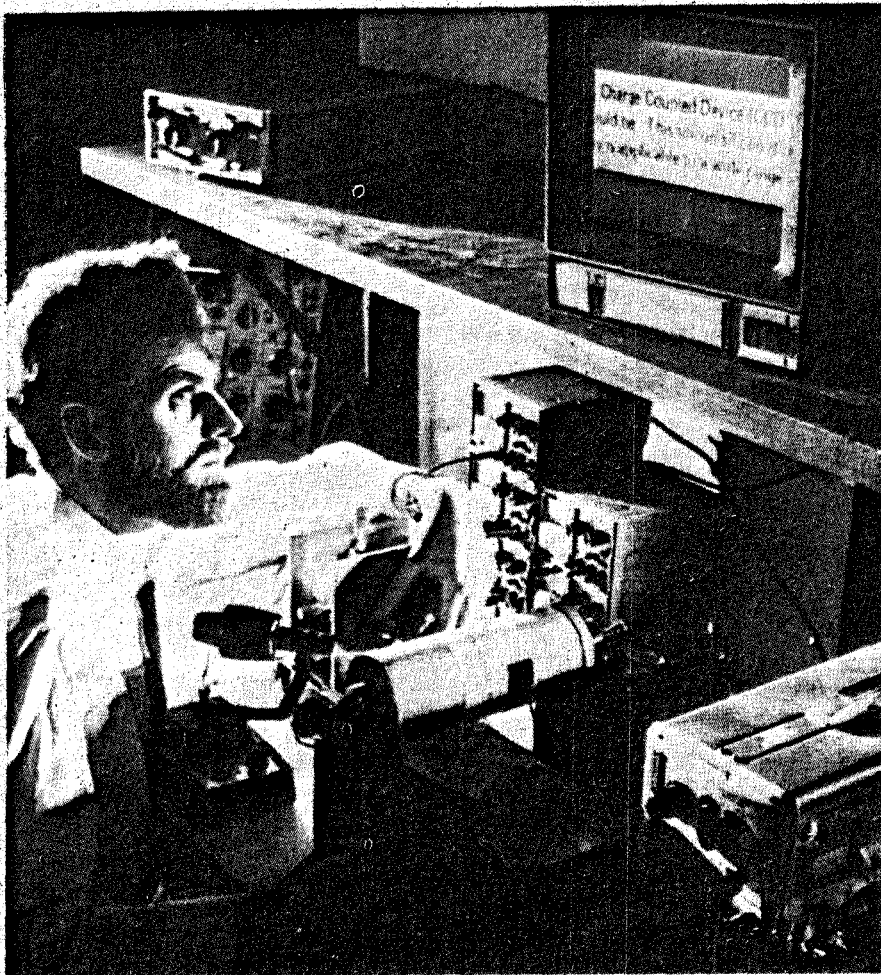
Complete instructions printed on pack.

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38.1813



New semiconductor principle permits simpler construction of many electronic devices.

A scientist adjusts the lens of an imaging device using the charge-coupling principle.

CHARGE

A new solid-state device for electronically "reading" graphic material has been developed at Bell Telephone Laboratories (BTL) using charge coupling, a recently discovered semiconductor principle that permits simpler construction of electronic devices.

The device can be used to scan print or photographs line-by-line, and convert variations in light intensity into an electrical signal. Transmitted to a remote location, this signal can reproduce an image of the original with high resolution.

The imaging device, which represents an important practical application of

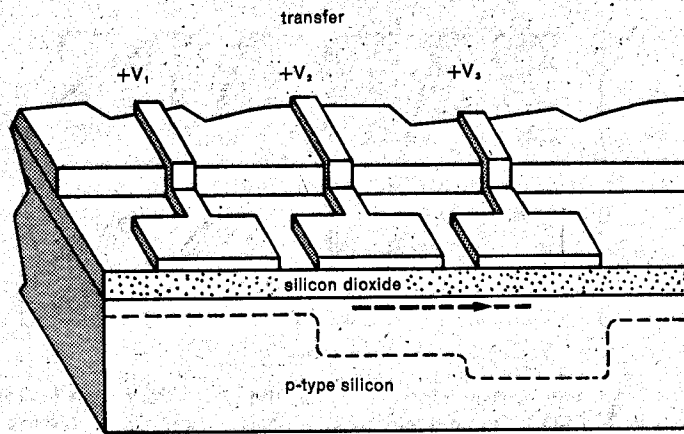
the charge coupling technique announced by Bell Telephone Laboratories last March, ultimately could be used to transmit images of print, drawings or photographs over the telephone network.

The charge coupling principle makes possible simple devices that perform electronic functions usually requiring complex integrated circuitry. Fewer critical processing steps are required for fabrication than with many integrated circuits.

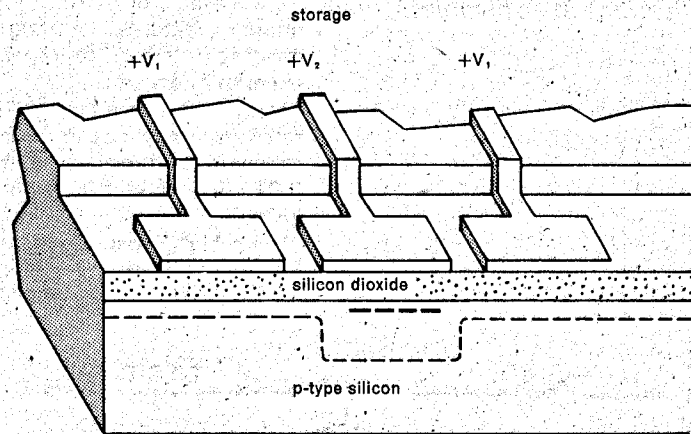
Charge coupling can also be used to make devices for information storage in computer memories and telephone switching systems as well as devices to perform information processing functions.

The imaging device is a silicon chip oxidized on one surface with a linear array of 288 electrodes deposited on top of the oxide. Electrodes on the device operate in groups of three, and every third electrode is connected to a common conductor running the length of the device. The region under each three-electrode group serves as one light-sensitive element, for a total of 96 elements.

In operation, the lens focuses an image of the document onto the surface of the silicon chip. Light from the document causes minority carriers or negative charges to be generated within the silicon. More charges are generated where the light is brighter; fewer where the light is less bright.



In a charge coupled imaging device, incident light causes free electrons to be generated within the silicon, more where the light is brighter and fewer where it is less bright. An array of electrodes overlies the silicon and the free electrons collect at the electrode with the highest positive potential in the area where they are generated. These charge packets are transferred along the surface of the silicon by applying a more positive voltage to the electrode next to the one holding the charge. The varying packets of charges collected at the end of the device are read out as an electrical current whose analogue variations represent variations in light intensity on the document being transmitted.



COUPLING

In each element, the centre electrode is connected to a more positive voltage with respect to the silicon than the other two. Charges, generated by the light near that element, collect at the surface of the silicon under this centre electrode. Since the number of collected charges at each element is proportional to the light flux falling on the silicon at that position during an accumulation period, the resulting concentration of charges is a linear measure of light and dark areas on the original document. In the experimental device, the charge pattern is accumulated in 2.5 ms:

At the end of the accumulation period, the groups of charges are

transferred along the surface of the silicon by successively applying a more positive voltage to the electrode next to the one holding the charge, while decreasing the voltage on the electrode over the charge packet. This causes the packet to move from under one electrode to under the adjacent electrode. This transfer process, called charge coupling, is repeated until each charge packet has passed along the array of electrodes to the end of the device.

When they reach the last electrode, the packets of charge are collected by an output electrode, forming an electrical current whose analogue variations represent variations in reflected light intensity along a line of

the original document. Read-out from the device requires about 96 μ s.

The experimental line-imaging device scans the document to be transmitted along one dimension and converts light and dark areas into an electrical signal. The document being scanned must be moved relative to the device to generate a two-dimensional image.

In this experimental version, the scanning system containing the new device consists of a light source to illuminate the document, a lens to focus an image of the document onto the surface of the imaging device, a drive mechanism to move the document from line to line as it is scanned, and the silicon imaging device itself.

FARADS GALORE

Introducing the ESD — a brand-new component with a myriad of applications in electronics.

A new energy storage device, the ESD, is an electrochemical capacitor with quite a few unique features. Among those of greatest interest to engineers and experimenters are:

Very high capacitance — Values are rated in *farads*, not in μF or pF as are conventional types. Currently made in 0.01, 0.1, 0.5, 1.0, 5 and 50 farad units.

Very high capacitive density — The 50-farad unit occupies less than 0.33 cu. in. Density averages 160 farads per cubic inch.

Very high leakage resistance ($\cong 10^{10}$ ohms) — Retains more than 97% of its initial charge after 16 months of storage.

Very low leakage current — Typically less than 1 pA. A particularly useful factor when charging current is a few microamps or less and discharge current is in milliamperes.

Stores large amounts of charge at low voltages. — A 50-farad unit stores up to 25 coulombs at 0.5 volt.

ESD cells can be paralleled or series-connected. — Follow conventional capacitor and battery arrangements for greater voltage and higher current capability.

Low equivalent series resistance (R_{es}), R_{es} is inversely proportional to the diameter of the device — less than 1 ohm for a 5-farad, 1-inch diameter device and less than 10 ohms for a similar device 0.5 inch in diameter. The R_{es} is the sole factor limiting the ability of the ESD to transfer its charge to a load.

The ESD is composed of chemically stable compressed powders and there is no danger of damaging or destroying adjacent components due to leakage. Shelf-life is said to be indefinite, even when stored under random temperatures ranging from -65°C to $+140^{\circ}\text{C}$. It is a sturdy component, not prone to catastrophic failure. It takes large amounts of energy to destroy an ESD used outside its ratings.

When used as a power source, it has a low power density when compared with batteries. Further, both its maximum voltage and current per cell (500 mV and 1 mA) are much lower than most other electromotive cells. ESD's can be connected in series, parallel and series-parallel for the desired current and voltage ratings.

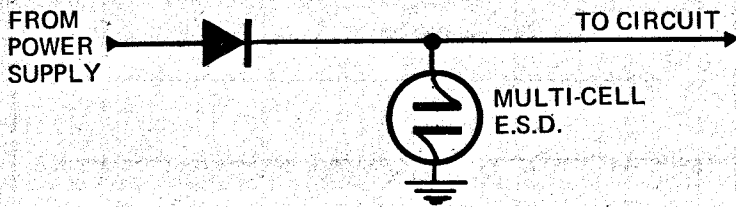


Fig. 1a. Circuit symbol ESD represents dual function of a filter capacitor rated in farads, and as a low capacity storage battery.

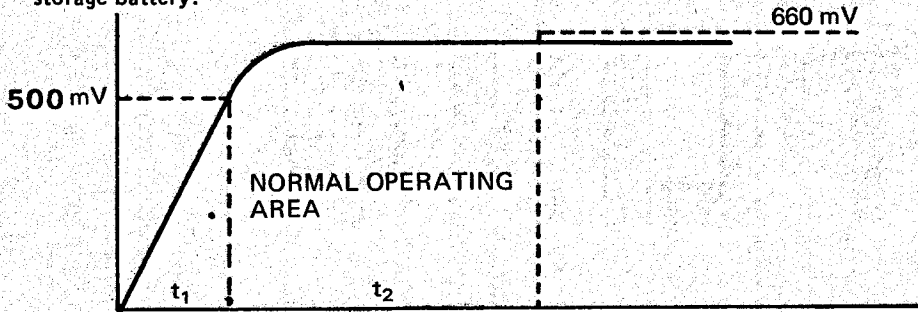


Fig. 1b. Discharge/time curve for ESD at constant current. Normal full charge is to 500 mV. Charging to 600 mV increases operating range by at least ten times.

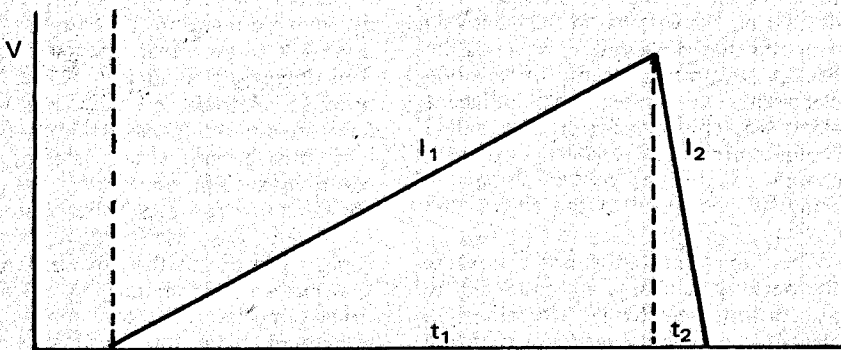


Fig. 1c. ESD timer uses charge and discharge time of device. Short circuit discharge is prevented by current rating of device.

Figure 1-a shows the symbol the manufacturer uses for the ESD. Figure 1-b is the constant-current discharge curve for a typical ESD. When used purely as a capacitor, the current-time characteristic capacitance is

$$C = I_t/V, \text{ where } V \text{ is } 500 \text{ mV.}$$

When used as an energy source, ESD's can be operated at up to 625 mV per cell for an increase in energy storage capability of approximately ten times.

For example, with a 5-farad, 10-cell ESD a 1-volt drop (from five to four volts), 100-mA drain can be sustained for about 50 seconds. With a 1-mA drain it would take about 500 seconds for the charge to drop 1 volt. The same ESD charged to 6.25 volts would have a power increase of at least ten times. This allows an increase in current or time, or a reduction in device size.

APPLICATIONS

Source of standby power in cases where loss of primary power can be either dangerous or extremely inconvenient. For example, in a crystal-controlled digital clock, a simple circuit like that in Fig. 1-a might be used to supply the oscillator and counters so they won't lose step during power interruptions. The same applies to memory systems in computers.

An excellent decoupling device for use when large numbers of circuits are operated from a common power supply.

Pulse-power source to minimize overall power drain in devices with low-current power sources which must have an occasional low duty-cycle, high-current output. A typical example might be a remote weather station or flood-warning system powered by solar cells. Power is stored slowly over relatively long periods and then pertinent information is telemetered out in one short burst of energy.

In timing circuits, the charge-storage capability and low leakage-current make the ESD an excellent current-time integrator whose performance is limited only by the characteristics of the external circuit components. Fig. 1-b shows the time versus constant-current charge/discharge curve for the ESD. Note that regardless of the charging current, time t is linearly proportional to voltage. Due to the low voltage at which a charge can be stored in an ESD, the device can be charged from a voltage source through a resistor that holds the current constant.

Since time equals KV (where K is a constant and V is voltage), time can be set as accurately as voltage can be

measured. Although some ESD's show capacitance increases up to 0.1% per degree C, the voltage/time repeatability is better than 0.1% when temperature is held constant.

For indefinite life, the maximum charge and discharge currents of an ESD should be limited to 1 mA although occasional higher currents can be tolerated.

In most electronic timers, a capacitor is charged to a given voltage level and then discharged rapidly through a short circuit to reset for the next timed cycle. This method is not particularly suited to this new device. For example, a 0.5 F, 1-inch diameter ESD — when shorted — has an R-C time-constant of about 0.5 second (R_{es} is less than 1 ohm) and takes around 3.5 seconds to discharge to 0.1% of its initial charged value. When discharged through a 500-ohm resistor — to limit current to 1mA at 0.5 volt — the R-C time-constant is 250 seconds and the period required to discharge to 0.1% is 1750 seconds; nearly 30 minutes.

However, when timing is based on the R-C time-constant — the time in seconds required for the voltage across the charging capacitor to rise to 63% of the applied voltage or to lose 63% of its charged voltage — the long discharge-time required by the ESD

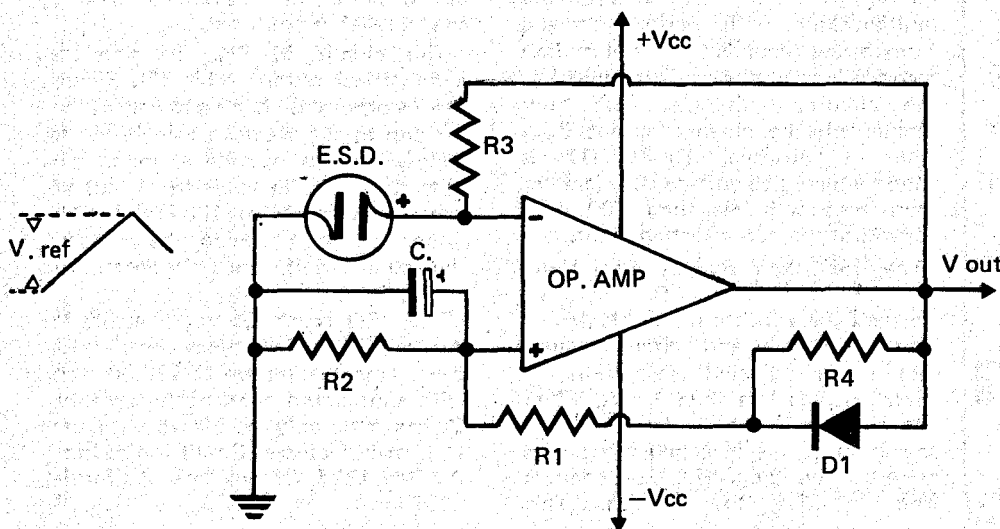
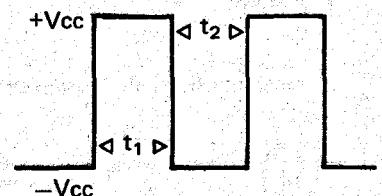
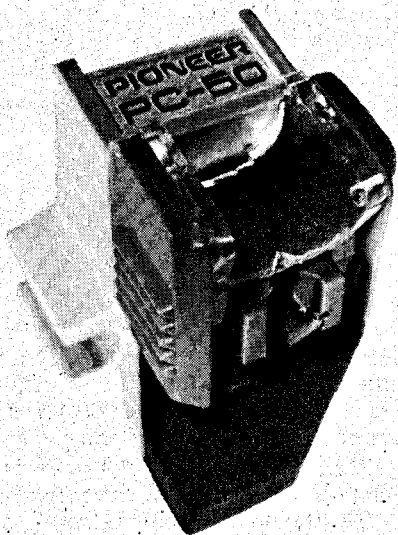


Fig. 2a. Op-amp flip-flop uses an ESD to provide periods up to several million seconds with symmetrical mark space ratio.





THE LONG DISTANCE CARTRIDGE

The PC50. Top of the line induced magnet cartridge by Pioneer.

The large magnet of the PC-50 is located close to the armature, resulting in a higher output voltage than that usually achieved by conventional induced magnet-type cartridges. This voltage, a measured 3mV, is important in reducing hum and noise throughout your stereo system.

Specifications

Type: Induced magnet type.

Frequency Response: 10 to 25,000 Hz.

Output Voltage: 3 mV at 1,000 Hz (50mm/sec. or 2 inches/sec.).

Stylus: 0.5 mil block diamond (PN-50).

Weight: 0.25 oz./7.2 grams.

Available from all Pioneer dealers.

PIONEER

high fidelity stereo. That's how perfection sounds.

AS-131-V

may still be acceptable. For example, when charging current is limited to 10 μ A, the charge time is 25,000 seconds. When the discharge current is limited to 1mA, reset time is 250 seconds, only 1% of the time interval and quite acceptable in many applications.

When a more rapid reset time is needed, the timed period may be made equal to the sum of the charge and discharge times. In this case, the circuit is held in the required state as long as the ESD is charged above zero (see Fig. 1-c). In this type of design, the ESD is completely discharged and the time delay before the next period begins is a function of the system's logic speed.

Figure 2-a shows how the ESD, an op-amp and a few components can be

reverse-bias D1 and the voltage at the non-inverting input drops to zero. The ESD is then discharged from the negative V_{out} through R3. When the voltage across the ESD becomes more negative than zero, the op-amp again switches state — going from negative to positive (the starting condition) and the cycle repeats.

Thus time $t_1 =$ time t_2 , and if $V_{ref} = 500$ mV:—

$$t_1 = \frac{C V_{ref}}{I(ESD)}$$

Thus with $C = 0.01$ farad
 $I_{ESD} = 1$ mA
 $V_{ref} = 500$ mV

$t_1 = 5$ seconds.

When using the same ESD and setting I_{ESD} at 10 μ A the time increases to 500 seconds. By using higher ESD values and charging currents around

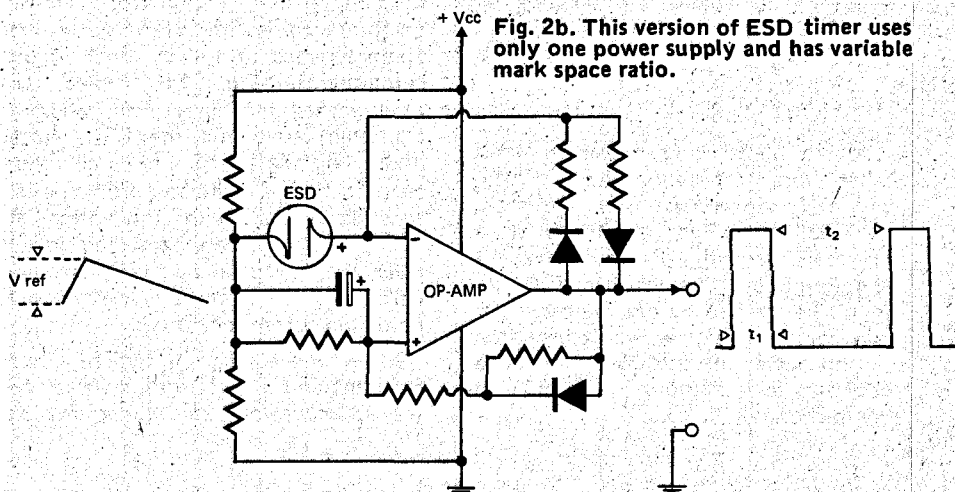


Fig. 2b. This version of ESD timer uses only one power supply and has variable mark space ratio.

used to make a free-running multivibrator with periods ranging from a few seconds to several million seconds. When power is first applied to the circuit (with the ESD fully discharged) the op-amp output V_{out} will be positive. Diode D1 is forward-biased so voltage V_{ref} (greater than zero and less than 500 mV) appears at the non-inverting input.

The ESD then charges from V_{out} (positive) through R3 at a constant-current rate I_{ESD} . Maximum I_{ESD} is 1mA and circuit values should be adjusted so $(V_{out} - V_{ref}/2)/R3$ is less than 1 mA. When the voltage across the ESD — appearing at the inverting input — is more positive than V_{ref} , V_{out} changes from positive to negative. This

10 μ A, times up to 2½ million seconds can be reliably produced.

The circuit in Fig. 2-a provides symmetrical output ($t_1 = t_2$). Figure 2-b incorporates changes to permit the op-amp to operate from a single power supply and to provide asymmetrical output. The ratio between t_1 and t_2 can be as much as 100,000:1 with either t_1 or t_2 being the greater, depending on the input bias current of the op-amp.

The ESD is not as yet available in Australia. The eight types covering six capacitance values are US\$30.00 each with a minimum order of three pieces. Orders may only be placed with the U.S. manufacturer: Gould Ionics Inc., PO Box 1377, Canoga Park, California 91304.

TRANSDUCERS IN MEASUREMENT AND CONTROL

(continued from page 62)

The tube, therefore, converts image dimensions into time signals, so size of the image, and hence the object of interest, can be ascertained from the video signal. This method is not restricted by object size for the optical system can scale up or down as need be. Applications range from microscope slide examinations, to sizing steel billets in the rolling mill, and tracking of missiles from ground level to that height where radar is effective. Precision is limited to 0.1% of the image size, so it is not in the same accuracy class as machine tool transducers, but the advantages of fast response time and easily adjustable scaling make it attractive in many applications.

Scanned Laser Beams — If a laser beam, which has a divergence of 1 mrad (or less when used with a telescope), is scanned across an object, the time taken for it to reappear after being vignettted by the object is a measure of size. Two ways are employed. In the first the rotation is at a fixed speed so distance is proportional to time of obscuration. Alternatively, the rotation can be locked to an angular resolver in which case scan speed is not critical.

SURVEYING RANGE

There are a number of precise techniques for determining distances greater than a kilometre. These use electromagnetic radiation and are known as electromagnetic distance measuring (EDM) devices.

During World War II both Britain and Germany developed radar to plot positions of friendly and enemy aircraft. The technique was to send a burst of carrier and time its reflected return. Electromagnetic radiation travels at around 300 mm per nanosecond, so the resolution is decided by the ability to detect small time intervals. With early equipments only several metre resolution was possible.

A more accurate way to resolve the time is to use a continuously transmitted carrier and compare the phase of the returned signal with the source. (The phase-analogue method again).

No doubt the development of radar prompted subsequent developments, for in 1949 a device, called a Geodimeter, was announced. In this a modulated light beam is sent out and returned from a distant target reflector. The phase between the transmitted and received signal subdivides the whole

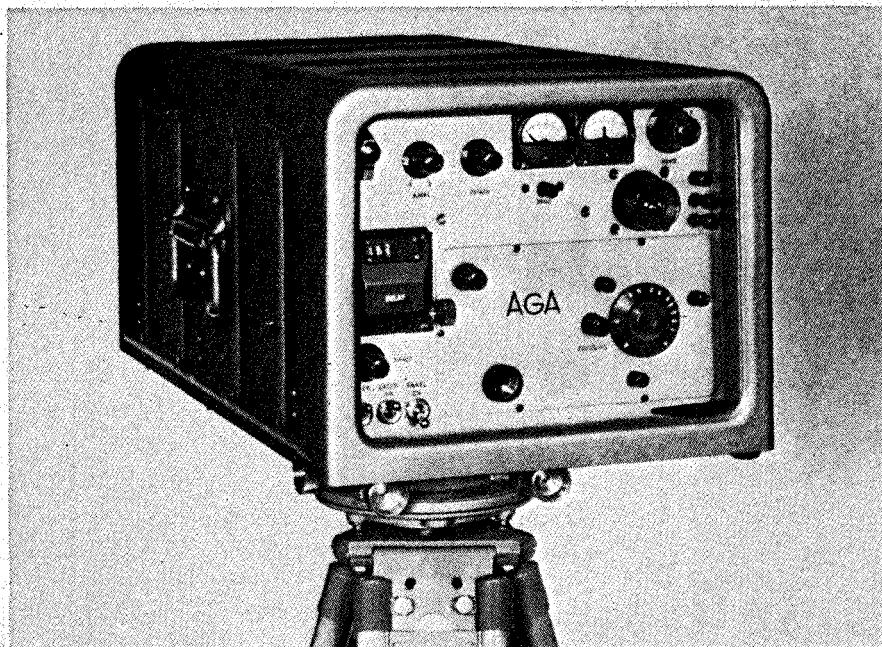


Fig. 12. The EDM instrument uses a modulated laser beam to measure distances up to 60km with an accuracy of 6 mm.

cycles and coarse position is found by determining which coarse cycle is being used. As it is not practical to traverse the whole distance and count cycles, a method of frequency changing is used to decide the coarse distance. This light beam method can measure 20km distances to 10 mm. The latest units, (one is shown in Figure 12), use laser sources to improve the range in daylight.

Then came the Tellurometer — in 1957. This South African development uses microwave radiation. Original units used a 3000 MHz carrier modulated at 10 MHz. Distances from 150 m to 80 km can be measured to the same 10 mm resolution. The latest microwave EDM device operates on a 8 mm wavelength and gives millimetre resolution.

Numerous other devices have followed but with one exception they are modelled after the Geodimeter or Tellurometer. The exception is the Mekometer, a British development from the National Physical Laboratory near London. This uses a short burst of light in which the polarization angle is modulated (rather than the beam angle). By incorporating free air in the modulating cavity, errors due to ambient conditions are reduced. These have been used in recent land crustal movement surveys in Iceland and Greenland and to set up the 300 m diameter intersecting storage ring at Cern near Geneva.

In all EDM instruments, the path being measured is in free air, so the pressure, temperature and water vapour content alter the refractive index and hence the travel time of the radiation.

These effects limit the accuracy to some two parts per million.

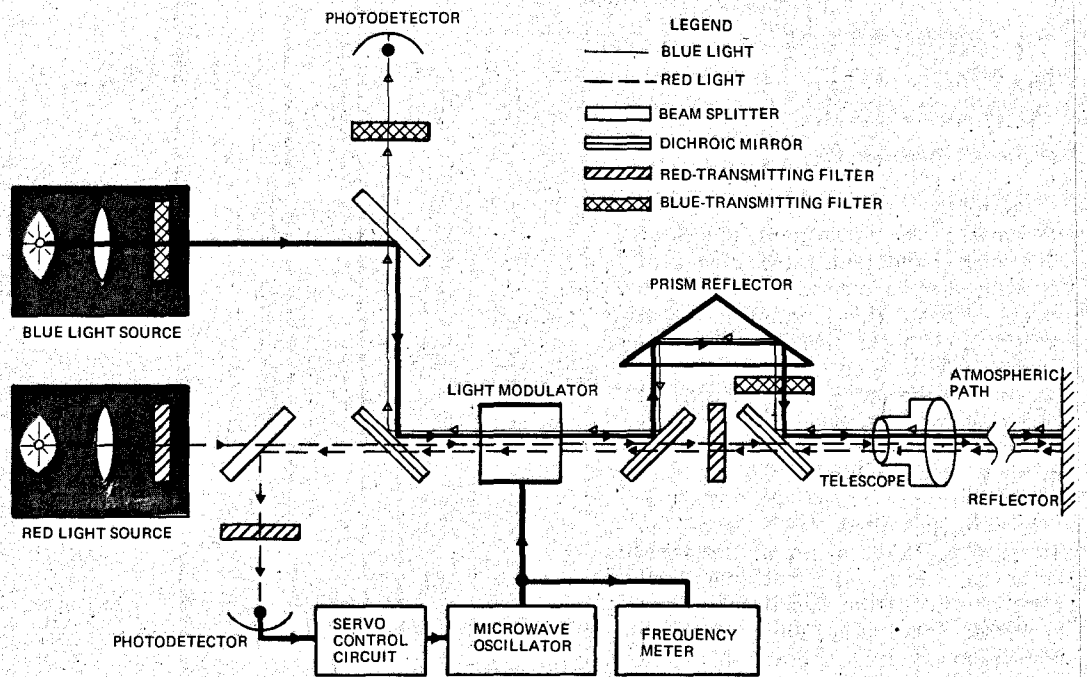
One approach currently under intensive investigation is to use two systems together each having a different wavelength carrier. Common elements are combined for reasons of economy as shown in the system developed by the United States Environmental Sciences Service Association (see Figure 13). The two measurements can be combined to reduce the path errors by 5 to 10 times. It should not be long before dual frequency EDM devices are commercially available.

Until 1968 there was no way to measure short distances (up to a kilometre) with comparative ease. But that year the major surveying instrument manufacturers in Europe each released a ranger which used the solid-state gallium arsenide light emitting diode. This diode is able to provide pulses of intense and highly chromatic light in the red region. In these meters, (one is illustrated in Fig. 14) the transit time technique is used in which the time between sending a pulse and its subsequent return is gated and displayed as distance on a digital readout. Resolution is limited to several millimetres but this is quite suitable for much of surveyors' requirements.

So far we have only considered using phase or gating methods used in conjunction with EM radiation. Acoustic or soundwave radiation travels slower, by a factor of at least one million, so better resolution is possible for a given technological limit on gating a pulse.

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TRANSDUCERS IN MEASUREMENT AND CONTROL



A schematic of a two-colour distance measuring technique used by ESSA in the United States of America.

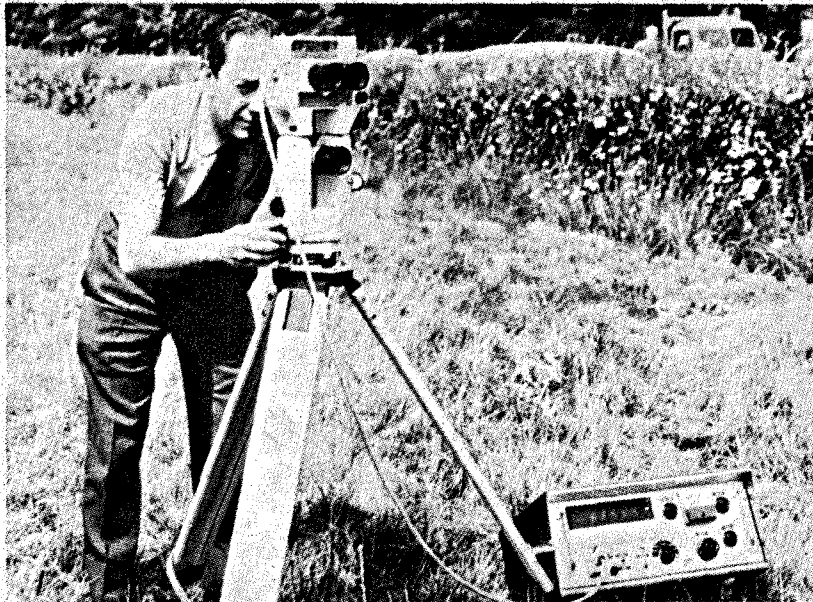


Fig. 14. Gallium-arsenide diode powered transit time ranger.

ranging under water. Ultrasonic methods work well in a dense field or a solid as the transducers can be efficiently coupled to the medium transferring the wave. Ultrasonic methods are seldom used in air as the coupling is poor.

Ultrasonic distance gauging is applicable for both long and short ranges (as mentioned in the last article). It has been used in submarine tracking, surgical probe guidance, water level sensing, determination of wheat level in silos and thickness measuring in industry. An interesting application is its use to guide a deep sea drill bit into an entry cone fastened on the sea floor many thousands of metres below a drilling platform.

CELESTIAL RANGE

As man's desire to explore space is realised, it is increasingly necessary to

know where an object is with respect to another planet — for instance the Earth. Better measurements of distance are possible in space due to the absence of an atmosphere, and also because the distances are large enough to enable transit-time methods to be effectively used, for grating error is insignificant.

During the recent Moon visits, retro-reflectors were placed on the surface to return powerful pulsed laser beams back to Earth. From this method it has been possible to determine the distance to the Moon to an incredible accuracy, and we will now be able to observe such effects as the Chandler wobble of the Earth by monitoring the Earth/Moon distance variations.

A space vessel is guided to another planet by servo-systems locking onto the planet's image, or by relation to certain chosen stars in the star field.

Once near to the planet the vessel locks on to the horizon of the planet until its radar is within range. For the last few hundred metres of descent it might use ultrasonics, television or even a weighted tensioned cord to control the final approach velocity. These have all been used at some time or another.

So far we have described how we can transduce lengths from 10^{-14} m to 10^{20} m or more into electrical signals.

In the following article, transducers for converting angles into electrical signals are outlined — these are very much tied to the measurement of dimension and position. ●

FURTHER READING

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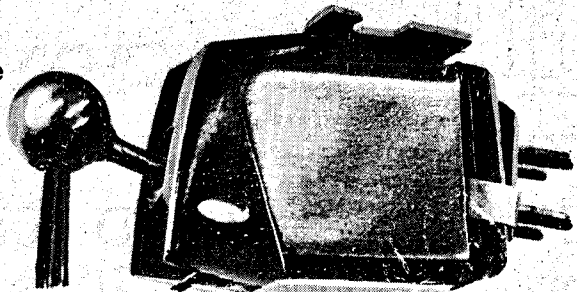
"Handbook of Applied Instrumentation", D.M. Considine and S.D. Ross, McGraw-Hill, 1964.

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"Position-sensitive Photocells and their application to static and dynamic Dimensional Metrology", Optica Acta, 1969, 16, 3, 377-389.

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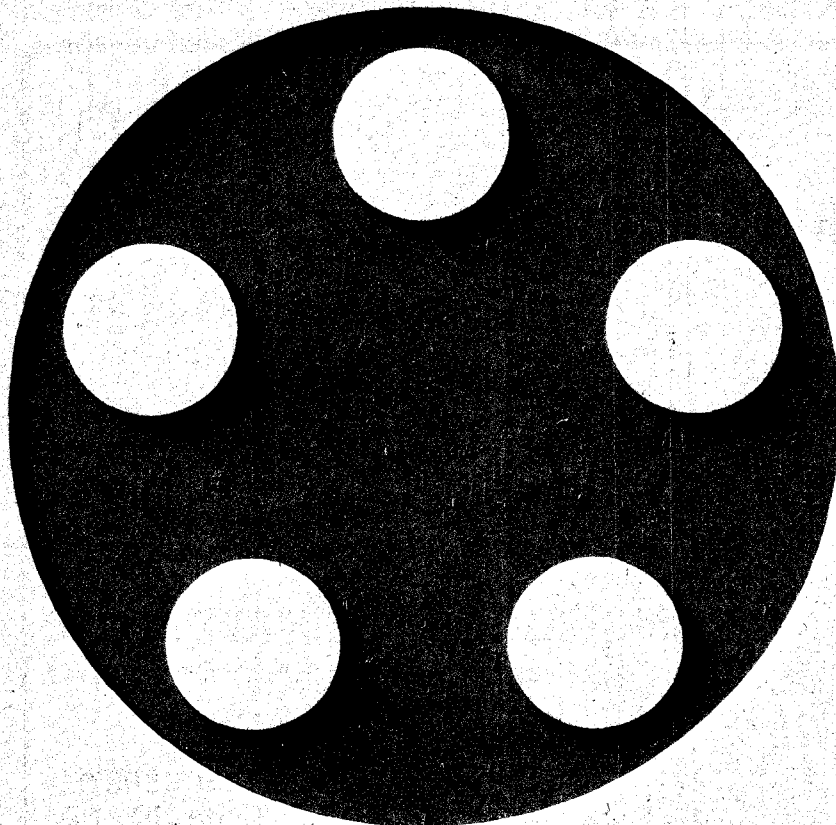
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ELECTRONICS IN THE ANTARCTIC

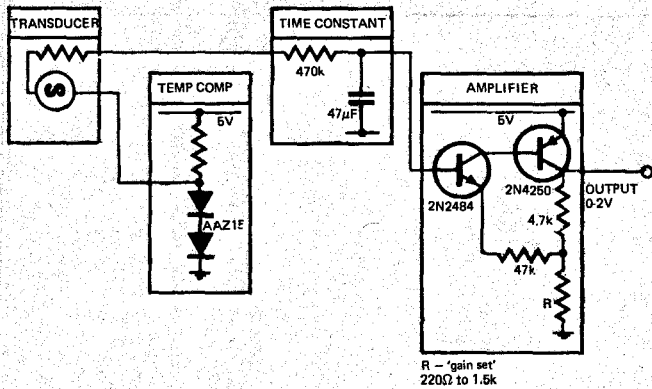


Fig. 16. Meteorology electronics.

(Continued from page 21)

temperature change $+20^{\circ}\text{C}$ to -75°C , the impact strength at -40°C may be only 12 percent of that at $+20^{\circ}\text{C}$; this emphasises the mechanical design criteria of avoiding sudden loads — achieved in the auroral camera by Geneva drive to the film.

Mylar base magnetic tape is adequately flexible at -80°C and at slow tape speeds significant mechanical stress is avoided. The permeability of ferrite falls with temperature decrease; at -100°C a value about 50 percent of that at $+20^{\circ}\text{C}$ is typical.

Accurate timing is fundamental in geophysical research for the inter-relation of data. For the work covered by the present observatory an absolute accuracy around 10 seconds is required throughout the year; long-term stability is thus the major criterion.

The observatory uses a stable quartz crystal reference divided to provide time pulses and BCD time data in the range one second to 999 days.

CHRONOMETER

For chronometer accuracy of ten seconds per year, a long-term stability of 3×10^{-7} is required. Assuming stable operating conditions and linear aging, the reference crystal must have an average weekly rate within 1×10^{-8} . Modern frequency standards, based on ovened AT-cut crystals, readily meet this requirement but with power consumption of typically 15 watts. For low-power operation the oven must be either eliminated, or drastically reduced in power.

Over the past decade, Antarctic Division station chronometers have used DT crystals as the frequency reference. After an initial ageing period, these crystals have maintained a stability around 1×10^{-7} per month, using simple ovens. More recent work with high stability proportional ovens has shown frequency stability

approaching the present requirement of 3×10^{-8} per month. Crystal ageing may be related to manufacturing procedures, current techniques appearing to ensure a low ageing rate after an initial operating period of about two months.

The temperature for zero coefficient of DT crystals may be controlled in manufacture to within 10°C over a wide range. By choosing this temperature to be $20-30^{\circ}\text{C}$ above the mean annual temperature for the site, the oven power is minimized for the temperature expected in the shelter.

Due to difficulties with the GT crystal, the ovened DT was chosen. The Colpitts derived oscillator (Figure 11) and the temperature controller are mounted in the oven.

CRYSTAL OVEN

The circuit of the oven temperature controller is shown in Figure 12. The oven temperature is sensed by a thermistor. Over a one-month test period, the temperature was maintained within 0.02°C for an ambient temperature range of $\pm 15^{\circ}\text{C}$

and supply variations of five to ten volts.

FREQUENCY DIVISION

The Antarctic Division's experience has shown that binary ripple counters are superior in conditions of low temperature, variable supply voltage and noise. At clock rates of less than 10kHz the principal load of a binary counter is its static power consumption. As frequency rises the circuit dynamic impedance must fall to cater for the increased switching speeds, with consequent rise in power consumed. A typical power frequency profile, comparing 10 kHz power consumption with that at 1 kHz and 1 mHz, shows a respective power increase of three and 100 times, thus power is conserved by limiting the reference frequency. From consideration of stability and power, a fair compromise in the present application is 100 kHz.

The basic binary circuit (Figure 13) consumes about 0.1 milliwatts and operates at temperatures from $+40^{\circ}\text{C}$ to -100°C with supply voltage in the range three to 10 volts.

The complete chronometer is illustrated in Figure 14.

THE INSTRUMENTATION

The riometer is a device that measures the relative opacity of the ionosphere due to changes in the electron density.

Basically, it is a 30 MHz radio receiver coupled to an antenna that looks vertically. The riometer compares incoming cosmic noise passing through the atmosphere, with a noise source reference. It uses synchronous detection and a

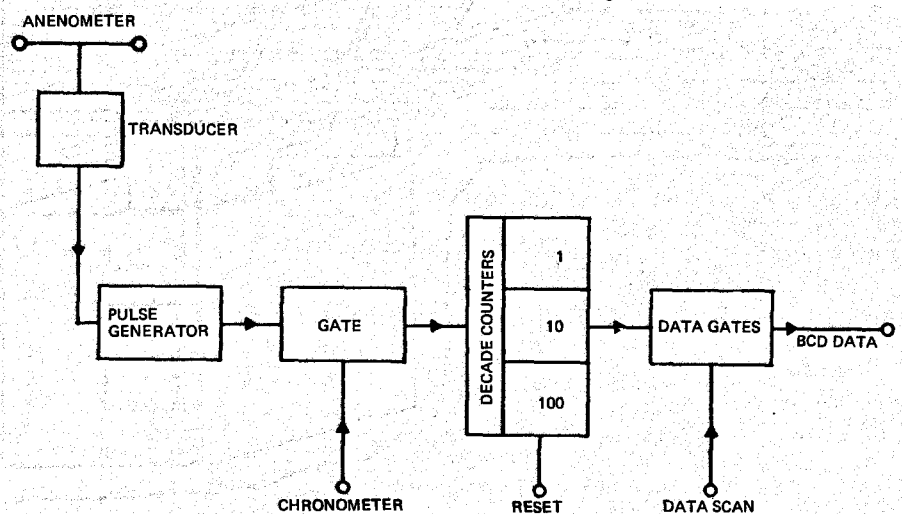


Fig. 18. Anemometer electronics.

ELECTRONICS IN THE ANTARCTIC

servo-controlled system to balance the two noise signals. A block schematic drawing of the riometer is shown in Figure 15.

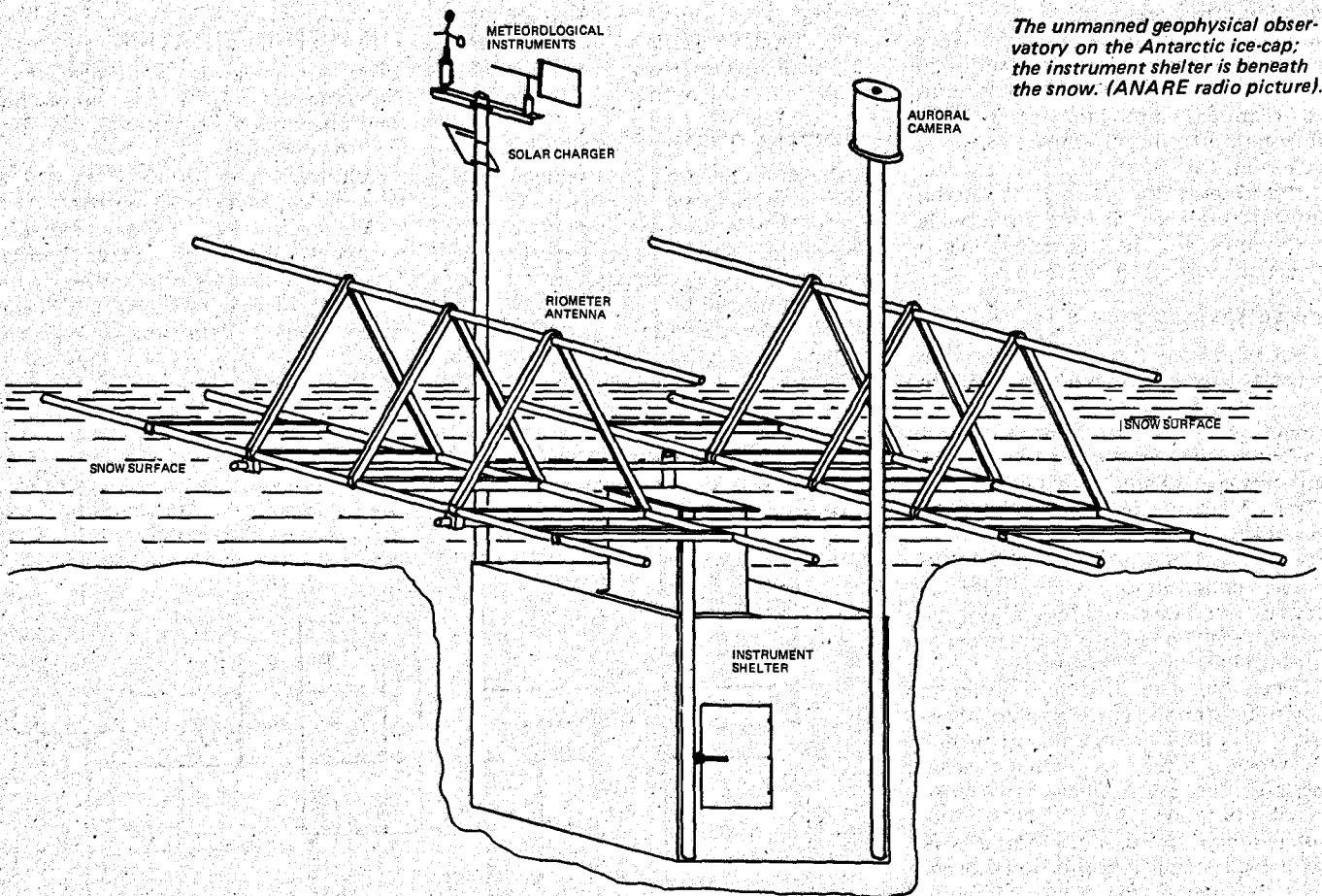
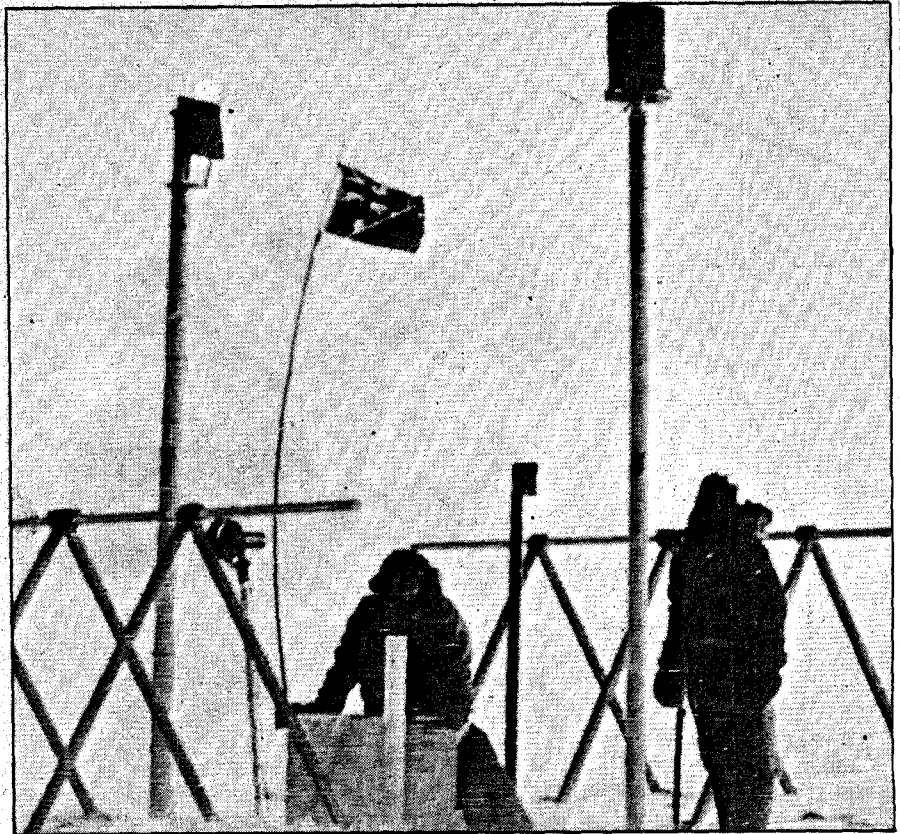
Existing riometers suffer from a number of disadvantages as far as their application to low power, low temperature, unattended operation is concerned.

The riometer designed and constructed for the Antarctic Division's unmanned observatory overcomes these problems. Many new techniques have been incorporated.

The power consumption of the unit is only 100 milliwatts, and this is a significant advance on the ten to twenty watts consumption of most other units.

Another new technique is the use of the shot-noise of a transistor (operated well above its corner frequency) as a noise generator. This has resulted in noise variations as low as one percent for 50°C changes in ambient temperatures.

The input noise figure of the riometer receiver is a mere 5dB and it will operate satisfactorily at temperatures as low as -70°C.



The unmanned geophysical observatory on the Antarctic ice-cap; the instrument shelter is beneath the snow. (ANARE radio picture).

ELECTRONICS IN THE ANTARCTIC

MICROPULSATIONS MAGNETOMETER

The strength of the earth's magnetic field is influenced, to some extent, by the charged particles trapped by the solar wind in the magnetosphere. The effect of these particles is to cause very small, generally rapid fluctuations, called micro-pulsations, having periods from 0.5 second to several hundred seconds; these micro-pulsations are of interest to physicists.

These micro-pulsations are measured by utilising the change in voltage induced in a coil by the changing flux of the earth's magnetic field; the amplitude of the induced voltage is proportional to the rate of change of magnetic flux.

As with riometers, instruments currently available were not suitable for the rigours of unattended Antarctic operation and once again the Department designed and constructed their own instruments. High performance operational amplifiers using integrated circuit techniques have been used, and the resultant units are capable of detecting pulsations in the order of 0.1 gamma (10^{-6} gauss).

The output of the magnetometer is recorded on a four-track analogue tape recorder operating at 2¼ in. per hour. For later analysis the ¼ in. tape is played back at increased speed and the output analysed by a conventional audio spectrum analyser.

Power consumption of the instrument, including the tape recorder, is approximately 100 milliwatts, and the instrument will operate down to -70°C .

METEOROLOGY

Micrometeorology of most Antarctic inland areas is relatively unknown. Consequently, data, even though at low resolution, are valuable.

Wind speed and direction, barometric pressure and air temperature are averaged over 20 seconds and recorded hourly by the digital logger; this time-integration limits the effect of transient variations from the mean value. The equipment is powered for about 5 minutes each hour and consumes an average 50 milliwatts.

Transducers

For wind direction, barometric pressure and temperature, resistive

elements provide a variable voltage from a stable reference supply; circuits to provide damping and amplification are shown in Figure 16. An optical wind speed transducer provides a pulse output. All transducers must be ruggedly constructed and have a well proven performance under Antarctic conditions.

Electronics Today International would like to thank the Antarctic Division of the Australian Dept. of Supply for their assistance in the preparation of this article.

Wind Speed

The anemometer generates one pulse per revolution; at wind speed of ten metres second⁻¹ the pulse rate is about 300 per minute and is linear within one percent over the range 0.25 to 60 metres second⁻¹. The pulse is generated by chopping light from a light-emitting diode directed onto an integrated photo sensor, thus providing BCD data for the digital logger (Figure 18).

(i) Air Temperature

For small temperature sensors, aspiration is not absolutely necessary for satisfactory measurement, but a free flow of air is required through the radiation shield.

(ii) Barometric pressure and wind direction

Both barometric pressure and wind direction are sensed by resistive elements in the transducer unit. The barometric pressure aneroid element provides resolution around one millibar. The transducers are supplied with stable 450mV.

INSTRUMENT SHELTER

The extremes of surface temperature may be avoided by sub-surface installations. Above-surface installation is attractive for ease of placement and retrieval of the observatory, however, the very considerable thermal inertial provided by even moderate snow cover is

important for a non-thermally controlled shelter. The philosophy of the installation is to remove from the surface environment all but those instruments and structures necessary for data collection and power generation.

The shelter is a 2.2 metre cubic non-ferrous structure of aluminium section sheeted with plywood and insulated with rockwool. It is buried so that the roof is one metre beneath the snow surface. Temperature variations inside this structure will be within $\pm 12^{\circ}\text{C}$ of the mean annual temperature for the site; thus, for the worst case of a mean temperatures of -58°C , the lowest instrumentation temperature is about -70°C inside the shelter and possibly -100°C for the above-surface equipment.

As the shelter is a magnetic observatory with sensors mounted in close proximity, there is no significant volume of ferrous material in its structure, fittings or instrumentation.

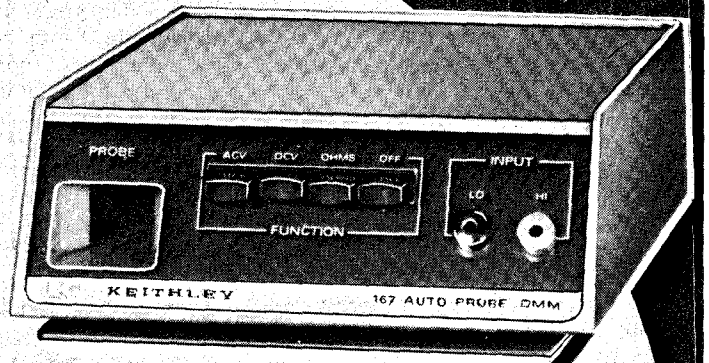
The structure also functions as a container for transport of the equipment to the site, a shelter for on-site work, a darkroom for film handling and a foundation for the above-surface structure.

CONCLUSION

A prototype automatic geophysical station for unmanned operation in Antarctica has been designed to function at unusually low power consumption and temperature; the environment has been used to advantage for solar and wind generation of power, increased circuit reliability and to avoid the extremes of surface temperature.

Some of the techniques used should find wider application in geophysical instruments. In particular, application of solid-state devices to the riometer noise source and magnetic micropulsations amplifier meet real needs.

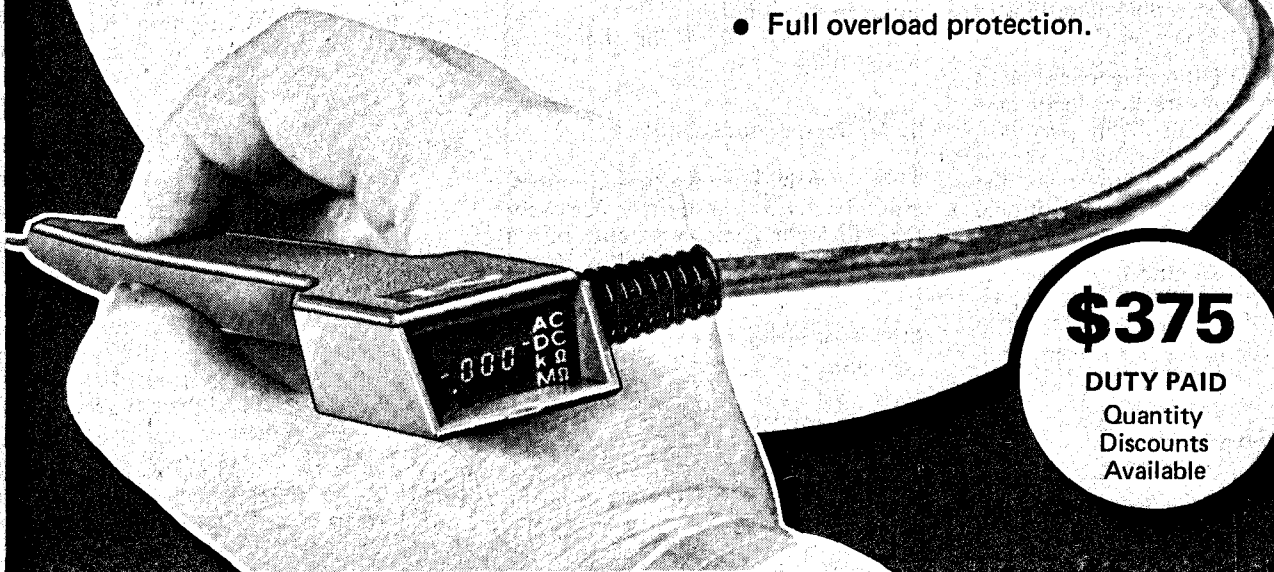
New technology, no doubt, will simplify the circuitry and improve reliability. An inexpensive and efficient low temperature power source is still needed. At this stage the isotope power source seems the only suitable source for use below 75°S latitude. Satellite links would upgrade the usefulness of these unmanned observatories. ●



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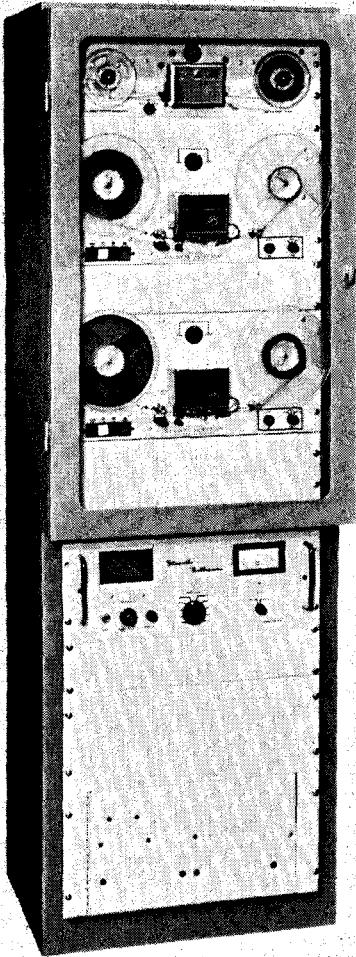


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EQUIPMENT NEWS

100-HOUR 20-CHANNEL LOGGING RECORDER



A new dual transport logging recorder system with up to 20 recording channels is now available from Plessey Electronics.

This latest addition to the comprehensive range of Stancil-Hoffman logging recorders is the AN/GSH/34 which is said to be capable of recording 50 hours of radio or telephone traffic on each tape. In normal operation one transport records all 20 channels for 50 hours then the second tape transport starts, providing one hour of overlap.

In addition to the dual transports, each cabinet-mounted system features a voice time announcer, a separate portable reproducer and a remote console to indicate the operating status of both transports.

During emergencies both transports can record simultaneously allowing one transport to be used at any time for message recall without disrupting the recording of the other transport. In addition to the time

clock changeover at 50 hours, all critical parameters are continually sensed. Should there be a tape stoppage due to any malfunction, transfer is automatically made to the standby transport.

This new equipment has been field tested under continuous operating conditions for the past two years logging air-ground-air communications at United States Air Force Bases in many parts of the world.

The equipment is installed in mobile trailers. Up to 19 channels of voice conversation are recorded between pilots and air traffic controllers together with landline communications. One channel is used to record time information.

Stancil Hoffman have also up-dated the well established GRM Series of logging recorder equipment which is available for one, two and four channel operation on 1/4-inch tape, 10-channel operation on 1/2-inch and 20-channel operation on 1-inch tape. All these units operate at 15/32 inches per second and provide 25 hours continuous recording on a 7" reel.

Further details from Plessey Electronics Pty. Limited, 91 Murphy Street, Richmond, Vic. 3121.

TELETRACER - A NEW MINIATURE POCKET PAGING SYSTEM



A new miniaturised pocket paging system is now being marketed in Australia by Standard Telephones & Cables Pty. Limited.

Called the TeleTracer, the new system provides personalised push-button contact with any person carrying a tiny transistorised receiver, which clips neatly and unobtrusively into the pocket.

STC claims that the maximum use of miniaturised components, integrated circuits and printed circuit techniques makes TeleTracer the most advanced of its type in the world, providing up to 1000 individual

receivers on a single system.

With the new pocket page system, not only is the person 'buzzed' and alerted to pick up the nearest telephone to receive a call, but he may be spoken to direct on his receiver if necessary.

This is a distinct advantage, particularly if the person being called is nowhere near a telephone.

Another facility in the system is the 'group call' feature which can alert and transmit a voice message to any pre-determined group of receivers simultaneously.

Group call is often used to alert cardiac arrest teams in hospitals or a group of doctors in a casualty ward. It is possible to have several groups within the same system and all receivers in each group can still be paged individually for normal page calls.

If a person with a receiver leaves a building, a hospital or any complex where the system is installed, there is no need to advise the operator. He simply slips his receiver into a storage container at an exit point. Not only does this container store his receiver till he returns, but it also re-charges the receiver's battery in his absence and gives the operator an indication that the person has left the building.

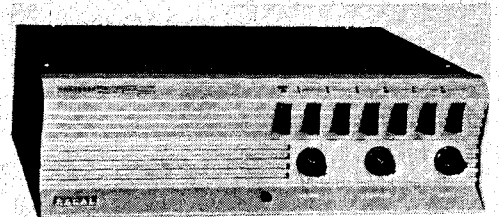
TeleTracer systems can be readily connected to the STC PRO 511 hands free intercom telephone system, allowing each telephone to perform as a paging station. This option allows a person to press a single digit which connects him to the TeleTracer system. He then dials the receiver number of the person he requires and sends a voice message to the person.

All TeleTracer equipment is in accordance with relevant P.M.G. specifications.

The system can be installed in Australia on a leasing basis or can be purchased. If at any time a receiver requires service, STC will repair the unit and return it to the user within 24 hours.

Further details:- Standard Telephones & Cables Pty. Ltd., 252-280 Botany Rd., Alexandria, NSW.

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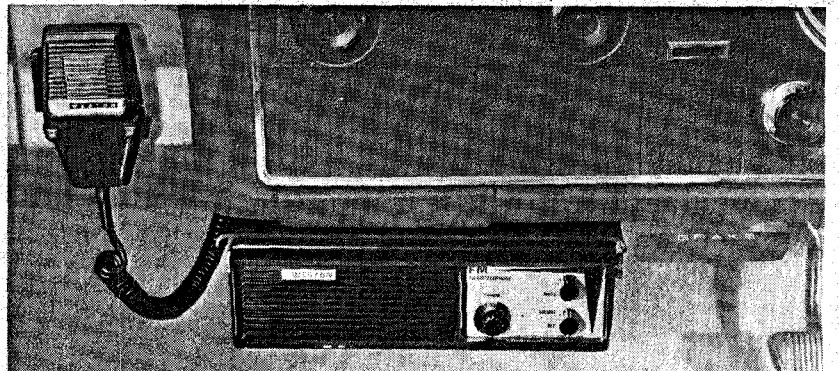
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EQUIPMENT NEWS

transceiver TRA. 7928 which covers the frequency band 2-10MHz and can be fitted with up to twelve channels. A compatible amplitude modulation option is available if required.

Of particular interest is the integral crystal oven, which the manufacturer claims, keeps the equipment accuracy to plus and minus 50 Hz for temperatures from 0°C-60°C.

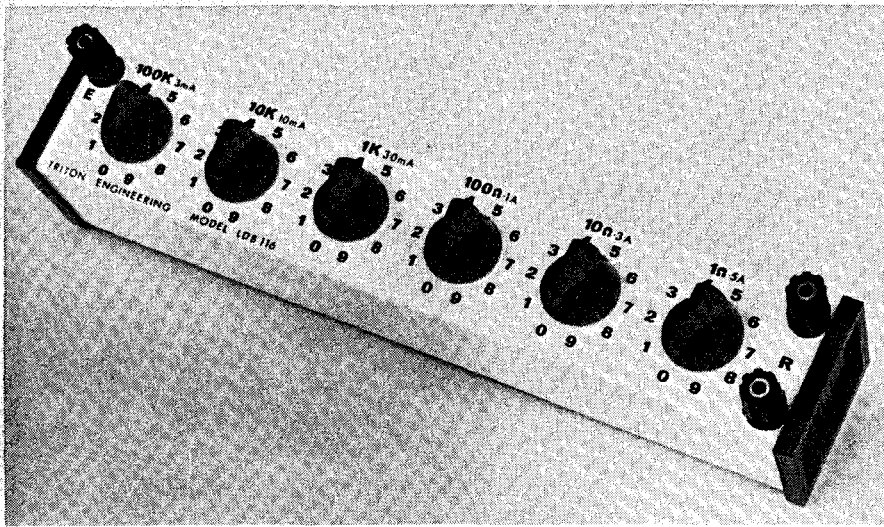
The broad band design of the transceiver also allows additional channels to be fitted, it is claimed, without the need to add coils or align the equipment; only additional crystals are required.

Aerial matching is obtained with an internal or external aerial tuning unit and the solid state linear power amplifier is fully protected against accidental open circuit or short circuit conditions.

Applications for the TRA 7928 transceiver are in the mobile and marine communications field and for base and point to point operation the transceiver can be used with an optional power supply from standard mains supply.

Further details:- Marine and Mobile Division, Racal Electronics Pty. Ltd., 47 Talavera Road, North Ryde, N.S.W. 2113.

LOW COST DECADE RESISTANCE BOX



An Australian-made decade resistance box from Triton Engineering is now available. The unit has six decades and is adjustable from 1 ohm to 1 megohm in 1 ohm steps.

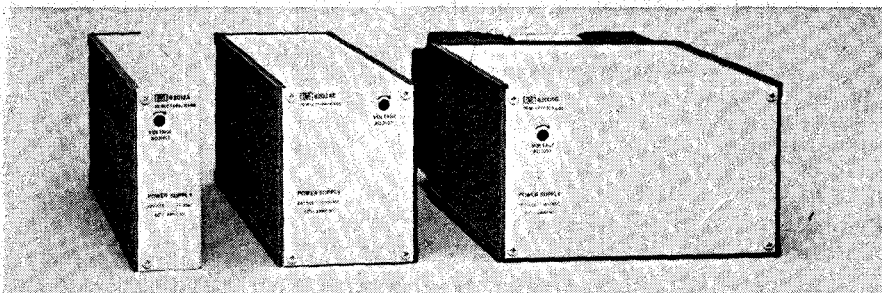
Accuracy is claimed to be $\pm 5\%$ from 1 ohm to 9 ohms, and $\pm 1\%$ from 10 ohms to 900k ohms maximum loading is 1 watt at

20°C for step.

The unit is specially suitable for use in schools, industry, laboratories and the serious amateur.

Further details from DC Electronics Pty. Ltd., 32 Smith St., Collingwood, Victoria. 3066.

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A family of forty-four new modular power supplies is the start of a new line by Hewlett-Packard. Output voltage ratings are from 3 to 48 volts. For each voltage rating, four current ratings are available. For example, at 5 volts, there are 2.0, 4.0, 8.0 and 16.0 ampere supplies available. Output voltage adjustment range is ± 0.5 V dc or $\pm 5\%$, whichever is greater. All units deliver

full rated output to 50°C, with derating to 71°C.

Packaged in three case sizes, these power supplies can be used alone in "buried" OEM applications, or combined with others in a system. Various combinations of the 1/8, 1/4 and 1/2 rack cases can be mounted in an accessory rack mounting tray.

These series-regulated, fixed voltage

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Not at all. Prices in these areas are for the "Joneses" with whom we feel we have to keep up. But you can not only keep up with the Joneses — you can surpass them with a pair of Celestion Ditton 25 speakers under \$500.

Pleasant surprise?

But an even more pleasing factor than the price is the performance! Celestion Ditton will produce all musical frequencies with the utmost realism. Five drive units cover the range from 20Hz to 40kHz.

Electronics Australia said: "One of the most stringent specifications on any speaker regardless of price. Probably one of the finest loudspeakers ever introduced to the Australian market".

The design utilises the highly successful Auxiliary Bass Radiator to extend the low frequency response so that even organ pedal notes etc., are reproduced with superb realism.

The ultra-wide bandwidth and smooth response ensures truest reproduction of all types of orchestral and vocal sounds.



Technically: Size 32" x 14" x 11"
Overall Frequency response: 20Hz to 40kHz
Power handling capacity: 25 watts RMS, 50 watts peak.
Impedance: 4-8 ohms
Drive units: 12" Auxiliary Bass Radiator, 12" long throw bass speaker, 2 pressure type mid and high frequency units, 1 pressure type ultra high frequency unit.

Write for reviews on Celestion Ditton 25, and Ditton 10 Mk11 (under \$140 pr.), Ditton 15 (under \$240 pr.), Ditton 120 (under \$180 pr.), or hear them at specialist Interdyn agents:

N.S.W.: Encel Electronics Pty. Ltd. 260 Elizabeth St., Sydney. Tel. 212 3722.
Q'LD.: Stereo Supplies, 100 Turbot St. Brisbane, 4000.
S.A.: Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide.
TAS.: Audio Services, 72 Wilson St., Burnie.
VIC.: Encel Electronics Pty. Ltd., 431 Bridge Road, Richmond. Tel. 42 3762.

SOLE AUSTRALIAN DISTRIBUTORS:

INTERDYN

To: International Dynamics (Agencies) Pty. Ltd.
P.O. Box 205 Cheltenham. Vic. 3192.

Please send information on Celestion speaker.

NAME

ADDRESS

EQUIPMENT NEWS

supplies are claimed to provide low ripple dc output with 0.01% line and load regulation. Ripple and noise is less than 1 mV RMS and less than 3 mV peak-to-peak (dc to 20 MHz).

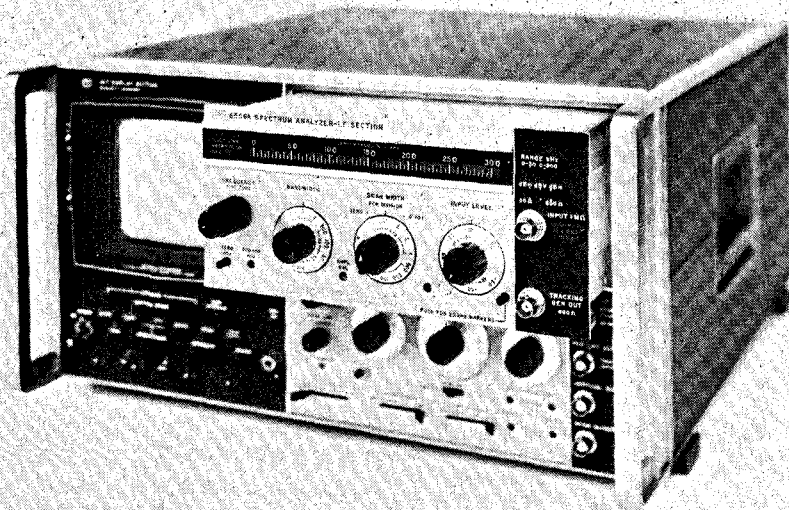
Remote sensing is standard and separate sensing terminals are provided. Built-in protection prevents excessive voltages to critical loads, should a remote sense terminal be accidentally disconnected. Reverse voltage protection is also built-in. Adjustable cut-back-current limiting, another feature, limits current to less than

10% of the rated output, should the power supply output be shorted. A built-in thermostat opens the fused ac line automatically if the supply overheats from high ambient temperatures.

Overvoltage protection (an internal crowbar) is available as an option. Crowbar operation occurs in less than 10 microseconds, the trip voltage is adjustable.

Further details:— Hewlett Packard Australia Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria, 3146.

AUDIO SPECTRUM ANALYZER WITH BUILT-IN TRACKING GENERATOR



Hewlett Packard's latest spectrum analyzer system includes a CRT-equipped mainframe, plug-in IF sections, and plug-in swept tuning sections each covering several octaves of spectrum. A new audio tuning section, the 8556A, which scans over the 20Hz to 360kHz range, extends spectrum analyzer capability for fast, accurate characterization of signals to a wide range of low-frequency systems and devices — audio amplifiers to baseband communication equipment.

The spectrum analyzer is a superheterodyne receiver with a swept CRT display and is claimed to have absolute amplitude calibration, distortion-free 70dB display range, and high sensitivity (20 nanovolts into 50 ohms). As the spectrum analyzer sweeps across the selected range, it displays the amplitude of detected signals as a function of frequency. Resolution is claimed to be so high that the analyzer can resolve power-line-related sidebands 60 dB down from a CW signal.

In addition to its low-frequency analyzer capability, the new audio tuning section contains a built-in tracking generator. As the analyzer scans, a high-level signal that precisely tracks the analyzer tuning frequency is generated. Frequency response of external devices and networks can then be measured, by applying this leveled signal to the unknown and reading the response on the analyzer's CRT. Because the analyzer tracks the test signal, effective dynamic

measurement range is said to be greatly increased — to as much as 120 dB. Frequency of low-level signals appearing in the analyzer display also can be determined with precision by measuring tracking-generator output with a frequency counter.

Further details from Hewlett Packard Australia Pty. Ltd., 22-26 Weir St, Glen Iris, Vic. 3147.

INTERFERENCE LOCATOR

Total Electronics are importing a solid-state interference locator made by Sprague (USA).

Designated Model 600, it is a completely solid-state interference locator that is expressly designed for electric utilities, laboratories, and industries concerned with detection and location of r-f noise sources. It should prove highly effective in preventive maintenance programs because many incipient faults begin to emit detectable radio noise before actual service failure occurs.

Easy-to-operate, the Model 600 tunes from 540 kHz to 220 MHz in 6 bands. This range covers standard broadcast, shortwave, and VHF-TV spectrums.

The unit has meter indications proportional to the quasi-peak value of the interference or carrier, the manufacturer claims a sensitivity of 2 microvolts or better,

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VIC.: Encel Electronics Pty. Ltd., 431 Bridge Road,
Richmond. 3121.

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To International Dynamics (Agencies) Pty. Ltd.,
P.O. Box 205 Cheltenham, Vic. 3192.

Please send information on Rotel 210

Name

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ET8589

EQUIPMENT NEWS

for 5% meter deflection over the entire tuning range.

Rugged and compact, the instrument is readily portable. Measuring 4½" high x 16½" wide x 11" deep, it weighs but 17.5 pounds, including batteries. A detachable shoulder strap is provided for convenient

field use.

In addition to the basic instrument, a complete set of accessory items is available to facilitate use of the locator in tracing all types of interference.

Details from Total Electronics, 239 Bay St, North Brighton, Vic.

TRIMMING RESISTORS BY LASER

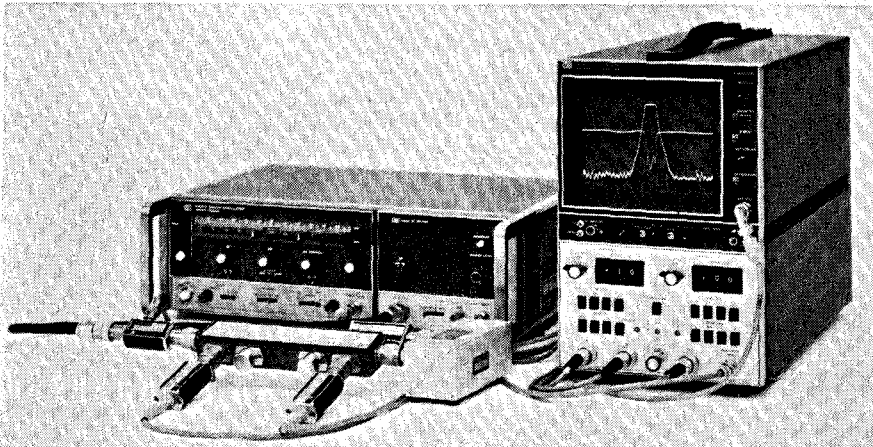


One laser resistor-trimming set-up at Motorola Inc., Semiconductor Products Division. Here, resistors on hybrid circuit substrates are trimmed to tight ohmic tolerance by a laser beam which cuts into the film resistors used. TV monitor displays hybrid circuit workpiece, while

computer/measurement system (right) monitors and controls the trimming operations.

Further details from Motorola Inc. Semi-conductor Products Division, P.O. Box 20912, Phoenix, Arizona, USA.

FREQUENCY RESPONSE TEST SYSTEM 0.1 - 18GHz



A new Swept-Frequency Response Measuring System (Hewlett-Packard 8755 series) analyses the amplitude response characteristics of unknowns over a frequency range from 100 MHz to 18 GHz. It is claimed to achieve a 60 dB display with only 10 mW of drive, which means it's fully compatible with microwave solid-state sweep generators, such as the HP 8620 series. The results are displayed on a standard oscilloscope screen. Two traces may be seen at once. Used with directional couplers or bridges, for example, the system can show insertion loss and return loss versus frequency.

The system consists of detectors, a modulator and the analyser, which is a plug-in for any of the HP 180-series oscilloscopes. Because measurement is of detected audio-rate information, three major performance advantages exist:

(a) The display is drift-free.
(b) High sensitivity (-50 dBm) is achieved.

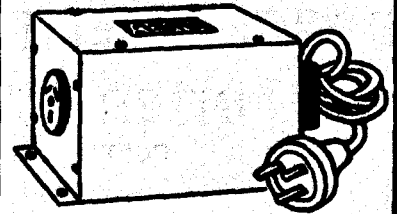
(c) Wider dynamic range is obtained than with traditional crystal detectors.

Push-button selection permits either amplitude levels or ratios to be displayed, with direct dB calibration. Stability and a flat frequency response within ± 0.5 dB, the

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* registered trade mark

Mains Filter



Aegis Range of mains filters consists of:

MF2A	240V	0.5 amps
LF1	240V	2.0 amps
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Distributors in all States. Write for technical details and prices.

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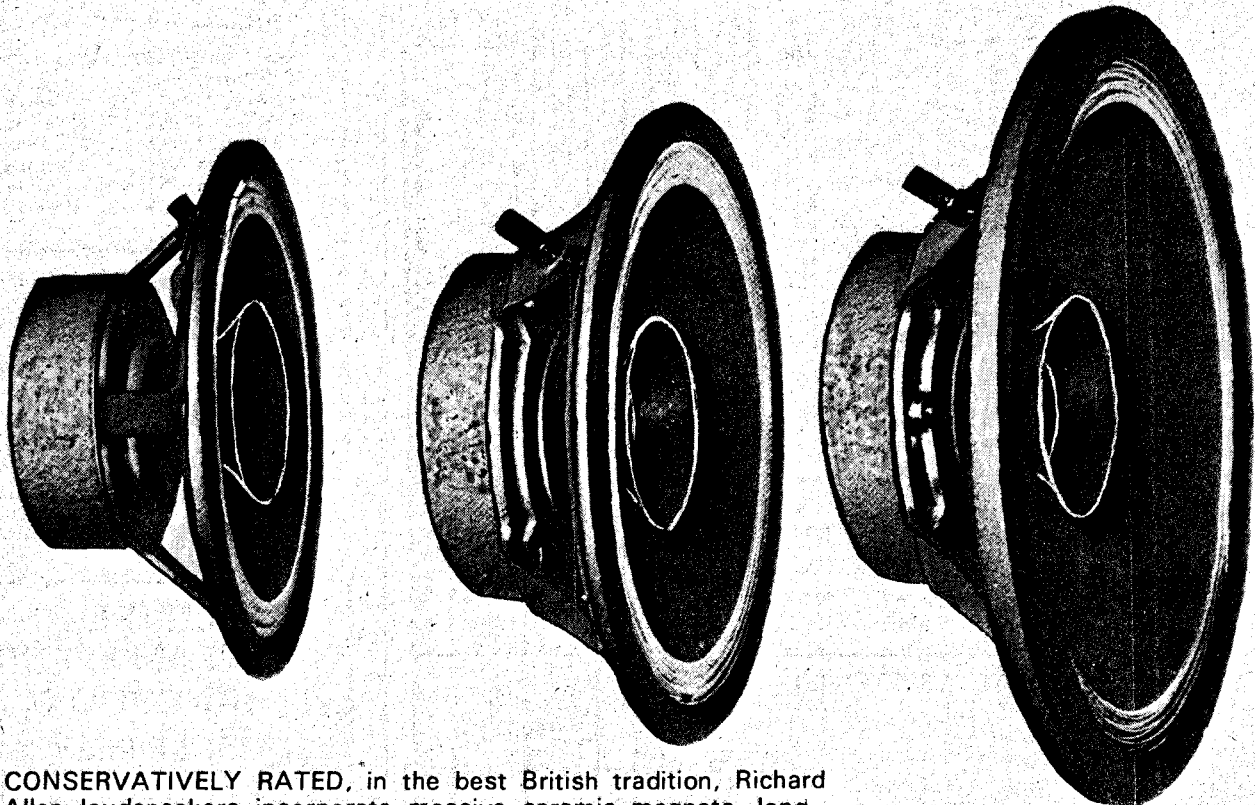
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3003.

EQUIPMENT NEWS

manufacturer states, mean that single-point level calibration with an external power meter will provide long-term absolute level measurement over the full frequency span and dynamic range.

Direct reading offset controls allow positioning of the display to a nominal zero; this feature, together with sensitivity controls calibrated in dB/div provides convenience of operation. A vernier control allows those amplitude offsets due to such factors as coupling ratios to be adjusted out. Once the system is calibrated with a through-line and short, the characteristics of the unknown can be directly read from the CRT without overlays or calibration tables. Three inputs are measured; these can be displayed individually, dually or in ratio form (single or dual).

Components of the test system are:

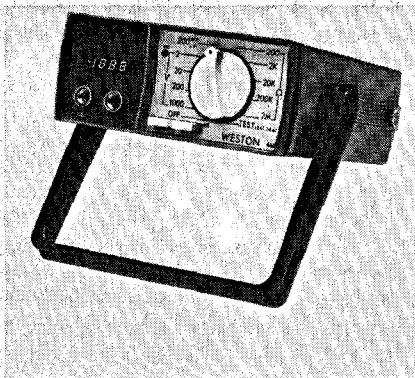
(a) 8755A Swept Amplitude Analyser Plug-In.

(b) 11665A Modulator.

(c) 11664A Detectors (three needed).

Further details:- Hewlett-Packard Australia Pty Ltd, 22-26 Weir Street, Glen Iris, 3146, Victoria.

LOW COST DIGITAL MULTIMETER



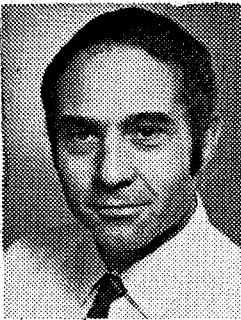
The Schlumberger/Weston Model 4440 is a 3½ digit low cost, solid state portable Digital Multimeter designed specifically for field use.

The 4440 is light weight (2.5 lbs), shock proof, and has a self contained rechargeable battery pack providing 8-12 hours continuous operation.

Facilities offered include seventeen ranges at 3½ digit resolution covering 200 mV to 1000 V ac/dc, 200 ohms to 2 Megohms, plus ac and dc current.

Special features of the model 4440 include solid state LED readouts designed specifically for the unit, a dual slope high impedance bipolar A/D converter, which it is claimed provides excellent accuracy and long term stability, a single MDS LSI plug-in chip for all of the logic circuits, auto polarity, automatic blanking of unused digits to conserve battery life and full overload protection.

Further details:- Schlumberger Instrumentation Australia Pty. Ltd., P.O. Box 138, Kew, Victoria. 3101.



ALEX ENCEL SAYS:

This month, a brief and important message for Sydney audio fans.

WE'VE MOVED OUR SYDNEY PREMISES TO 260 ELIZABETH ST CITY TEL. 212 3722

They're more accessible, they're larger, there's more room for demonstration, more room to move about, more room for a wider than ever range of the world's top components, and more room to display our own custom-built systems.

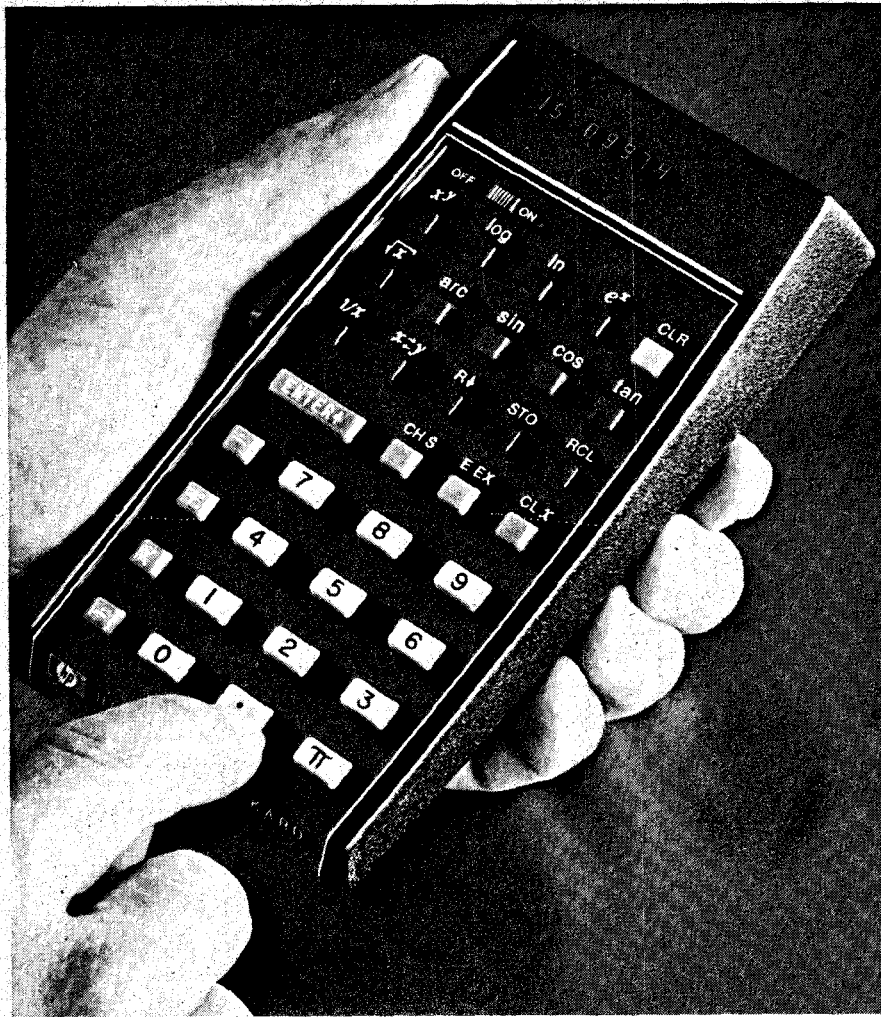
Call in and talk to Vince Ross and his team of audio specialists, and inspect our new showrooms. I believe you'll be delighted to make it your headquarters for all stereo requirements.



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431 Bridge Rd. Richmond. Vic. 3121
260 Elizabeth St. Sydney. N.S.W. 2000

POCKET ELECTRONIC CALCULATOR



A powerful new electronic pocket calculator, the HP-35, has been introduced by the Hewlett-Packard Company.

The new calculator is designed for a broad range of applications in science, engineering of all types, statistics, mathematics, education, business and finance. Customer deliveries are expected to begin in July or August of this year.

The calculator weighs only nine ounces (complete with rechargeable nickel-cadmium battery) and fits into a shirt pocket. The new battery-powered unit can be likened to

a "fast, extremely accurate electronic slide rule, with a solid-state memory similar to those used in computers", says Hewlett-Packard.

The HP-35 bears little resemblance to other pocket calculators, is said to offer many features previously found only on large desk-top machines costing several times as much.

All trigonometric and logarithmic functions, square root, addition, subtraction, multiplication and division, together with several other mathematical operations, are performed by the HP-35 in a fraction of a second. Each of these operations

This new broad-range calculator can fit into a shirt pocket.

is carried out with a single stroke of one of the unit's 35 keys.

The unit has an "operational stack" of four registers, plus a data storage register for constants. The stack holds intermediate answers, and, at the appropriate time, automatically brings them back for further use. This eliminates the need for making notes or re-entry of intermediate answers when performing chains of calculations such as sums of products or products of sums.

HANDLING CAPABILITY FROM 10⁻⁹⁹ TO 10⁹⁹

Answers appear automatically on the calculator's bright red light-emitting-diode display, which can show numbers having up to 10 digits plus two-digit exponents and appropriate signs. The HP-35 features automatic decimal point placement and automatic scientific notation for very large or very small numbers. Like larger, more expensive calculators, the HP-35, is accurate to 10 significant digits, and has the ability to handle numbers as small as 1×10^{-99} or as large as $9.999999999 \times 10^{99}$ (that's almost a 1 followed by a hundred zeros).

The size (approximately 3" x 6" x 1"), convenience and power of this calculator should change present patterns of calculator usage. With the HP-35, intricate calculations that are currently handled only with larger calculators in the laboratory or office will now be performed on the spot, in the field, in meetings, at home or whilst travelling, state Hewlett-Packard.

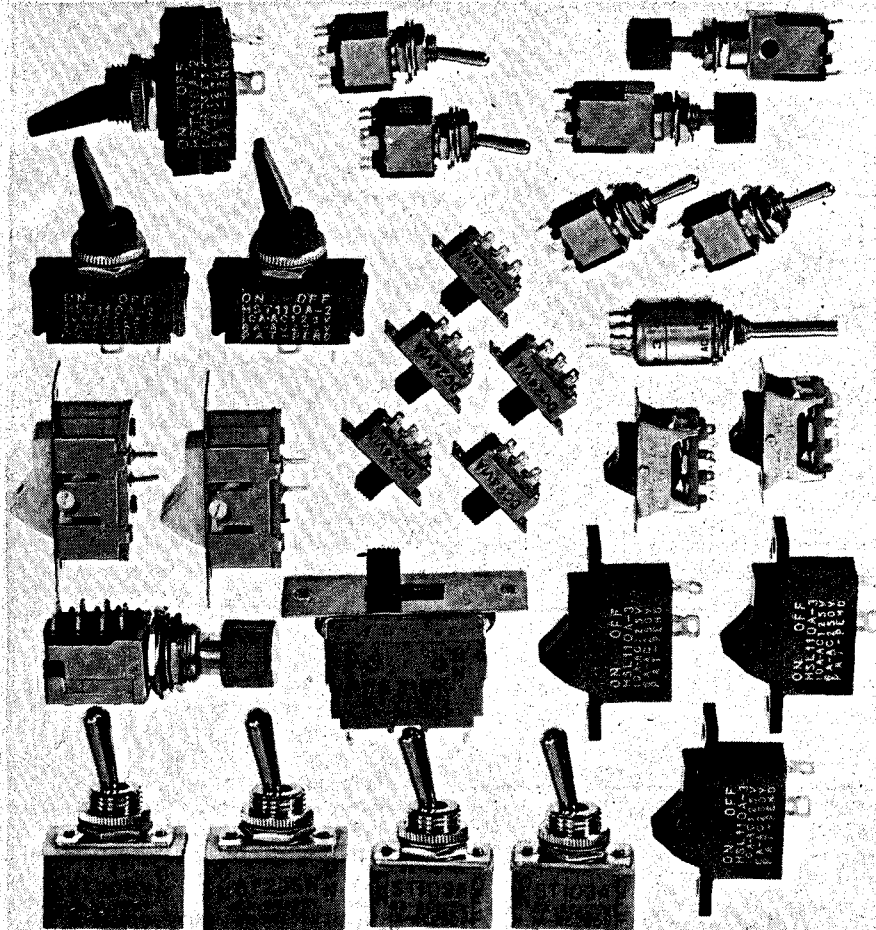
LARGE-SCALE INTEGRATED CIRCUITS (LSI)

The HP-35 has especially designed MOS/LSI (Metal-Oxide-Semiconductor/Large-Scale Integration) circuits using a new low-power, high-performance ion-implant process. These circuits are believed to be the largest presently in volume production in the world. Each is equivalent to 6,000 transistors — a total of 30,000.

The new calculator comes with a sturdy travel case, a soft leather personal carrying case, a battery pack, an AC adaptor and battery recharger, foil name tags and an instruction manual. Additional battery packs are available as optional accessories. The calculator carries a 12-month warranty. ●

COMPONENT NEWS

LOW COST SWITCHES — PROTOTYPE PACK



WARBURTON FRANKI recently announced the release of a Special Offer, "prototype pack" of FUJISOKU Switches.

The "prototype pack" represents a novel approach to enable switch users to evaluate some of the more popular switches to ascertain for themselves the many benefits offered, and in particular, the high reliability of this extensive range of low-cost, FUJISOKU Switches.

FUJISOKU is claimed to be the largest manufacturer of switches in Japan and as a result of many years experience, they have developed considerable expertise in switch manufacturing.

All popular switches are stocked in Australia, with production quantities available on short delivery. Special switches are available on request.

Further details from Warburton Franki, Adelaide, Brisbane, Hobart, Perth, Melbourne and Sydney.

NEW COMPONENTS FROM STC

- Australian made TRIAC type TC1101 in T08 case has rating of 400V and 10A.
- Silicon controlled rectifiers type TS1201 to TS1205 are rated at 1.6A RMS and have voltage rating from 50 to 500 volts.
- Silicon controlled rectifiers type TS1216 to TS1220 in T066 case are rated at 10 amps RMS and 50 to 500 volts.
- STC now have available Australian made unijunction transistors type 2N2646 and 2N2647.
- A thin-film video amplifier type 131 BCR has high input impedance ($>15k\Omega$) and low output impedance ($<100m\Omega$). The device operates with supply voltages of +8.5 and -4.5 volts and has a frequency response within $\pm 0.1dB$ to 5MHz, typically -3dB at 28MHz.
- Silicon capacitance diodes type BA163, BA243 and BA244, have capacitance values

from 2 picofarad to a maximum of 260 picofarad.

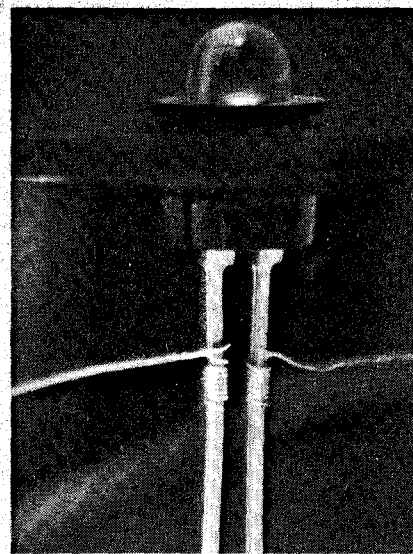
- Medium current silicon rectifiers types 1N4719 to 1N4725 are rated at 3 amps RMS and voltage ratings from 50 to 1000 volts.

- The STC DIAC type 413 is a silicon-planar, bidirectional, three-layer trigger diode. It has symmetrical switching characteristics and is suitable for firing TRIACs and SCRs. The device is available in three different break-over voltage ranges.

- A 1200 amp RMS ac switch is available, types 1100/801 W/AC to 1100/250 W/AC which are water cooled back-to-back SCR devices rated at from 800 to 2500 volts. The devices are suitable for furnace and motor control too, high voltage switch and resistance welding units.

Further details:— Standard Telephones & Cables Pty. Ltd., 252 Botany Rd., Alexandria, NSW.

SOLID STATE LAMPS FOR WIRE-WRAP ASSEMBLY



Hewlett-Packard Australia has announced the release of a new series of solid state lamps.

With 0.7 inch long, 25 mil by 25 mil cross-section leads, they can be wire-wrapped with Gardner-Denver Models 14R2, 14XL1, 14XA2 or equivalent. They can be panel or printed circuit mounted and the leads wire-wrapped directly without using a socket. Stiff leads are on 0.1 inch centres. A simple snap-in clip is available for panel mounting.

The 5082-4880 series is available in three light levels, each with three different lenses.

Light levels available are 0.5, 1.0 and 1.6. The lamps rated at 1.6 millicandelas are the highest brightness in this size offered by the industry, claim the manufacturers.

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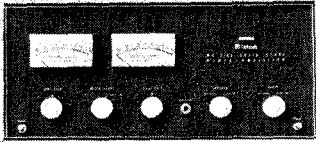
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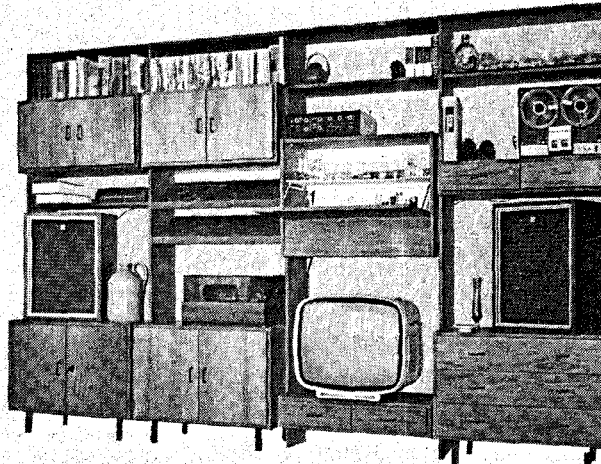
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NEWS

Uniformity of brightness makes them ideal for applications where a large number of lamps in a display are required to be lit at one time.

Lenses available are red diffused, clear diffused and clear. The lamps have high visibility over a wide viewing area.

The 5082-4880 series are said to be compatible with most integrated circuits without additional drive components, and are ruggedly constructed, making them suitable for use where shock, vibration and repeated switching are encountered by equipment.

Further details from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Victoria, 3146.

COMPACT, LOW POWER LED DISPLAY

The latest addition to the range of over 50 Hewlett-Packard optoelectronic devices is the Model 5082-7405 five-digit display.

Designed specifically for applications where space and available power is limited, the 5082-7405 is claimed to require only 7 milliwatts per digit. Luminous efficiency is increased through the use of an integral moulded lens, and this unique self-magnifier enlarges each digit of the display cluster to a height of 0.112 inches (2.84 mm). The width of the five-digit cluster is 0.75 inches (19.5 mm).

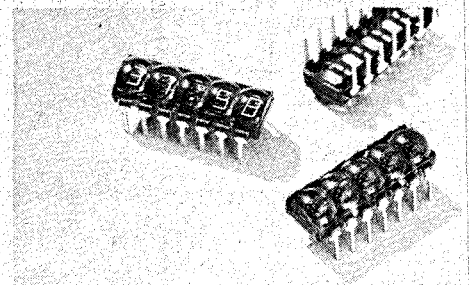
The low power requirement, compact size and low cost are said to make the 5082-7405 ideal for use in instruments such as battery powered multimeters, probes and miniature calculators. The inherent ruggedness and reliability of monolithic solid-state devices make them especially suited for portable, hand-held devices subject to rough handling.

The 5082-7405 package is a standard 14-pin dual-in-line (DIP) form, consisting of the plastic encapsulated lead frame with the integral moulded lens. It is designed to plug into DIP sockets or to be soldered into printed circuit boards. The shoulders of the lead frame pins are intentionally raised above the bottom of the package to allow tilt mounting of up to 20 degrees from the printed circuit board.

The display also includes a decimal point centered inside the lower half of the digit. One digit is thus dedicated to the decimal point, resulting in excellent decimal legibility. This feature is also compatible with calculator printers where one character position is used for the decimal point.

A red dye incorporated in the plastic filters out all visible light except the 655 nanometre wavelength emitted by the diode, thus assuring good contrast. In addition, portions of the lead frame are darkened to reduce reflections.

Further details from Hewlett-Packard Australia Pty. Ltd., 22-26 Weir St., Glen Iris, Victoria 3146.

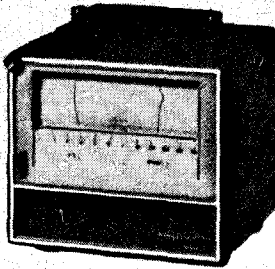


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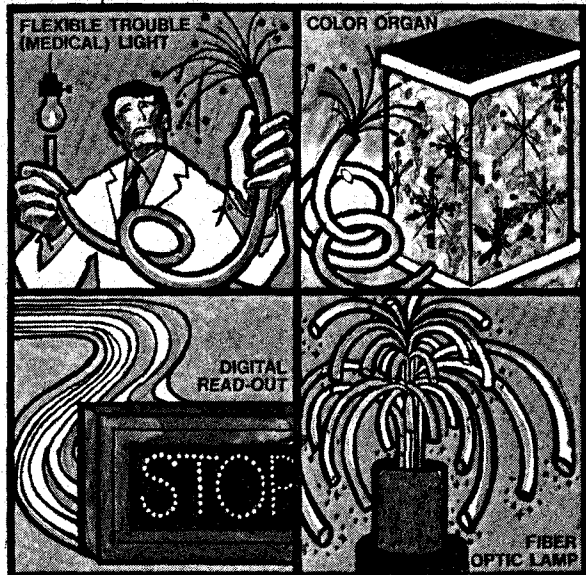
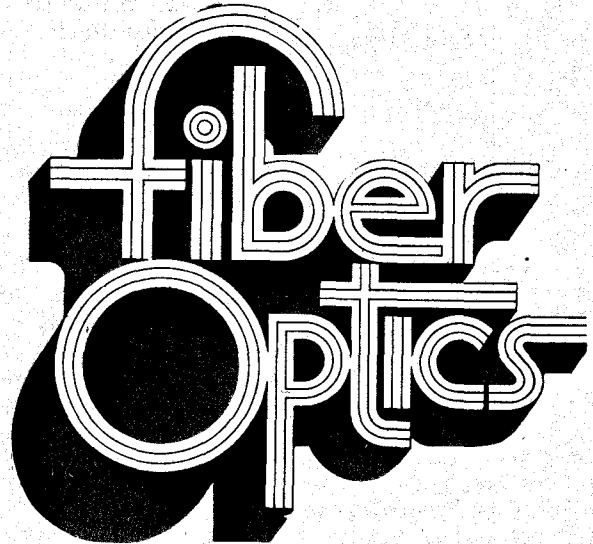
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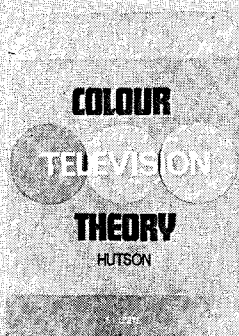
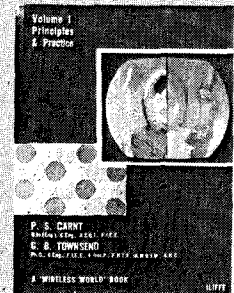


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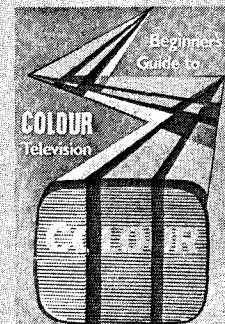


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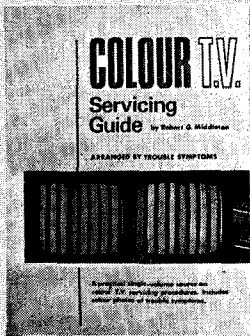
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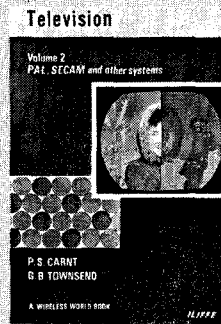
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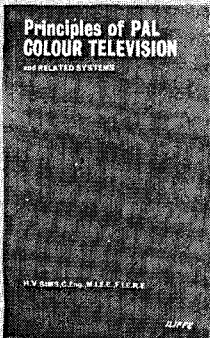
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COLOUR TELEVISION — Vol II Pal, Secam and Others — By Carnt and Townsend — 276 Pages — \$16.10. CONTENTS: N.T.S.C. system — revised, PAL System and Equipment, Comb filter, Secam Equipment, ART, NIR and other Systems, Dot Structure and Cross Colour.



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PRINCIPLES OF PAL COLOUR TELEVISION AND RELATED SYSTEMS — By: H.V. Sims, C. Eng., M.I.E.E., R.I.E.R.E. CONTENTS: Development of Colour Television; The NTSC System; Phase Distortion; The PAL System; Some Inherent Deficiencies; PAL Decoders; The SECAM System; Comparison of the Systems; Bibliography. PLUS: A Flying spot colour television transparency scanner and examples of the effects of phase distortion in the PAL system. PRICE: \$6.30.

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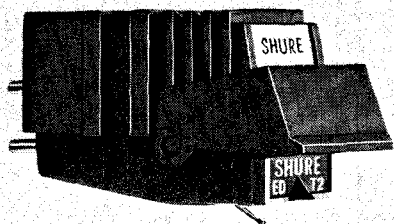
AUDIO NEWS



SONAB PROMOTION

The Australian Sonab organisation are currently arranging a series of in-store demonstrations promoting the range of Sonab omni-directional speaker systems and associated equipment.

The first promotion of this type was run very successfully by Sonab's Jackie Pugh at Photo Hi Fi in Sydney during March.



NEW SHURE CARTRIDGE

A new high trackability cartridge from Shure is said to offer performance second only to the company's V-15 Mk 11 (improved) unit but at a substantially lower price.

The new unit has a low-mass stylus assembly and a biradial elliptical stylus, and is claimed to be ideally suitable for encoded (matrix) four-channel stereo systems.

FOUR-CHANNEL DISCS

As reported last month the EMI group are the latest of 15 companies now producing the CBS SQ four-channel matrixed records.

Now the competing and non-compatible Japanese Victor CD-4 system has been adopted by the Philips group who produce records under labels such as Mercury and Deutsche Grammophon.

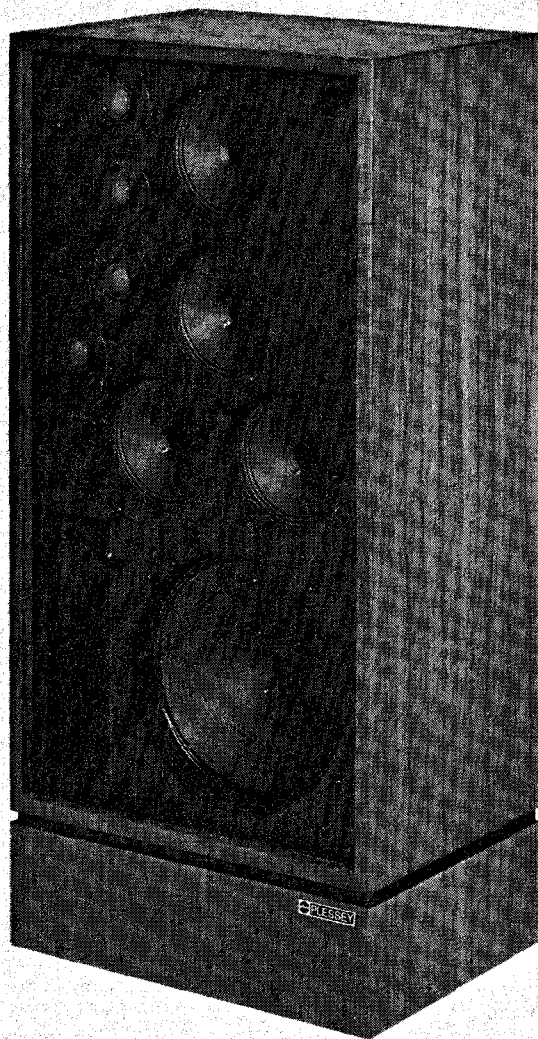
PLESSEY SPEAKERS IN USA

Amongst five Plessey Rola speakers exhibited at the recent IEEE (Institute of Electrical and Electronic Engineers) in New York was the four cubic foot, nine speaker enclosure shown above right.

The new unit - designated the 'Plessey Sigma', has a total power handling capability exceeding 50 Watts rms.

All five enclosures feature wool grille cloths which have the advantage of being available in a very wide range of colours and designs. This makes it possible to match speaker enclosures with other furnishing fabrics used in the home.

As an added bonus, tests conducted at the Plessey Rola Audio



Laboratories in Melbourne indicate that many of these woollen fabrics have superior acoustic qualities compared with the more conventional grille cloths used in earlier enclosures.

IREE AUDIO GROUP

The Sydney Division of the Institution of Radio and Electronic Engineers Australia has formed a study group known as IREE Audio Group - Sydney Chapter.

The objects for which the group is established are:

(1) to promote the science and good practice of audio engineering and to facilitate the exchange of information and ideas in relation to this subject;

(2) arrange and hold meetings and demonstrations for the reading and discussion of papers and equipment;

(3) to render all necessary assistance to the Standards Association of Australia in defining proper standards of performance and measurement;

(4) cause to be disseminated for the public benefit, printed or other information designed to stimulate and encourage interest in the appreciation of audio engineering and new developments in this field.

Ordinary membership of the group will be available to persons who have an interest in acoustics, the production, recording, reproduction and reinforcement of sound and such other fields as are directly contributory to or derived from them.

SANSUI COMPETITION

An unusual and exciting competition is currently being organised by Simon Gray Pty Ltd, Australian distributors of Sansui hi-fi equipment, in conjunction with our sister publication Modern Motor.

The competition involves assessing the performance of the Bob Holden-driven Sansui-Ford Escort sports racing car during a series of touring car races to be held in May, June and July of this year.

Prizes are substantial and include four-channel equipment. Numerous other prizes will be won by runners-up.

Entry forms, full details and form guides will be included in the June issue of Modern Motor — on sale April 25.

Details and entry forms will also be included in the June issue of **ELECTRONICS TODAY INTERNATIONAL** — on sale May 16. However, as our publication date is fairly close to the date of the first race, intending entrants are strongly advised to obtain the June Modern Motor to ensure that their entry arrives in good time.

The promoters specifically state that actual knowledge of motor racing is not required.

NEW CASSETTES

Four new blank cassettes for tape recorders have been introduced by Mallory Batteries (Australasia) Pty Ltd, each designed for a specific segment of the cassette market — audiophile, office dictating, the youth and broad consumer market.

For the audiophile, the company is offering its Professional Duratape — a new sophisticated 'cobalt energised' tape claimed to be capable of studio-quality recording and sound reproduction.

The other three tapes, are Executape for the office dictating group; Fliptape, moderately-priced and for the youth market, the largest segment in the cassette field; and Duratape, for the broad consumer market. Duratape has an exclusive built-in head cleaner that automatically cleans cassette recorders before recording or playback.

The new tapes will be available late March 1972, and will be distributed nationally through existing channels.

STOP PRESS

NEW CASSETTE TAPES

Latest news on cassette tapes is that Philips, originators of the tape cassette system, will shortly bring out a new line of chromium dioxide tapes.

Japan's TDK organisation will also shortly announce the C-180 (90 minutes playing time per side) cassette, together with an even higher-performance version of the already very excellent Super Dynamic high-density iron oxide tape. It is also believed — but not confirmed — that TDK will soon market their own chromium dioxide tapes.

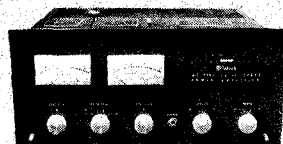
MATRIX PATENT

In the USA a patent has been issued to Peter Scheiber of Audiodata Co. covering encoding and decoding matrix systems for four-channel recording and reproduction. Scheiber and Electro-voice had previously agreed to pool developments from both firms.

It is believed that the patent is basic and may cover all current and future matrixing systems.

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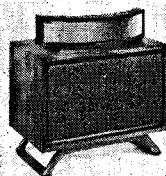
MODEL C26 PRE-AMP

MODEL MC2105 POWER AMP

In January, **ELECTRONICS TODAY** reviewed the "Mac" pair, C26 Preamplifier and McIntosh 2105 Power Amplifier (210 watts RMS. Total.) Here are highlights from the review. "At rated output of 105 watts per channel the frequency response was flat from 20Hz to 20kHz \pm 0.1dB. With such a high output rating we were surprised when after two hours operation with one channel operating at 105 (RMS) Watts and one at 250 watts (that's right — 250 watts), the temperature rise did not exceed 80°F above a 70°F room temperature on the overloaded channel heatsinks... The total harmonic distortion was particularly low... The McIntosh is the best amplifier we have ever tested."

The C26 will control any good amplifier, \$550.80. The MC2105 Power Amp can be driven by any good amplifier modified by Convoy, \$1076.

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Spin-flip laser measures air's dirt

By Dr. John Lenihan, Director,
Department of Clinical Physics and Bio-Engineering,
Western Regional Hospital Engineering Board, Glasgow, Scotland.

Over much of the modern world the greatest threat to the future of mankind is not war, disease or famine. It is pollution — the destruction of the environment through careless use of technology. In the face of pollution, modern man is the Sorcerer's Apprentice, unable to hold back the disaster that he has made by playing about in his master's laboratory.

Some forms of pollution are obvious enough — stinking rivers, poisoned lakes and filthy beaches — and a few cities already have a perpetual blanket of smog, a mixture of smoke, fog and poisonous industrial fumes.

These are examples of pollution that has gone too far; but there are other dangers which may, in the long run, be just as serious, though at present we know little or nothing about them. In particular, the atmosphere is being continually polluted by aircraft vapour trails, rocket and missile exhaust and a witches' brew of assorted gases resulting from the progress of technology.

ATMOSPHERIC UMBRELLA

Many scientists fear that permanent harm has already been done by changing the composition of the atmosphere. It is not always realised that the air above us has a vital rôle in letting through the useful parts of the sun's radiation and holding back the dangerous parts.

By tampering with the make-up of

the atmosphere we could produce a steady cooling of the earth; there is some evidence that this has already begun and that another Ice Age may be on the way.

SIMPLE QUESTION

It begins with a question: why is the sky blue? This simple problem was first answered about a century ago by the English physicists, Tyndall and Rayleigh. They showed that the light of the sky is sunlight which has been scattered by molecules of air or microscopic dust particles. The scattering is greater for light of short wavelength (that means blue colour) than for other parts of the spectrum. The sun's yellow colour is simply the result of removal of blue light; seen from the airless moon, the sun is a brilliant white.

The blue sky was a familiar sight to Chandrasekhara Raman when he was a student in Madras nearly 70 years ago; when, after ten years as a civil servant, he became professor of physics in Calcutta, the scattering of light by air and water was his main research interest.

The Raman effect, which he discovered in 1928, brought instant fame — a knighthood in 1929 and a Nobel prize in the following year — but was for a long time a scientific curiosity of no obvious value in the world outside the laboratory.

But now the Raman effect is being used in experiments which may lead to

important new techniques for the measurement and control of atmospheric pollution.

INFRA-RED SOURCE DIFFICULTY

A good way of analysing a transparent sample, such as a liquid is to send a beam of light through it and measure the intensity of the light which comes out at the other side. Ultra-violet and visible light are often used in this technique; for many purposes, infra-red light would be much better, but until now there has been no suitable source.

The difficulty is that there is no really sensitive detector for infra-red radiation. This would not matter much if the analyst could find a powerful source for his experiment.

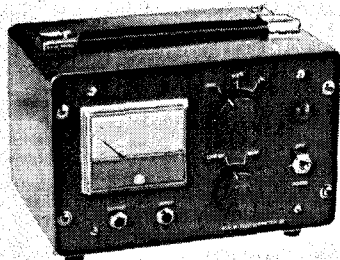
Any hot body emits infra-red radiation but with a great mixture of wavelengths. White light contains a range of wavelengths which can be split into red, blue, green and all the other colours of the rainbow, allowing the chemist to choose whatever wavelength he wants for his experiments.

A simple infra-red source can be treated in the same way — but unfortunately the intensity remaining at any particular wavelength is not enough for the analyst. This is the problem that has now been solved.

The Raman effect is simple. When an intense beam of light is focused on a liquid or transparent solid, most of it goes straight through but a small percentage is scattered sideways, and this light is of a different wavelength to the original beam. The reason for the change is that molecules in the sample have absorbed energy from the light beam; removal of energy in this way means an increase in wavelengths.

IMPURITIES IDENTIFIED

The chemist learns a lot from this experiment because the change in wavelength is characteristic of the molecule concerned; by analysing the scattered light he can identify impurities in the sample, even at very



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low concentrations.

For the study of atmospheric pollution, a strong source of infra-red radiation is needed. The analyst would like also to be able to tune it to different wavelengths — something that has never been possible until now.

The particular form of Raman effect used in the Edinburgh experiments (by Professor S. D. Smith and colleagues at Heriot-Watt University) involves an unusual process graphically named spin-flip. The electrons which congregate in the outer part of every atom and molecule appear to be spinning like tops. For this reason each electron acts as a tiny compass needle.

If a sample of material is put between the poles of a magnet, most of the electrons line up in the direction of the magnetic field; if they are given a kick they can be turned over and will then go on spinning happily in the reverse direction. This process is the spin-flip.

ONE STAGE FURTHER

The Raman effect supplies the kick — and reveals itself by the change in wavelength of the scattered radiation. The Edinburgh team (and, simultaneously, another group at the Bell Telephone Laboratories in the United States of America) have gone a stage further.

The energy required for the spin-flip depends on the strength of the magnetic field — just as an inside-out umbrella is more easily restored in a light wind than a gale.

The wavelength of the scattered radiation depends on the energy removed from the original light-beam in flipping the electrons. So if the magnetic field (which fixed the spin-flip energy) is varied, the wavelength of the scattered light can be varied also.

In the Edinburgh experiment, a powerful laser gives a beam of infra-red light which falls on a small block of indium antimonide held between the poles of a powerful magnet. The scattered radiation is on an infra-red beam and its wavelength can be altered simply by changing the current driving the electromagnet.

UNPRECEDENTED SENSITIVITY

With this new tool it will be possible to detect and monitor most of the common atmospheric pollutants with a sensitivity never previously available; even substances likely to be used in chemical and biological warfare will alert the electronic eye before they reach dangerous levels.

The research is still at an early stage of development but the infra-red spin-flip laser is a heartening sign that science can do something about the pollution that it helps to create. ●

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REVIEWER, John Araneta.



SCRIABIN - Piano Sonatas Nos. 4-10. Roberto Szidon (piano) 2-DGG 2707 053.

This year being the centenary of Scriabin's birth, we have already had one complete recording of the Sonatas, a rather apathetic and non-magical performance from HMV. DGG assures us that Szidon will in fact be recording the sonatas complete, so that we shall soon have at least two complete sets to choose from and I doubt very much whether this set will be the last one to be put before the recording public. Well, yes, this performance is certainly to be preferred to Ogdon's. Szidon evidently sounds like he should be fond of these works. These are very acceptable performances, but they are hardly what DGG bills them to be: "The foremost exponents of Scriabin, Horowitz, Rubinstein, and above all Sviatoslav Richter, have now been joined by Roberto Szidon." Rubbish. Scriabin not only needs almost superhuman varieties of shade (which this performance really does not have) but also an almost neurotic nervousness to produce something like what the Romans liked to call "incantatio." The player's command of the resources of the pedal must be nothing short of magnificent. Szidon is, as yet, no Horowitz, or Richter, nor even a Rubinstein in this music. All one has to do is put on Horowitz's recording of the ninth sonata and the first few chords should be enough to convince one that Szidon is not in the same class. Far from it. There is no diablerie here, only plush. Perhaps some recording company should engage the services of Moravec for another complete recording. Of course, there is always some slim hope that CBS will prevail upon Horowitz to record these sonatas. That would be something indeed. Meantime I would advise the prospective buyer to wait a bit.

DGG's album format is evidently designed for the occult inclined listener, with special billing for the "WHITE" and "BLACK" Mass Sonatas. And I have seldom seen a finer collection of pretentious claptrap for notes, including some of Scriabin's own

rubbish: sample - "I will be the longing of all for the bliss of supreme fulfillment." Scriabin's own reflections on the occult and art are an unbelievable fluttering and plucking of this metaphysical bit, and that for a remarkable garbage of dilettante posturing. The sort of chatter that turned away a great number from any objective appraisal of his music. We, however, live in a day when this sort of nonsense might just help Scriabin along and DGG is doubtless economically wise to play with it. No, I must finally also admit that this is not the music I take to. I always feel, despite the remarkable harmonic novelties and the tremendous expansion of pianistic technique, that Scriabin simply never learned the virtue of economy, a word, by the way, that I do not necessarily associate with austerity or sobriety. Chopin, Debussy, even Liszt did it far better and with more discipline. Still, I can feel the music deserves reappraisal. It can be interesting, or at the very least, hypnotic and image conjuring. And it deserves much more than this good performance. - J.A.A.

PAGANINI - VIOLIN CONCERTO NO. 3. Henryk Szeryng, London Symphony, Alexander Gibson (cond.) PHILIPS 6500175.

Another work the world would have been better without?

If this Paganini concerto had been as readily accessible as the numerous bad Liszt we are subjected to, there would perhaps be less to do about this trivia. And not very good trivia this is. There must be other more worthy violin concertos worth recording. A new recording of the Bruch Second?

But I may be wrong.

Paganini's first two concertos are always popular and they are as wretched as this one. Now that Henryk Szeryng has been allowed the premiere and first recording of this work we have five Paganini concertos readily available on record. Why have sales of this record already been so good? Is it the romantic aura surrounding its having been kept captive, as it were, by the composer's descendants? I am more inclined to believe Paganini's astute spirit is still very much around after a hundred and thirty one years.

That Paganini was perhaps the very greatest violinist the world has heard, and an equally remarkable innovator of the techniques of his instrument, the difficulties of this concerto and the standard of this performance make obvious. Pizzicato et arco runs, high double notes, whatever you like, Paganini's innovations are in this concerto, and perhaps this record is valuable for the document. The fact that we are used to later violin concertos that have utilized Paganini's innovations hardly convinces me that these innovations can never again sound astonishing to us in his own works. But

performance of those works must be necessarily extraordinary. Szeryng plays very well, but as with most violinists who have played or recorded Paganini there is ever the faulty intonation, the feeling that this or that run could have been negotiated with greater ease. We know Paganini was often indifferent about his interpretations but his tone was always true no matter what passage was played.

One must be taken by surprise at the virtuosity with which this work might be played, precisely because significant musical content is notably absent. It is not enough to sound good most of the time. One must astound. Szeryng here is most successful in lyrical passages, although I feel he takes things too seriously. Technique in a concerto like this is the main thing. It is a mystery to me why a violinist like Heifetz has never recorded more Paganini. His approach may be cool compared to Szeryng's but of his technique there can be no question. To hear him play two of the caprices on RCA LM-2382 is perhaps to experience what audiences must have felt when they heard Paganini. The two bands on that record are quite enough to convince me of the uniqueness of Paganini's achievement. We must wait for a more virtuosic performance of this concerto. For those who will disagree let me say that Gibson and the LSO second Szeryng very well and that the recording is excellent. - J.A.A.

BEETHOVEN - FIDELIO Soloists, Berlin Opera Chorus, Berlin Philharmonic, Von Karajan (cond.) HMV SLS 954/3

I was almost ready to castigate this new Fidelio as needless duplication, the more since EMI already has a notable recording in the COLUMBIA Klemperer set. Having also heard Karajan's only so so recording of the Fidelio overture for DGG I must admit to being hardly prepared for this. I put the first side on - no, the first two chords did not impress me, the overture was just too exciting to notice details at first hearing. One was simply caught up by Beethoven, here powerful and brooding. More important, one felt drama preparing. Drama, is in fact the key word to describe this new recording. In all other available performances, one might think at most of a dramatic cantata, powerful but static. Karajan's view here of Fidelio is above all human, heroic opera. The end of the overture did not find me waiting for each number as it came along. Dialogue, spoken by the singers, is at all times spontaneous, each word, as it were, understood and meant, quite a rare experience in Fidelio I can assure you. As for the singing in the first act, it is a joy to hear, and this is not just beautiful singing, here is first rate acting as well. For once, characters are believable.

CLASSICAL

Jaquino (Horst Laubenthal) and Marzelline (Helen Donath) are the young would-be lovers they should be. Helga Dernesch's Leonore may sound at first youthful especially when one hears Florestan (Vickers) later on. But I find the aural age gap emphasizes the romantic qualities of the opera.

In "Abscheulicher!" Dernesch does have difficulties but these are more than compensated for by its delivery and because the aria is well prepared for. We do not, then, get an, as it were, inserted grand aria, nor does Leonore sound like an accidental Wagnerian heroine. And when Rocco sings his often omitted Gold Aria, one feels not only the humour (a quality never omitted in this performance) but also that Beethoven knew this honest fellow well. Karajan is always considerate about his singers, but his orchestra is also always there bringing out the humanity of the situation. Perhaps the most notable achievement of Karajan's direction is his unflinching sense of continuity. But to listen to the way Karajan brings out nuance in his performance is to realize how so many conductors do not quite believe in Beethoven's dramatic abilities. That mysterious orchestral passage before the prisoners' chorus, to give an example of Karajan's fine direction, is unforgettable.

The end of the first act, unfortunately, takes us to the one failure in this otherwise superb performance. The nasal tone of Jon Vickers' Florestan sounds immediately out of place here. His overly dramatic delivery also sounds like maudlin. But the Berlin Philharmonic plays movingly and one's frustration is alleviated. Fortunately, Vickers does seem more natural in the Duet and thereafter. At any rate, nothing stops the enthusiasm of this performance.

There remain a few pitch problems in the final ensemble, hardly unique to this set in view of the difficult vocal writing. Nevertheless, I would not hesitate to recommend this Fidelio to all others, because it does convey why Fidelio towers over most other operas of the period, with its sense of humanity and excitement.

The libretto translation by William Mann is refreshingly straight forward. Recording is excellent. — J.A.A.

BRUCKNER — Symphony No. 3 (Nowak Version). Karl Bohm, Vienna Philharmonic DECCA SXL 6505

Listening to this record makes me realize all over again how suitable the Vienna Philharmonic is to Bruckner, and especially the tone of its horn and brass. Nor is Bohm exactly a stranger to Bruckner's music. If memory serves, his Seventh was one of the earliest Bruckner on LP, although surprisingly not much has been heard since then. The general tendencies of that recorded Seventh are also very much in evidence here.

Like Haitink and Szell, Bohm uses Bruckner's third revision of the score (1890) as edited by Nowak. This version, while one of the approved scores and usually heard

nowadays, nevertheless omits the various quotations of Tristan and Walkure in the first movement, quotations which emphasize this symphony's tribute to Wagner. Whether these excisions are really of importance I cannot really say. Unfortunately neither of the recordings (Jochum and Schuricht) which use the 1889 and second version of the score really measure up to either this or the Haitink and Szell all of which use the 1890 score. Bohm is particularly impressive in the first movement and seldom has the structure of this movement been so clearly put forward.

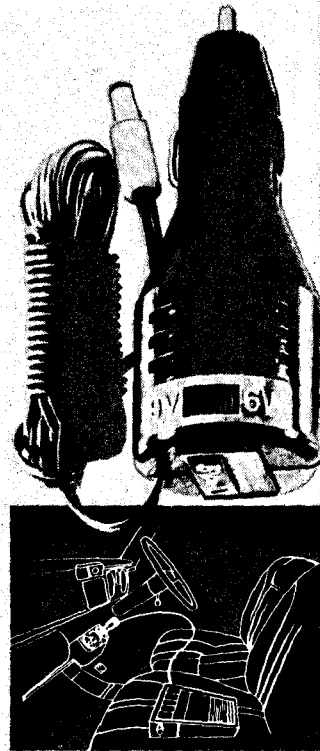
Once again it is hard to resist calling attention to the beauty of the orchestra's sound. An especially moving instance is the tranquil passage shortly before the development section. In general, Bohm's approach to this movement and the symphony as a whole is certainly more compelling than Haitink's, although there is a rather gentle quality to it all which I do not think exactly suited to this work. For instance, strong as this first movement is, there seems not enough tension, and the misterioso opening is hardly mysterious. Similarly, the second movement Adagio is much too easy going. Also, while Bohm's control in the first movement seems firm enough, he does tend to let things go here much to the detriment of the movement's continuity. Nor does the side break here help matters although in all fairness no other recording does without it.

The Scherzo has Bohm once more in firm control but one is again forced to reflect Bruckner's scherzos are seldom just naive. Bohm's fourth movement is perhaps the weakest part of his performance. Once again he leaves things a bit and everything just falls short of going to pieces. Nevertheless this is the most recommendable version of the Third available in this country, certainly preferable to either the Jochum or Haitink, and the recording here is quite fine.

For a more powerful account of this symphony, one that makes sense of the work as a whole and especially of that difficult final movement, one must look elsewhere. Some years ago while searching for a fine recorded performance of this Symphony, I remember being surprised that a Viennese friend of mine should recommend the Szell-Cleveland recording on CBS as being far and away the most impressive performance he had heard live or otherwise. That a Viennese should recommend such a combination determined me to investigate the matter. Well, that Bruckner Third is certainly one of the fine performances of Szell on record. There is not only the precision that characterizes most of the late Hungarian conductor's recordings, but Szell keeps things together and going, while at the same time conveying as much of the drama of this score as we shall ever hope to hear. A tremendous performance and the virtuosity of his Cleveland orchestra is awesome to hear. It is a performance in fact that should make people in this country who are sure American orchestras cannot do Bruckner or the classic scores beautifully, reflect anew on their bit of mythical nonsense. — J.A.A.

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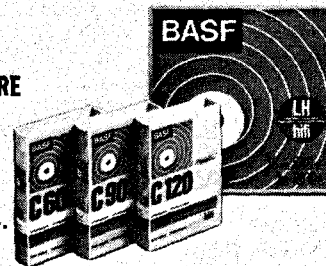
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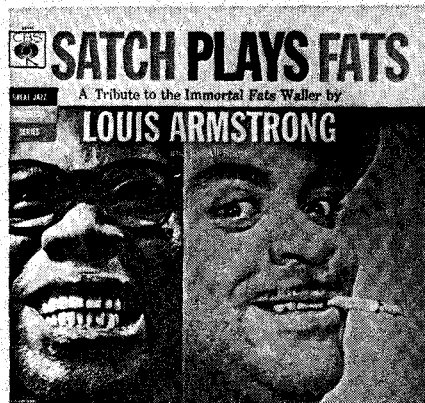
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RECORDINGS... JAZZ

REVIEWERS: John Clare
Bert Williams



LOUIS ARMSTRONG – Satch Plays Fats. French CBS 62441, Honeysuckle Rose, Squeeze Me, Keepin' Out Of Mischief Now, Blue Turning Grey Over You, I'm Crazy 'Bout My Baby, All That Meat And No Potatoes, I've Got A Feeling I'm Falling Black And Blue, Ain't Misbehavin! Trummy Young, trombone, Barney Bigard, clarinet; Billy Kyle, piano; Arvell Shaw, bass; Barrett Deems, drums; vocals by Louis and Velma Middleton.

In the fifties when I, in my teens, first began to collect jazz records, most jazz critics that I read seemed out to convince me that I had come along in a bad time. Everything good had already happened.

This was pretty confusing. I first heard the record under review about that time. Soon came Ellington at Newport 1956, then Ellington at Newport 1958 (with one of Hodges' greatest solos and the underrated piece, 'Princess Blue'). Diz Big Band had been released early in the fifties. Later we got Dizzy at Newport (which should have been called Greatness In Mad Ones). We got Miles Ahead, Porgy and Bess and Sketches Of Spain, not to mention Workin', Relaxin', Kind Of Blue and so on. Further: Louis Armstrong Plays WC Handy, Ambassador Satch, and I think that should be enough to get you thinking.

I still have all these recordings. They all stand up with the best jazz of any period, and in a couple of cases they sound fresher and more powerful than some famous earlier performances which have begun to take on a quality of fading glory. I take them out and play them quite often – so as not to allow them to sink back into some mythical and imperfectly remembered Golden Age with which I might be tempted to compare unfavourably everything contemporary, as I am sure did many of those critics who so confused my youth.

One of the culprits was a New Yorker whose fancy style hypnotised so many fellow writers into just not seeing such gems as the following:

"Since the mid-thirties, his (Louis Armstrong's) style, hampered by an

inevitable lessening of physical power, has become a mixture of his first two periods – short, simple, declamatory phrases placed end to end with uncertain, empurpling sorties into the high register."

By the time that was written – just after this recording – after a period of being overweight, Louis had actually gained in physical power. Certainly he was blowing right through the instrument more, in the modern method which he largely pioneered (a psychological thing in part: blowing right through instead of into the instrument). He rarely attempted the rapid valve work of his early days, that is true, but his use of the high register here and on the WC Handy and Ambassador Satch records is as stunning as anything any player has recorded. Some of his high notes over the final chord of a song are played a little sharp (the one on Ain't Misbehavin' is definitely off) and at times during this period – though not on this record – he would use a device which involved holding a high note, dipping an octave and then glissing up again, which was sometimes a bit sloppy, but mostly everything is smack on the button, and if your hair doesn't lift at least four times on each side of this recording I will send you a get well card. While we are on the subject: for consummate timing and beautiful tonal production in the upper register, there is nothing to surpass Armstrong's breaks on Twelfth Street Rag from Ambassador Satch.

There is a great sense of completeness to this record. I don't think that Louis has sung much better than this, and his trumpet is nearly as good as on the WC Handy album (also available in Australia through Avan Guard). It's the best I've ever heard Barrett Deems play, and Velma Middleton is alright as a foil for Satch. Trummy Young is for me, always, a complete knockout. Taste Schmast! I have to agree with the critics who said that Barney Bigard was not at his most scintillating. He sounds like some drunk quite blissfully on the point of passing out. This more than somewhat languid quality is heightened when he follows Trummy, who sounds like a draught horse charging out of its stable, kicking the door down in the process.

Although basically the accent is on the marvellous songs and the solo performances, there are a couple of quite magic ensemble moments, the best being on Ain't Misbehavin'!

Listening to Louis' rich vocal texture and superb phrasing on Blue Turning Grey, and to the great breadth of sound he gets from his trumpet once he takes out that straight tin mute he occasionally uses (and which only makes his tone thinner and more nasal), I have often thought that this was the simple but deep satisfaction one should, but rarely does get from popular music. As popular music it's up with the best of Frank Sinatra or the Beatles. As jazz it may not reach the heights of pure invention of Armstrong's earlier masterpieces, but it is just as strong and involving. – J.C.

THE WOMBAT – Roger Bell and His Pagan Pipers. When You're Smiling; Candy Lips; The Wombat; What's The Pitch; Honi Soit Qui Mallee Root; Ain't It a Shame About Mame; Dapper Dan; The Onion Bender's Lament; What Can I Say; Hindustan; It's Right Here For You; You Rascal You; Roger Bell, trumpet; Ade Monsborough, clarinet and alto saxophone; Neville Stribling, clarinet and alto sax; Rex Green, piano; Peter Cleaver, banjo; Jack Varney, guitar; Lou Silbereisen, bass; Len Barnard, drums and washboard. Swaggie S1286.

Before Eddie Condon came to Australia in 1964, Roger Bell said: "I just want to see Pee Wee's face when we play What's the Pitch". Pee Wee Russell came out with Condon and Roger and Ade Monsborough were then playing with Frank Traynor's Jazz Preachers, the band which opened Condon's Melbourne concerts. I don't know who mapped out the Frank Traynor's band programme on those two historic nights, but What's the Pitch was not one of the items played. A pity, for I too would have loved to have seen Pee Wee's face when it was played.

I've never even heard Pee Wee's record of this politely screwy piece. The version on this Swaggie reissue is the only one I know and Ade Monsborough pours out his heart on clarinet trying to get that pitch.

This record was first issued on W & G the year it was made, 1963. Max Jones reviewed it in the English magazine The Melody Maker. He found it so distinctively Australian, so redolent of the Graeme Bell's band's 1948 and 1951 tours of England, that he fully expected to hear Mel Langdon say something behind his shoulder. (Langdon was the band's manager on those tours).

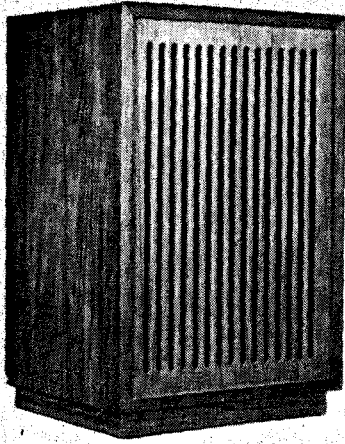
It is, I think, the most satisfying record made under Roger Bell's name. The title track is his own appealing composition and Honi Soit and Onion Bender's Lament are also compositions by him.

He sings on When You're Smiling (which goes straight into the vocal after the drum introduction), Ain't It a Shame About Mame (that wonderful knock-about tune Wingie Mannone recorded), Dapper Dan, You Rascal You and It's Right Here For You.

It's Right Here For You is a fine old Perry Bradford tune and the only other time I can remember hearing it sung was at the 1948 jazz convention in Melbourne when Don Reid deserted his drum set in Tony Newstead's band and stepped up to the mike to give out with the fact of life Bradford gives us in the lyrics.

This track, What Can I Say and What's The Pitch give us the lyrical highlights of the session. Len Barnard drums superlatively on all tracks (except Onion Bender's Lament, Candy Lips and You Rascal You, on which he plays washboard), but I particularly commend his work on It's Right Here For You. His work in the last chorus is very reminiscent of Dave Tough's work in the

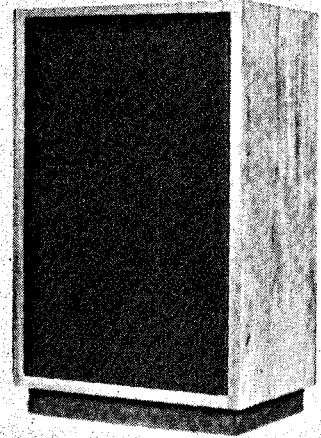
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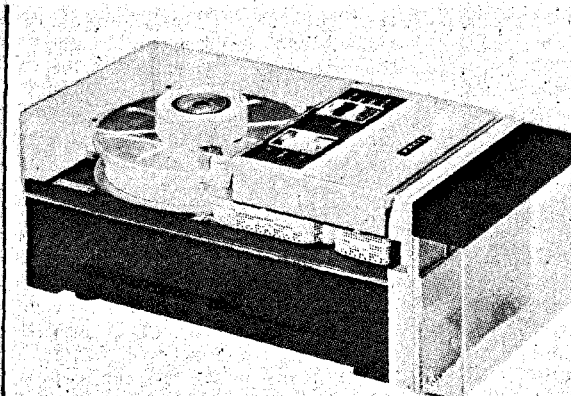
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JAZZ

last chorus of Condon's 1939 record of *Someday Sweetheart*.

Monsborough and his alter ego, Neville Stribling, are on clarinet and alto saxophone. Stribling obviously subscribes to the theory that imitation is the sincerest form of flattery. It is at times hard to distinguish one from the other, but Ade on the whole has the fuller tone on sax and the more piercing and impassioned on clarinet.

Rex Green is one of the very few Australian pianists to have obviously been influenced by Earl Hines. One of his best contributions is on *The Onion Bender's Lament*, on which he plays eight bar exchanges with Len Barnard on washboard. He takes another good'un on *Honi Soit*.

This, like *The Wombat* and *Onion Bender's Lament*, is an original Roger Bell composition. It has excellent verse, on which Roger plays some of his best trumpet of the session and which floats over an easy swinging rhythm section.

Jack Varney, who played alongside Roger in some of Graeme Bell's early bands, (including the one that toured England and Europe in 1947-48), takes an excellent guitar solo on *What Can I Say Dear*. I wish more Australian jazz bands featured acoustic guitar of this standard.

I wish more Australian bands played like this. — B.W.

(Swaggie records are distributed in the UK by Dave Carey, 1b Mitcham Lane, Streatham London, SW16.)

DUKE ELLINGTON — Masterpieces By Duke Ellington. French CBS Stereo S63838 Mood Indigo, Sophisticated Lady, The Tattooed Bride, Solitude.

It looks as though this is reissue month. Although I have not seen this record before in Australia, it has been released at least once in England, for I saw it in a friend's collection there.

Considering that three of the tracks are extended arrangements of single tunes (half an LP side each) rather than series of themes, it is a remarkably successful album.

Mood Indigo is really an excellent vehicle for an extended arrangement. It is a most unusual popular song in that it keeps developing rather than being contained within the usual eight bar repetitions, and thirty two bars elapse before the first strain is repeated in full. This beginning is played here in time honoured fashion — though not quite the way it was first played — by muted or very closed-toned trombone, clarinet and, I think, tenor sax, while in this case a barely audible muted trumpet etches in a kind of monotonal shading at the ends of the long tones.

Russell Procope plays the middle part and then the band takes it while he exits with a series of fervent hums and decorative flourishes. My main objection to the recorded sound is founded here in the hollowness they have given to his low register. Hodges plays a beautifully lyrical and restrained chorus, building in strength over the last eight bars. There is a splendid piano interlude, which sounds as though it

just might not be Duke — in which case it would be Strayhorn, with whose work I am not familiar. There is a glorious moment when remote, stealing trombones begin to play the theme behind airy surges of saxes and clarinets, then depart from it, crossing and recrossing in some rich mysterious middle distance. Gonsalves at one stage oozes with his unique tortuous fluency through the ensemble for half a chorus.

Things fall off when the singer, who is listed simply as Yvonne, delivers her sultry and unremarkable rendition. They do not quite pick up again though there is an interesting variation of the melody at the end.

Sophisticated Lady, beautiful and strange as it is, falls into quite conventional popular song form. This does not begin so interestingly, but ends much more strongly than *Mood Indigo*. Carney plays the first chorus, staying close to the melody but producing his usual magnificent ornamentations. Here again I am not keen on the way he has been recorded (or perhaps it is the rechannelling for stereo) — I couldn't make up my mind at first whether he was playing baritone or bass clarinet. It is the latter. Harold Baker also stays close to the melody, displaying his lovely green-golden trumpet sound. Joe Wilder is the only other player I've heard get that strange woodland tone, though Miles had a trace of it when he recorded *Walkin' and Bag's Groove*. Early Clifford Brown too.

The singer comes in now, and she is in trouble from the start. Still it's good to hear the decidedly 'period' words that have been given to the song, turning it into an exotic melodrama. Very art nouveau. There is another fascinating rococo piano interlude, Ellington I'm sure, and then the band surges in as though on an air cushion, and now we are in business. There are some absolutely lovely touches by Jimmy Hamilton — I can taste the wood in the silvery liquid of his sound: I dig Jimmy Hamilton and then Lawrence Brown solos gloriously through the last chorus.

Tattooed Bride is in two sections. The first part is one of those bounding dances for the whole band — with a fantastic early climax for Cat Anderson and another beautiful solo by Hamilton. The second part starts as an irresistible surge over pounding tom-toms, abruptly cuts to a slow melodic glide with statements by Baker and Hamilton. There is a brief cadenza for Hodges, Gonsalves and Carney, then the melody starts again, with Hamilton playing the most delectable, sunny clarinet. Suddenly the tempo picks up again and it swings out to the close.

Solitude is pretty spare. Its main interest is in the solos by Gonsalves and Ray Nance — who is at his romantic best on trumpet. He too gets a beautiful sound, shining and opulent, with much more decorative vibrato than Baker.

It goes without saying that all the pieces have priceless piano introductions. There are some beautiful atmospheres, fascinating and deeply satisfying textures.

Sound is pretty good, with a couple of odd spots: a hollow false resonance here and there. I would definitely buy it. The rhythm section, incidentally is Wendell Marshall & Sonny Greer. — J.C.

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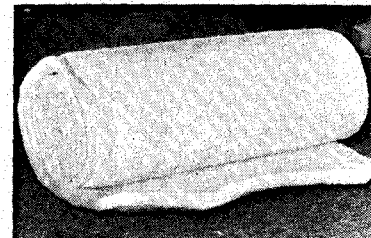
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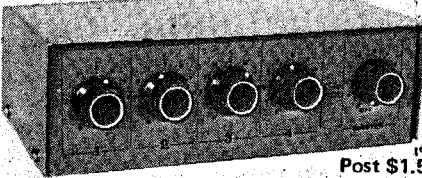


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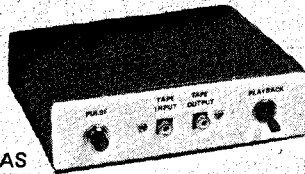


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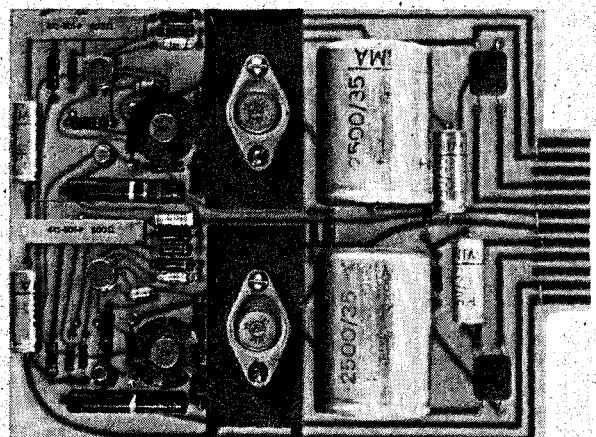
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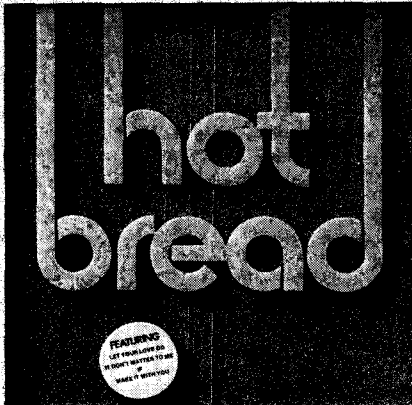
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RECORDINGS... POP TRENDS

REVIEWER:
Mike Delaney



"HOT BREAD" – Kinney. Stereo. EKS. 7701.

Let Your Love Go – If – Don't Shut Me Out – Take Comfort – Too Much Love – Live In Your Love – Make It With You – The Last Time – It Don't Matter To Me – I Want You With Me – She Was My Lady.

Pop can't really have changed all that much from the original concept. Here's Bread with a mixture of effervescent rock and romantic balladeering. The effect certainly has its moments. A deft dosage of lush strings weeping and wailing in the background with constant falsetto vocals just to make it sound plaintive. You couldn't go wrong with an approach such as this. The market is assured. Bread have seen to that, with no less than three consecutive top ten ballads within a little over one year. It's the return of tear-jerkers. "It Don't Matter To Me" and "Make It With You" let the emotions run riot. Nik Cohn would have called them 'maudlin flowerpots'. This may be a harsh term but then it does come pretty close to the truth. The style is eclectic. It runs the gamut from country through to orchestrated folk.

Composer-in-chief David Gates must see himself as pop's answer to Rodgers & Hart. He's not doing a bad job, regardless. His nostalgic melodies will be around long after Bread have been forgotten. "If" is the full lovelorn evergreen. It's going to be another "Yesterday". The appeal is ageless. There's a depth in presentation that owes a great deal to the deliberate arrangements.

The group relies heavily on semi-acoustic rhythms – subtle and persuasive. "Live In Your Love" is the type of heartfelt waxing that will no doubt become a firm favourite with the cocktail set. It's right mellow – ideal for subdued evenings spent at home. I think you get the picture. Bread can turn on the heat with the best of them. "Take Comfort" and "Let Your Love Go" are simple rockers – svelte; funky to a point. "Don't Shut Me Out" is a splendid piece of well-masticated bubblegum. The formula has been the basis for so many other songs it almost defies description. There's not one

repetitive cut on the album. Bread know the advantages of versatility. They make sure that the general character is least inhibited. "Hot Bread" is a composite disc. It's not great; merely exceptional. Production could be less routine. – M.D.

"20 GRANITE CREEK" – Moby Grape. Kinney. Stereo. RS. 6064.

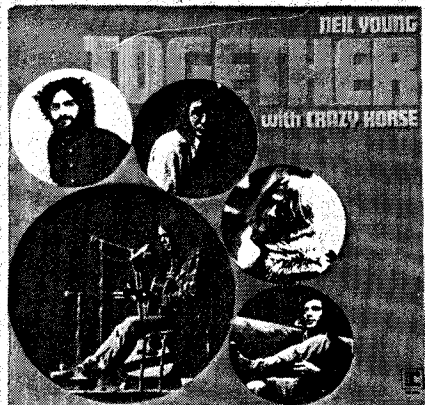
Gypsy Wedding – I'm The Kind of Man That Baby You Can Trust – About Time – Goin' Down To Texas – Road To The Sun – Apocalypse – Chinese Song – Roundhouse Blues – Ode To The Man At The End Of The Bar – Wild Oats Moan – Horse Out In The Rain.

You'd best start to spread the good news – Moby Grape have decided to reform following their two year trial split. It looks as though they finally found a chance to resolve the labour pains that so hindered their earlier commercial acceptance. It's not quite the same group once contracted to Columbia, as all the egotism and hype has vanished – no more superfluous trivia. Moby Grape have studiously avoided the high pressure sales sell. They've been through the gimmick machine and had their fingers burnt several times before. It won't happen again. The emphasis has been redirected back into their music and the result is possibly one of the greatest American rock'n'roll albums released over the last year. It contains the standard Grape ingredients stacked with volume and enthusiasm. The group tends to be deceptively complex, weaving textures otherwise denied to mainstream pop. There's an elaborate sense of contrast in their music that makes "20 Granite Creek" a pleasure for anyone who cares to listen. Each track expresses a brittle intensity that seldom falls short of the projected image. It's been five years since their first album and the basic approach hasn't altered in the slightest.

Moby Grape gave West Coast rock its most vibrant introduction outside the Byrds and now they're back to do it over a second time. Don't let it pass you by. This latest album has the essence of what could well be called the definitive Californian climate. They've refined each nuance down pat. "Gypsy Wedding" is orgasmic rock'n'roll – gruff and pugilant. It parallels "Road To The Sun" for drama. "Goin' Down To Texas" is one of those up-tempo road songs – spitfire; ever moving. Moby Grape keep away from self-obsessive tangents. There's no dreamlike guitar fantasies nor echo chamber choralizing. "Ode To The Man At The End Of The Bar" bops off with boozy thunder: 'Boy they're gonna hate me here/ I puked all over the floor. Now I just remembered why I got so drunk as I was walking out the door...' Yeah. That's Moby Grape. "Chinese Song" floats aloft a misty oriental theme supplied by double-track koto and conga percussion. It's

almost an entire suite within itself.

During their absence the group expanded personnel to include Gordon Stevens. His dobro/mandolin/electric viola has added a variety to the style that no longer restricts horizon. Moby Grape encompass most of the typical rock influences ranging from folk to blues. "Apocalypse is the sensible acoustic side – smooth; velvet soft. "20 Granite Creek" is just a little short of brilliance. It bubbles like a mountain stream continually changing form and impetus. This is an album to buy. Production is superb. – M.D.



"TOGETHER" – Neil Young & Crazy Horse. Kinney. Stereo. RS.5261.

When You Dance I Can Really Love – Dance, Dance, Dance – The Old Laughing Lady – The Loner – I Don't Want To Talk About It – Only Love Can Break Your Heart – Everybody Knows This Is Nowhere – Downtown – I Believe In You – Cowgirl In The Sand.

Neil Young is one of America's finest contemporary rock poets. His music links rural tradition with the pace and paranoia of modern living as if the two had always been inseparable. The man concentrates on atmosphere – bitter sweet; earthen. His songs carry a touch of welcome nostalgia for the time before rock became predictable. There's an ingenuous quality around his character that seldom fails to convey the immense feeling inherent within each work. Neil Young is a gentle prophet who believes in the homespun ideologies present in the acoustic country format. He's one of the few performers who still tries to preach about a better life. This in itself is unique. "Everybody Knows This Is Nowhere" and "The Loner" are two of his most positive statements along this line. Each is a specific comment concerning current attitudes.

Young has the prowess to continuously change emphasis within each song structure. His style incorporates flashes of everything. Each segment is neither separate nor incidental as the basic cohesion is drawn from contrast. "The Laughing Old Lady"

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follows this order with a selected series of images designed to understate the climax. Young never once loses control. "Only Love Can Break Your Heart" and "I Believe In You" are less progressive songs with the value centred on simplicity. There's rarely the slightest hint of repetition as each waxing has been fixed with multiple phrases. "Cowgirl In The Sand" is a cheerless batch of unrelated sketches more like a patchwork in texture and tone. It follows several themes at the one time. It's quite masterful. "When You Dance I Can Really Love" is up-tempo Neil Young best identified with his Buffalo Springfield period — masculine; heavy brooding. It's one of the few electric songs that has retained much of the purity otherwise left to his ballad approach. "Together" is a composite album with tracks culled from the three solo releases. Crazy Horse play two songs from their debut Kinney disc aside from the supplemented backings. "I Don't Want To Talk About It" and "Dance, Dance, Dance" make it obvious why Young has spent so much effort on their potential. Production is rich — lively and unpretentious. If you haven't caught on to Neil Young here's the chance. — M.D.



"THEIR 16 GREATEST HITS" — The Grass Roots. EMI. Stereo. SPBA.3024.
Sooner Or Later — Where Were You When I Needed You — Heaven Knows — Let's Live For Today — Temptation Eyes — The River Is Wide — Come On And Say It — Midnight Confessions — Wait A Million Years — Walking Through The Country — Lovin' Things — Things I Should Have Said — Bella Linda — Baby Hold On — Feelings — I Can Turn Off The Rain.

There'll always be a market for American fingerpop as long as the Grass Roots are around. They've spent the last six years steadily churning out top ten hit singles at the rate of one every four months. This Californian quintet uses the medium as their message. Each song is a total presentation incorporating an approach to satisfy every ear. In this aspect they're quite archetypal. The group just goes about business with a constant eye to the chart placing. This has undoubtedly been the reason behind their prolonged success in a field noted for rapid fancies. The group tries to supply current demand. "Their 16 Greatest Hits" is one of the finest albums of its sort as each track

traces the band history right from the first release.

The Grass Roots are pure entertainment value — musical fun power. They're one of those forces that'll keep rock from growing old. It's straightforward pop that doesn't require virtuoso performance to add sheen for the sake of sheen. "Midnight Confessions" and "Baby Hold On" bob about with hearty pop. "Where Were You When I Needed You" is a throwback to the first wave of Los Angeles folk-rock circa 1966. It still sounds great even though the style has long since passed away. "Come On And Say It" is supported by tight rhythm, supplemented by backbeat percussion — direct; instantly infectious.

The Grass Roots seem to have a knack when it comes to immediate material. Their dynamic arrangements and forceful brass/string overdubs, make the most of each melody no matter how insignificant. "I Can Turn Off The Rain" is the one effective pace change maintaining a sense of drama not evident in the up tempo frames. The vocal standard is exceptional. Both lead and harmonies have been constructed to leave no audible flaw. "Let's Live For Today" is their one classic to date. The lyrics are beautiful — precocious yet highly innocent. You'd do far better to buy this disc than to spend your bread elsewhere. There's absolutely no hype. — M.D.

PLURIBUS FUNK — Grand Funk Railroad. EMI. Stereo. SW.853. Footstompin' Music, People Let's Stop The War, Upsetter, Come Tumblin', Save The Land, No Lies, Loneliness.

Grand Funk Railroad is the definitive American noise machine. Their music slams home like a million ton sledge hammer that literally pulverizes everything within reach. It's just so darned monotonous. You can best describe their latest album as one sordid mess of riffs that were played out and buried a good three years ago. The effect is excruciating. Grand Funk drags out the skeleton of what was once enjoyable rock'n'roll and goes to extreme lengths to dangle it about as if there was no tomorrow. The similarity between each of the seven tracks is diabolical. They manage to create a vague pressure that could have been far from tedious had the band known how to develop a sense of dramatic contrast. This Michigan trio bases its sound on pure volume — predatory and unrefined. Their approach loses all control due to the lack of natural restraint. They stalk through each song with the kind of disoriented aggression that fails to produce any valid structure or tonal identity.

Grand Funk leaves little need for argument. It's not fun. Their material runs berserk with a bunch of those tired old cliches that keep on returning with dogged regularity. "Footstompin' Music" is an insipid up-tempo cut without depth nor character to support the flagrant guitar. It rasps along full of the typical Farner expressionisms — pouted vocal and sweat. "Save The Land" is the ecology song just to show that they've found a conscience. "People Let's Stop The War" has been included as the standard political statement. It's a dreary hype. Grand Funk Railroad is a pretentious heavy rock band who've yet to overcome the audible boredom syndrome. I'll not be playing this album again. Bad news. — M.D.

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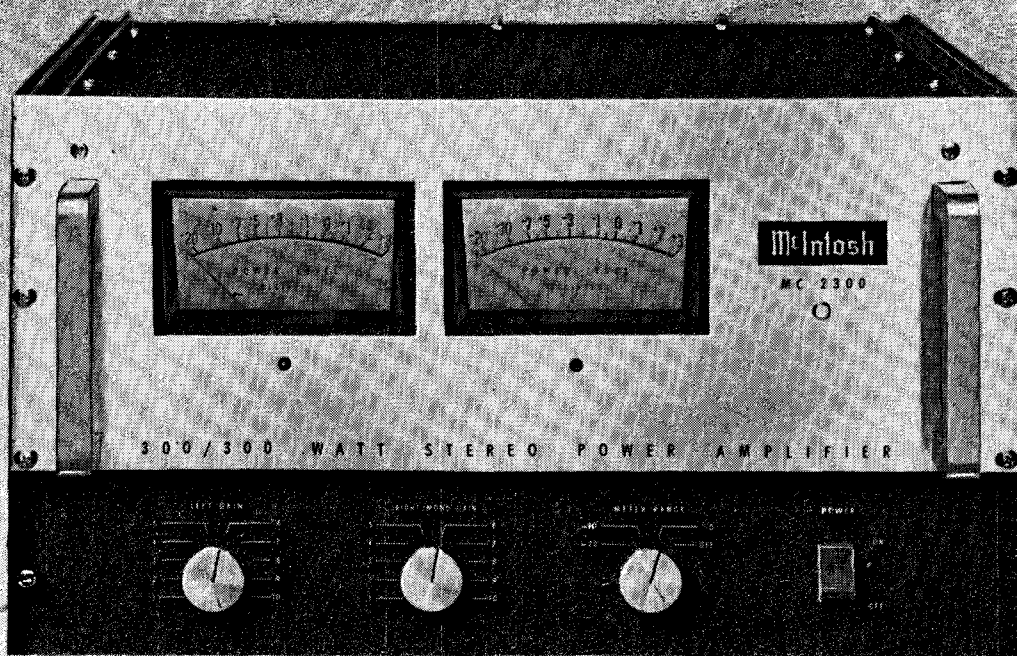
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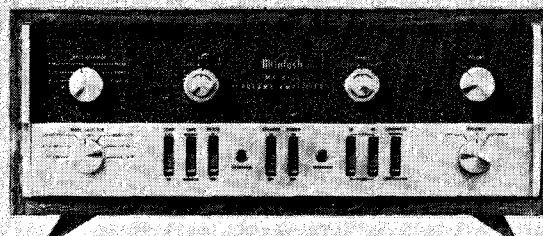
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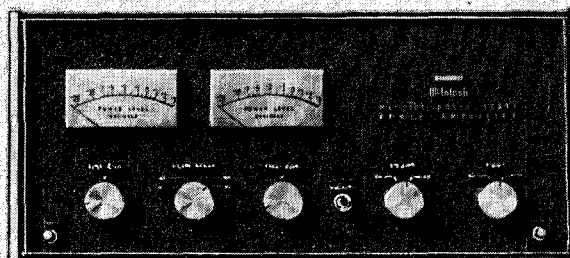
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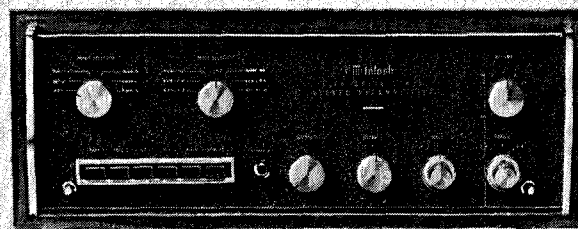
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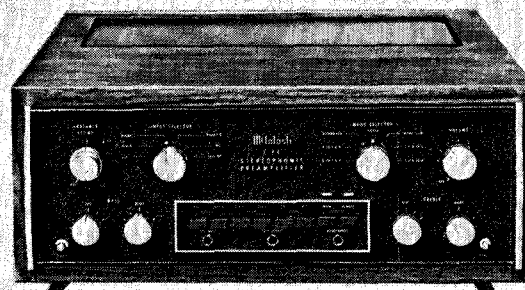
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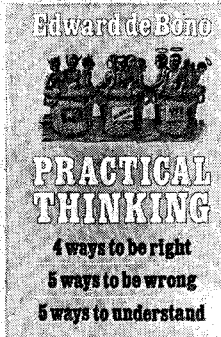
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BOOK REVIEWS

REVIEWERS: Brian Chapman,
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PRACTICAL THINKING By Edward de Bono.

Published 1971 by Jonathan Cape Ltd, London. Hard covers, 198 pages. Australian price \$5.95. Our copy supplied by the publishers.

de Bono has a basic contention that our traditional approach to thinking is not the best way. The traditionalist's argument is that if each small step is correct then the ultimate conclusion must be correct, but de Bono says it may be essential to be *wrong* in thinking at some stage to enable one to move far from the old pattern and restructure it. The 'intermediate impossible' is his name for an idea which is wrong in itself but nevertheless serves as a useful stepping-stone to an idea which is perfectly valid.

In this book, his examples of the ways in which people think, come from an experiment which he performed many times with a wide variety of subjects. "Imagine," he says "a tall black cylinder standing on a white table in front of you. No one is near the table and there is nothing on the table except the cylinder which stands stark and alone. Suddenly without warning, the cylinder falls over with a crash. Why? Given ten minutes, de Bono's subjects are asked to give an explanation. de Bono then analyses and grades their ideas as different levels of understanding, from simple descriptions, "It fell", to porridge words, "The cylinder had a mechanism to make it fall over" (words like "mechanism" and "device" are porridge words - no real form, shape or definite meaning in this context), to full details "concealed clockwork mouse with suction pad feet climbs up tube which becomes top-heavy and falls over. Clockwork mechanism is silent".

Throughout the book, de Bono uses the answers given by people in the experiment as examples for the points he is making in each chapter. He discusses the levels of understanding we use when we think, the basic thinking processes, (how we move from one idea to another or connect up separate ideas,) how we decide an idea is the right answer and the types of mistakes which people make in thinking their way to a conclusion.

Everyday thinking, he says is often different from the thinking of a scientist. Though it may appear that a deeper level of understanding is better, in our routine life when we must reach a level of understanding before we act, the lesser levels are often sufficient - knowing that a car works by switching on the ignition is a deep enough level of understanding for most people to be able to drive one. and the engineer who sneers at this ignorance probably does not know all there is to know about the physical chemistry of exploding petrol, the surface physics of lubricants or the metallurgy of gear wheels, yet he is still able to perform his job competently.

In describing different types of thinking, de Bono also defends each type. "Everyone is always right" and "no one is ever right" are his basic rules of everyday thinking. He does quite convincingly explain what he means by these apparently contradictory rules.

He is firmly against arrogance and dogmatism and people who feel they are so right they must impose their ideas on others. If one accepts that no one is ever right in an absolute sense then one is more willing to look around for better ideas and to look at the ideas of others. "I would go so far", he says "to suggest that a person who was incapable of arrogance would be incapable of stupidity".

His last chapter (Think-2) gives his suggestion for a different sort

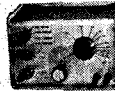
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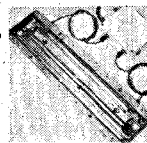
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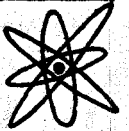
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BRISBANE & QLD.—RADIO COMPONENTS, 67 SANDGATE RD., ALBION, 4010

HOURS OF BUSINESS:
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No. 10 H.F. Panel Socket 65c + 10c post
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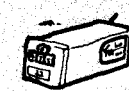
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MST-205S	DPDT (On)-Off-(On)	\$1.00
MST-105E	SPDT On-Off-On	\$0.75
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MST-205SA	DPDT (On)-On-(On)	\$1.00
ROTARIES		\$3.00
MRA-1-12SC	1 pole 12 pos. (Cont. rotation)	\$3.25
MRA-1-10	1 pole 2-10 pos.	\$3.25
MRA-3-3	3 pole 2-3 pos.	\$3.25
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MSP-103B	SPST Normally closed	\$0.55
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HIGH SPEED MAGNETIC COUNTER.

(4" x 1" x 1")
4 digit 0-9999. 500 ohm. coil 18-24v operation or 36v type. 2300 ohm. coil. For batch counting or lap timing, also dozens of other uses. 95c ea. post free.

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1972 CATALOGUE . . . Owing to circumstances beyond our control delivery of our catalogues have been delayed due to a printers' dispute. We trust that this will shortly be finalised and we can assure all our readers who have sent for this that these will be despatched with the utmost haste as soon as possible. Please accept our sincerest apologies.
MANUFACTURERS . . . We will purchase all your surplus, redundant and end-of-run Electronic components and equipment at the best prices. Cash paid. Please send lists or phone details to Mr. M. Sherdian.

REVIEWS

of thinking — which seems more a method of communicating one's own ideas to others. He says that if one assumes one is talking about the same thing as someone else, one moves steadily from idea to idea trying to convince the other person of the validity of the argument (and wondering why the other person remains unconvinced). Instead he says, each person should carefully map out the landscape of their own starting place. Thinking then becomes a matter of discovering where there is overlap and where there is distance. An attempt may then be made to set up new areas that are otherwise separate. One tries to find out where people are, instead of trying to convince them of where they should be. In the case of a father who has discovered that his daughter is smoking pot and wants to discuss this with her, daughter's ideas could be — only smokes it occasionally, does not want to appear square and old-fashioned, better than alcohol (no hang-over or sickness); while father's ideas could be, pot leads to other dangerous drugs like heroin and methedrine, failure as a parent, beginning of a downward trend from which there is no escape — etc. It is obvious then, says de Bono, that the starting places are so totally different that the two are really talking about different things. Each has a different point of view, different pictures.

In ordinary thinking one tries to reach a conclusion by making strenuous efforts to deny the right to exist of any picture that is judged to be 'wrong'. In Think-2 one accepts the existence of different pictures and then tries to develop new bridging ideas whereby one can move from one picture to a different one.

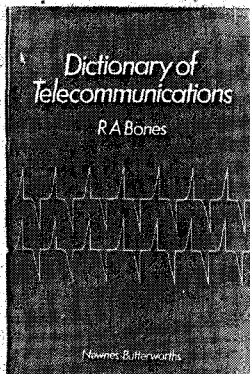
Practical thinking is de Bono's seventh book. All cover various aspects of thinking — the author is an internationally recognized authority on the subject and has lectured to a wide variety of groups throughout the world.

The book is well set out and clearly written. Each chapter is followed by a summary of the main points. The author uses amusing examples to illustrate his points but his intentions are obviously serious. He is not joking when he quotes de Bono's 1st and 2nd Laws.

Our present ways of thinking are not as productive as they might be, and the author's intention appears to be to convert readers to his suggested method. The suggestion that it is possible to change one's own thinking is interesting. For a time after reading this book one has a tendency metaphorically to stand back and watch oneself think. This may or may not be permanent. —J.V.

DICTIONARY OF TELECOMMUNICATIONS

By R.A. Bones.



Published 1970 by Newnes Butterworths Ltd, of London. Hard covers 200 pages 7" x 5". Australian price \$7.50. Our copy supplied by Modern Books and Plans.

This work is a companion volume to the "Dictionary of Electronics" reviewed last month. As the name implies, the coverage of this volume is more specialised, dealing specifically with terminology commonly encountered in the field of telecommunications.

Coverage is excellent, I tried many terms of recent origin. Only on one occasion did I fail to find a reference. I did feel however, that some of the references were too brief, to the point where it would be necessary already to know the answer in order to understand the explanation.

Nevertheless this dictionary must prove to be quite valuable to technicians and others employed in the field. — B.C.

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ELECTROLYTIC CAPACITORS. 500 uF. 50 volt. 50 cents. 640 uF. 16 volt. 25 cents. 32 uF. 350 volt. 35 cents, P/P. 10 cents.

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Add 60 cents for pack/post.

POWER SUPPLIES, 35 volt, 5 amp, C Core Transformer and Filter Choke 5-10,000 uF 50 volt electrolytics Transistor Regulator voltage adjustable. Size 21" x 7 1/2" x 7 1/2". Weight approx. 25 lbs. Price \$35.00. Freight forward.

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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.

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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.

CAPACITORS. Mixed values Mica and Ceramic. Poly bags, \$2 per 100 P/P 30 cents.

VALVES — 6J6, 30 cents ea. ATS 25-807, 50 cents ea. 6J7; 60 cents ea. 6SL7GT, 60 cents ea.

PHONE JACKS 3.5 and 2.5 mm. 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.

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Transmitters, Receivers, etc.**

TDK~SD*

THE ONLY SUPER-TAPE THAT WORKS PERFECTLY ON EVERY TAPE RECORDER OR CASSETTE PLAYER.

No problems in erasure • no squeaky highs.

(*SUPER DYNAMIC — EXCLUSIVE GAMMA-FERRIC)

Professional quality recording tape praised the world over. Tape recorders are . . . "dramatically Improved" says Consumer Guide, U.S.A. "Significantly different performance from other tapes that we have tested" says Electronics Today, Sydney.

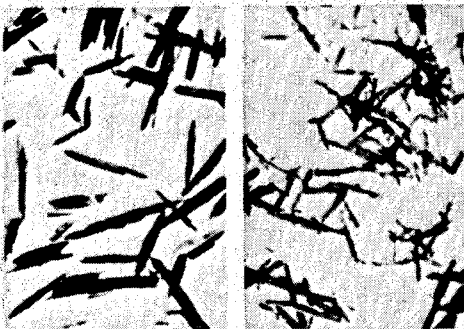
THE TDK STORY In 1932, TDK's founders invented a new class of materials, ferrites, that became the basis of the entire magnetic recording industry. Today TDK is an International Company with more than 5,000 employees in Japan, U.S.A., West Germany and Taiwan, maintaining TDK's leadership in audio, video and computer grade tapes.

'SD' SUPER DYNAMIC CASSETTE TAPE The tape that turned the Cassette into a High Fidelity Medium. Gamma Ferric Oxide, an exclusive TDK high resolution, high efficiency magnetic formulation, has made it possible to achieve fidelity in the cassette medium that could previously be obtained only with reel to reel decks.

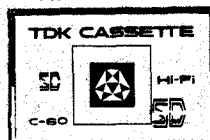
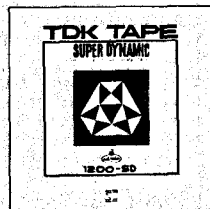
The surface of SD tapes is almost mirror smooth, which combined with special binders and lubricants has all but eliminated head wear. The tape offers the following features:

Frequency response from 20-30,000 HZ • Increased output level • Minimum distortion • Expanded dynamic range • Lowest noise, best signal-to-noise ratio • High reliability jam proof cassette construction • Polyester Base.

'SD' SUPER DYNAMIC REEL TAPE Engineered for the next generation of tape recorders, TDK Super Dynamic tape on open reels is capable of dramatically improving the performance of old recorders of modest quality. With reasonably good home equipment, it can produce professional, studio quality results 20-30,000 HZ.



(left) Ordinary magnetic particles, magnified (right) SD-tape microfine particles of Gamma Ferric Oxide exclusive to TDK, also magnified.



Size available:
7" 1200' & 1800'
10" NAB 3600'
C60, C90, C120,
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AVAILABLE FROM QUALITY HI-FIDELITY STORES.

OTHER TDK TAPES AVAILABLE FROM DISTRIBUTORS

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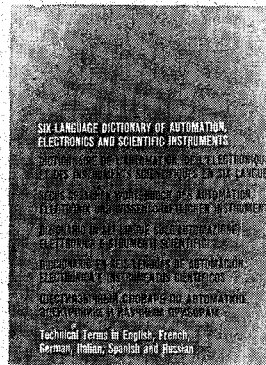
VIC — AMI, 155 Gladstone St., Sth Melbourne — 69 7281

QLD — Brisbane Agencies, 72 Wickham St., Valley — 21 9139

SA — Truscott Electronics, 64 Hindmarsh Square, Adelaide — 23 3024, 23 3278

WA — Arena Distributors (Aust) P/L, 196 Adelaide Terrace — 25 9993, 25 9098.

REVIEWS



SIX LANGUAGE DICTIONARY OF AUTOMATION, ELECTRONICS AND SCIENTIFIC INSTRUMENTS

Compiled by A. F. Dorian and published by Iliffe Books Ltd, London 1962. Hard covers, 732 pages 10" x 8". Australian price \$20.80. Our copy supplied by Modern Books and Plans.

Have you ever seen an interesting circuit in a foreign journal and been frustrated by not understanding the language.

Here is the answer, a cross-referenced dictionary of electronic and scientific terms in six languages. The languages are English, French, German, Italian, Spanish and Russian.

Although this book will by no means make you an expert linguist, it will enable you to get the gist of technical descriptions. This, of course, is all that is required by those who are proficient in their own field.

Structure of the dictionary is as follows: In the main body of the dictionary each English word or phrase is given a line number and the other five language equivalents are listed across the double page spread.

At the rear of the book, five separate listings are provided, one for each language. The procedure is to find the phrase in this alphabetical listing and hence a line number for the main cross referenced listing. It is thus quite easy, for example, to obtain the Spanish equivalent of a Russian phrase.

One criticism is that one needs to know the Russian alphabet to readily find a Russian phrase. The inclusion of a Russian alphabet at the beginning of the appropriate reference section would be of assistance.

Nevertheless, a very valuable book for those whose business it is to know what others are doing. — B.C.

110 SEMICONDUCTOR PROJECTS FOR THE HOME CONSTRUCTOR By R.M. Marston.

Published 1969 by Iliffe Books London. Hard covers, 125 pages 8½" x 5½". Australian price \$6.10. Our review copy supplied by Butterworth and Co (Australia Ltd) 20 Loftus St, Sydney.

One would expect this book to contain the usual gambit of 'one transistor' radios, audio oscillators and amplifiers, etc, found in other books with similar titles. To some extent this is true, but this one is decidedly a cut above average.

R.M. Marston is a wellknown freelance author who writes under several pen-names for most of the better known electronic journals. In fact, as is stated on the dust cover, R.M. Marston is probably five of the ten best known authors in the UK today!

Due to unfamiliarity with the various semiconductor devices, that have appeared so rapidly over the last few years, many hobbyists confine their activities to building pre-designed projects. Although this is interesting, how much more satisfying and rewarding it is to be able to design your own special gadgets.

The present volume tries (quite successfully) to achieve this aim by introducing new devices by experiment. A good sound explanation of device operation is given, unclouded by unnecessary mathematics, followed by projects which are designed to illustrate device application.

These projects are designed using commonly available components. In fact, there are 65 projects based on only two silicon transistor, one field effect transistor and one unijunction transistor. In addition there are 15 SCR projects and 30 linear IC projects. All IC projects are again based on the one IC, the μ L 914.

Excellent value as programmed instruction material and as a source book for useful circuitry. — B.C.

SANSUI...THE SILENT SOUND SOURCE.



SR-2050C

SR-1050C.

SR-4050C

FUNDAMENTALLY, A PARADOX SELLS SANSUI TURNTABLES.

When you are listening to your favourite stereo recording played on a Sansui turntable, you are quite unaware of the sound source. And isn't that the way it should be?

There are three models in the Sansui turntable range. All are silent, all share Sansui "know-how" and technology... and even the lowest priced model has a "wow" specification of less than 0.07%. Let's look at the three models:

SANSUI MODEL SR1050C — MANUAL OPERATION.

- Belt drive ● Two speeds ● 4 pole hysteresis synchronous motor ● Push-button controls ● Dual purpose cueing control ● Precision built tone arm with a lateral balancer and an inside force cancelling device ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.07% ●

- Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — \$181.

SANSUI MODEL SR2050C — FOR AUTOMANUAL OPERATION.

- Belt drive ● 4 pole hysteresis synchronous motor ● Automatic lift and stop which is electrically operated — a detector circuit operates a relay/solenoid system ● Push-button speed controls ● Two speeds ● Cueing control ● Precision built statically balanced tone arm ● Induced magnet cartridge with a frequency response of 20-20,000 Hz. and an output of 5 mV. ● Wow — Less than 0.07% ● Removable dustproof acrylic cover ● Hand finished cabinet of selected walnut ● Recommended list price — \$231.

SANSUI MODEL SR4050C — FOR AUTOMANUAL OPERATION.

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From these necessarily brief specifications you can see some of the advantages of a Sansui sound source. Get all the facts — see your franchised Simon Gray dealer. When you compare all the Sansui features... and hear the difference Sansui quality makes... you'll invest in Sansui!

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Simon Gray Pty. Ltd.
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Please rush me further information on the Sansui Model stereo sound source and the name of my nearest franchised Simon Gray dealer.

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SONATA

All silicone solid-state Hi Fi Stereo Amplifier Model NS-1600D

10 watts R.M.S. per channel. Each channel has separate bass/Treble controls.

Inputs for magnetic or ceramic cartridge, crystal mic., radio, tape — tapeout stereo headphones. 8-16 ohms. Instruction booklet, circuit supplied. Timber cabinet. Dimensions: 14½" x 8" x 4". Price \$67.50. Pack & Post \$1.50. Interstate \$2.50.

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30 — 16000 Hz.

6WR Mk.V	12 watts RMS	\$ 9.90
8WR Mk.V	16 " "	\$10.75
10WR Mk.1V	16 " "	\$11.50
12WR Mk.1V	16 " "	\$12.50

Pack & Post 65c. Send S.A.E. for Data Sheet.



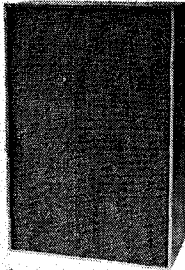
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Pack & Post \$1.50.

STEREO RECORD CHANGER

C141 — C142 — C142-A3

Current models, 4 speeds, automatic or manual operation. Deluxe model with 12in turntable. Cueing device, Ceramic cartridge, Diamond Stylus \$40.00
Deluxe model as above with — adjustable counter balance, 2 spindles, calibrated stylus pressure control added \$46.50
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Model C142, and C142-A3 can be supplied with Magnetic Cartridge and Diamond Stylus at \$10.00 extra.

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Pre-cut to suit the above changers and BSR player or blank. 18½" x 15" x 3½" teak. \$9.00. P.P. 75c.

PERSPEX COVERS

Fully moulded, smoke tinted. 17½" x 13½" x 4½". \$9.00. P.P. 60c.

MOVING MAGNETIC STEREO CARTRIDGE

SPECIFICATIONS

Frequency Response: 15Hz ~ 25,000Hz.
Output Voltage: 5mv 1,000Hz/5cm/sec.
Channel Balance: Within 1.5db at 1,000Hz.
Channel Separation: (Minimum 20db at 1,000Hz.
Tracking Force: 1 ~ 2.5 grams.
Stylus: Diamond.
Vertical Tracking Angle: 15 Degree.
Weight: 5 grams.
Mounting: 1/2".

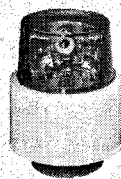
\$9.60

ROLA 12 U50

50 watts R.M.S. 12" Speaker. 8-15 ohms. Frequency response 25Hz — 11kHz. Fundamental resonance 40Hz ± 5Hz. Special purchase — \$35.00. Pack & Post \$1.50.

ROTATING DISTRESS EMERGENCY BEAM

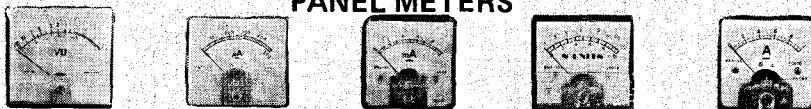
Fire Brigades and Rescue squads use them. So do Car, Truck and Boat owners who value their safety. At home on party nights, have a light show. Red, Blue, Amber — visibility ½ mile. 12v D.C. 1 amp operation, waterproof. Complete with heavy duty suction cap. Size 3½" dia. x 5½". \$5.75. Pack and post 35c.



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VU — Stereo Balance. Send for price list, S.A.E.

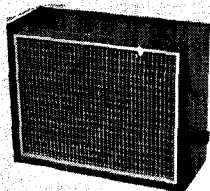


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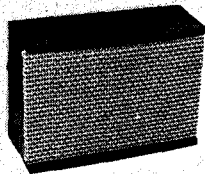
EXTENSION SPEAKER BOXES

A-1



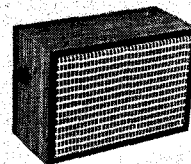
8 3/4" x 6 3/4" x 3 1/2" Speaker, 8 ohms, 5", 5 watts. \$12.50. P.P. 65c.

C-2



9 1/2" x 6 1/2" x 3 1/2" Speaker, 8 ohms, 5", 5 watts. \$11.50. P.P. 65c.

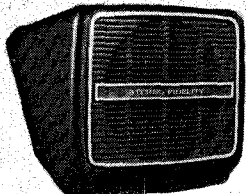
E-3



8" x 5 1/4" x 3 1/2" Speaker, 8 ohms, 6" x 4", 4 watts. \$10.50. P.P. 50c.

The cabinets are walnut and each model is fitted with a volume control, also a wall mounting bracket.

CAR SPEAKERS

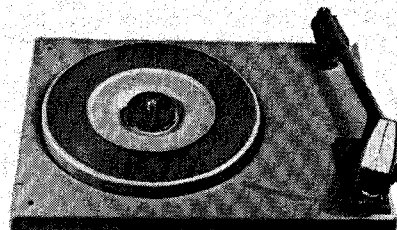


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LOCK-DOWN CAR AERIAL

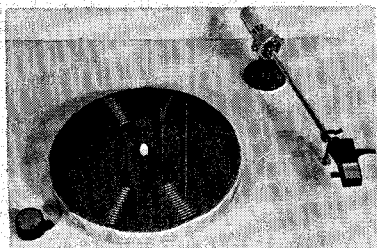
Complete with shielded cable, plug, mounting bracket, key. \$3.50. P.P. 50c.

GARRARD MODEL SRP-22 STEREO RECORD PLAYER



3 speed, 240v ac. 7" turntable, aluminium p/u arm, adjustable stylus pressure, auto-stop, sonatone HiFi ceramic cartridge. \$15.50. P.P. \$1.00.

STEREO RECORD PLAYER

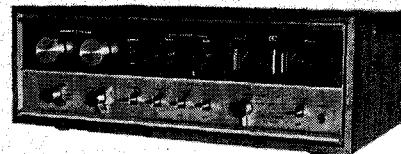


240V AC operation. Chromed tubular metal 9" tone arm with adjustable counter balance and nest — ceramic cartridge, sapphire stylus. 4-speed motor and 6 1/2" metal turntable with mat. \$7.90 — post 50c. Mounting platform 15" x 11" x 2 1/4" with cut-out to suit above record player. \$5.50 — post 50c.

SENNHEISER MODEL HD-414



Unique "Open Air" dynamic stereo headphones. Technical data: Freq., 20 — 20,000 Hz; Imp., 2000 ohms; Power Consumption, 1 mW; Audio Output, 122 dB 1% distortion. \$22.60. P.P. 60c.

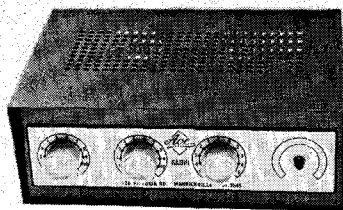


SONATA MODEL 600 SOLID STATE STEREO AMPLIFIER

Output transistor protection fuse, Speaker Imp. 4-8-16 OHMS. Inputs for microphones, ceramic, crystal, magnetic cartridges. Aux. tape in. Tape out. Tuner. Stereo headphones. Tape monitoring switch. Tone def. switch. Hi. freq. scratch filter switch. 20 freq. scratch filter switch. 2 v.u. meters. Loudness control. Separate bass, treble balance and volume controls. Specifications: Sensitivity, Mag. 2.5 Mv; Ceramic 50 Mv; Aux 100 Mv. Output Power: 20 watts R.M.S. per channel; Tone Control: Bass +12 DB. -12 DB at 50 HZ. Treble +12 DB. -12 DB at 10 KHZ. Loudness Control: +12 DB at 50HZ +4 DB at 10 KHZ. Cross Talk -50 DB. Residue Noise: Less than 1Mv. Dimensions: 19 1/2" x 11" x 5 1/2". PRICE \$133.50.

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INPUT GATE

LETTERS
FROM
OUR READERS

FAIR COMMENT

I congratulate you on your magazine's success in its first year and feel that your consideration of a few points of criticism at this time may help it to even further success.

On a number of occasions I have found the credibility of your editorial content damaged by avoidable inaccuracies. For example, you present the Fletcher-Munson curves in the December 1971 review of the Rotel RA-310 amplifier and label them "Frequency Response of the Human Ear." May I suggest that the frequency response of the ear would be an inverse function of these curves, as explained in your April 1971 article "Who Stole the Bass?"

The February 1972 article on crossover networks was of interest and value to me. However, the writer states that the dip in the sound pressure curves at the crossover frequency is an undesirable but unavoidable trait of crossover networks. Nothing could be further from the truth. This dip is essential to maintain a level output from the system. The listener hears the combined output from both speakers. At the crossover frequency the two speakers share the signal equally. Therefore to produce a level resultant output from the system the sound pressure from each speaker should be down 3dB (i.e. each contributing 50%) at the crossover frequency with respect to the reference level. Far from being undesirable this dip is necessary

READERS' LETTERS

It is our policy to reply to all readers' letters — but not necessarily via these columns. Please ensure that you write your full name and address on your letter. We have a number of letters — mostly from our younger readers in which not even the writer's initials are included.

We try to reply to letters as quickly as possible — however on occasions there may be some delay. But please don't think that your letter has been ignored.

to avoid the response peak which would result about the crossover frequency as each speaker added its gradually dying but still significant output to the full output of its complement. — C. W. M. Clayfield, Qld. 4011.

*Our correspondent is quite correct when he says that the curves shown in our December issue do not show the frequency response of the human ear — as he states the ear's response is in fact an inverse function of these curves. The error lies in the caption which should, of course, have read 'Fig. 1. Contours of average equal loudness'. Our apologies...

In his criticism of the article on cross-over networks our correspondent states that we wrote, 'the dip in the sound pressure curves at the cross-over frequency is an undesirable but unavoidable trait of crossover networks'.

But without wishing to split hairs this is not quite what we said. We did not state that this is 'an undesirable but inevitable trait', and we did, in fact, point out that amplifier power is divided more or less equally between the two speakers at the crossover frequency.

We completely agree with our correspondent's point that the resultant dip is essential to maintain level output — this is precisely what we meant to imply — but we perhaps expressed it in a somewhat clumsy fashion. Thank you for bringing it to our attention.

MUSIC SYNTHESIZER

Some time back you told readers that you would be publishing a constructional project for building a full-scale music synthesizer. Could you tell me when you intend to start this series. — GK. St. Ives, NSW.

* The design was finalised some time back, but ensuring that all components are available in Australia has taken rather longer than we had expected. We cannot advise a definite publication date at this stage — except to say that it will be very soon.

ACOS

REPLACEMENT LONG LIFE CARTRIDGES

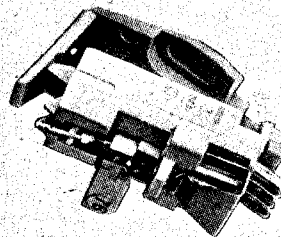
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2065. N.S.W.

INPUT GATE

DOLBY A

I was interested to see your review of our 360 Series professional noise reduction units (ET October, '71).

There are a few points which I feel should be clarified. The attack and release time of the Dolby compressors are not fixed at any one value. By using non-linear integration techniques, the time constant is continuously changed to suit the instantaneous programme. Under the conditions where overshoot in the main channel would be significant, the time constant is about 1 msec, not 100. In general the overshoot produced by any compressor is quite independent of time constant, and is usually equal to the amount of compression. Because our system is conceptionally different from conventional companders in that the output from our compressors is added (or subtracted) with a pure untreated component in the main path, we can use overshoot suppression techniques to ensure that the overshoot never exceeds 2 dB.

As you point out, the B-System uses a single channel whereas the A-System uses 4; however, the band in the B system does not cover the same frequency range as band 2 of the A-System since this would give no high frequency noise reduction at all. The B-System band at low levels provides significant noise reduction from about 300 Hz and above. The band is not a fixed band as in the A-System but does in fact change its lower cut-off frequency to maximise the noise reduction in the presence of programme.

It is extremely important that a Dolby encoded signal be decoded before any mixing is performed on the signal. Each Dolby encoded signal contains within the same signal the information needed by the decoder to correctly reconstitute the signal to its original dynamics. Thus if we mix two encoded programmes, the decoder cannot make a satisfactory job of the decoding process. The only procedures which can be carried out without decoding are editing of two sections together or making a 1:1 dub from one tape to another.

I hope that you will be able to bring these points to the attention of your readership to clear up what otherwise was a most interesting review.

D. P. Robinson
Chief Engineer
Dolby Laboratories Inc.

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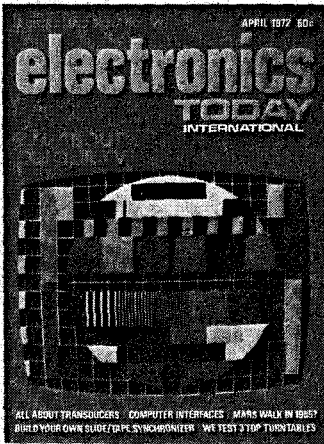
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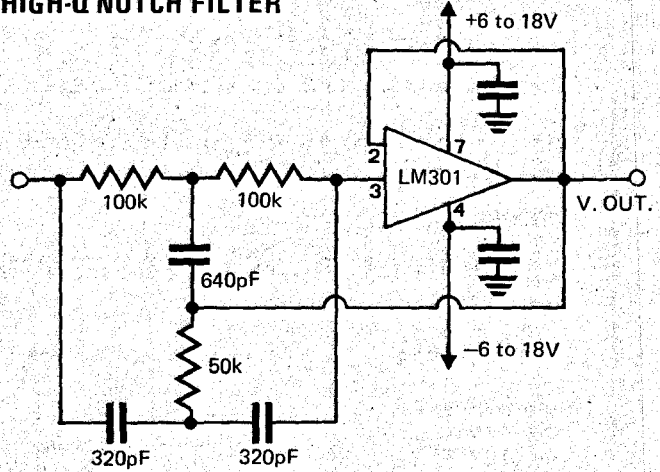
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TECH-TIPS

HIGH-Q NOTCH FILTER



An LM301 operational amplifier IC may be used to provide a 60dB notch filter at 50Hz by utilising a "Twin-T" network in the feedback path.

The circuit is easy to use, but attention must be paid to the careful selection of the "Twin-T" network components. Resistors should be 0.1% and capacitors 1% tolerance to achieve the full 60dB notch.

Other frequencies of operation may be chosen by selecting Twin-T values in accordance with the following formula

$$f_o = \frac{1}{2\pi R_1 C_1} \quad R_1 = R_2 = 2R_3 \quad \text{and} \quad C_1 = C_2 = \frac{C_3}{2}$$

TECH TIPS

Circuits described and illustrated in this section are derived from manufacturers' application notes, readers' letters etc. They have not necessarily been tested by this magazine.

The section is intended primarily as a source of ideas for electronic engineers.

Because of the nature of the information we cannot enter into any correspondence concerning any of these circuits, nor can we provide any constructional details.

LAFAYETTE GUARDIAN "6000" 6-Band

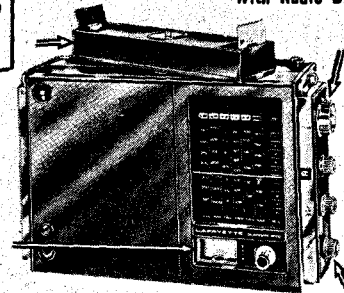
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Wave Film

The new TEAC A-350 reaches a new low in background noise. Because the Dolby Noise Reduction System** is incorporated into it. Signal-to-noise ratio is improved by as much as 5dB at 1kHz, 10dB at 4kHz and above. Eliminating coloration and audible noise and hiss inherent in the tape or induced by the recorder.

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The TEAC A-350 reproduces low frequencies never heard on a cassette before. As well as high. Multiple functions tape selector switch sets the exact bias and equalization for maximum frequency range from

any tape—regular or high energy and the new chromium dioxide tapes.

There's a new low in distortion. Peak Level Indicator warns you of overload *before* VU meters peak out. Especially critical with the new low-noise tapes which require a higher recording level. Expanded VU meters, too, for further accuracy. Up to +6dB vs. +3dB.

There's a new low in tape head wear and maintenance. High density ferrite heads are standard on the A-350, the same ones used on expensive open-reel machines. So durable and precisely milled, TEAC guarantees them for the life of the machine.

Not an improved model, the TEAC A-350 is an all-new tape deck designed especially for the expanded frequency range and low-noise characteristics of new chromium dioxide and high energy tapes.

Which is why it delivers a new high in cassette stereo sound reproduction.

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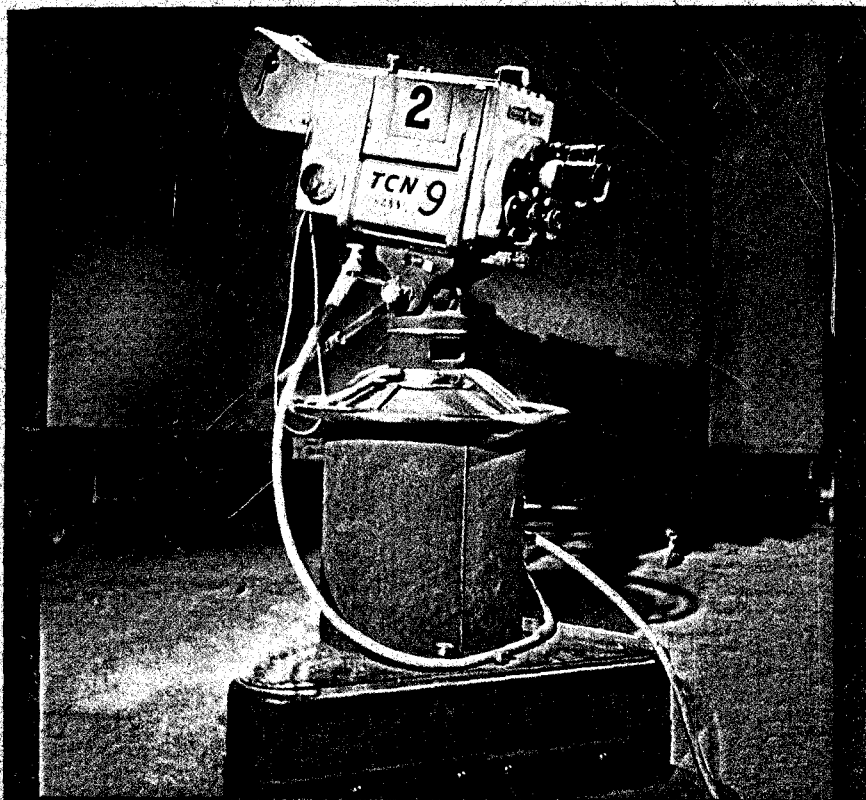


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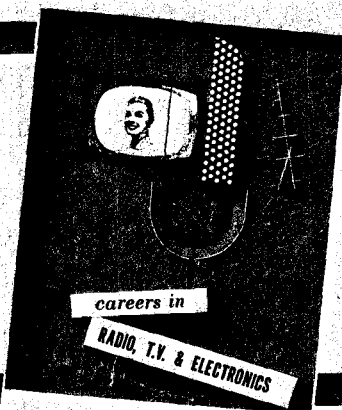
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