

AUSTRALIA'S DYNAMIC MONTHLY

JANUARY 1972 50c

# electronics TODAY

**4** PRODUCT  
TESTS

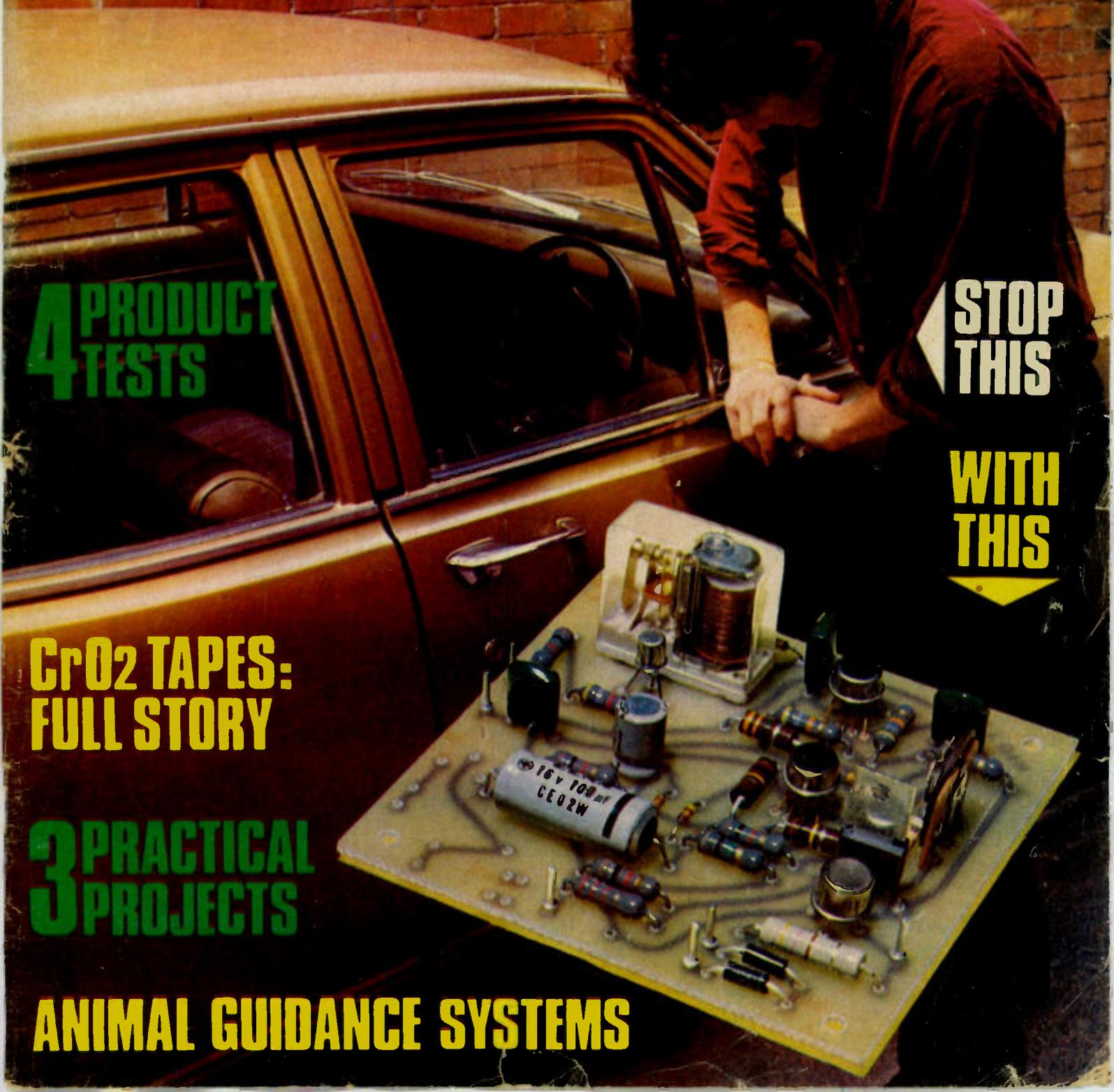
**STOP  
THIS**

**WITH  
THIS**

**CrO<sub>2</sub> TAPES:  
FULL STORY**

**3** PRACTICAL  
PROJECTS

**ANIMAL GUIDANCE SYSTEMS**



# QUADRADIALISTIC!

## OR HOW TO IMMERSE YOURSELF WITH SONY'S SENSATIONAL TC-366-4

Sony now makes it possible for everyone to enjoy the unmatched new thrill of 4-channel quadradial 'surround sound' with this impressive tape deck TC-366-4!

All the most advanced features are there — professional 3-head system with separate recording, playback and erase heads for 4-channel tape/source monitoring. Mechanical servo-controlled tape tension for absolute minimum wow and flutter. Mixing facility with 4 separate auxiliary and

microphone recording volume controls. 4VU meters. Tape selector for recording on normal tape or high quality tape such as Sony's SLH tape. Separate record buttons for front channels and rear channels. Slant front for easy operation. Outstanding high frequency tape bias. And many more.

Also available as a slant front 4-track conventional stereo tape deck — Model TC-366.

### SPECIFICATIONS

- System: 4-track 4-channel quadradial stereo recording and playback  
4-track 2-channel stereo recording and playback
- Power requirements: AC 240V, 50Hz
- Power consumption: 40W
- Tape speeds: 7½ ips, 3¾ ips
- Recording time: 1.5 hours at 3¾ ips (4-channel quadradial stereo with 1,800ft. tape); 3 hours total at 3¾ ips (2-channel stereo with 1,800ft tape)
- Reel capacity: 7" or smaller
- Fast forward and rewind time: 2 minutes (with 1,200ft. tape)
- Semiconductors: 49 transistors, 6 diodes
- Heads: Record head, Playback head, Erase head
- Frequency response: 20-25,000Hz at 7½ ips, 30-20,000Hz ± 3 dB at 7½ ips, 30-17,000Hz at 3¾ ips
- Signal-to-noise ratio: 55dB (with SLH tape), 52dB (with standard tape)
- Distortion: 1.2%
- Flutter and wow: 0.09% at 7½ ips; 0.12% at 3¾ ips
- Inputs: Microphone inputs (4); Sensitivity -72dB (0.2mV); Accept low impedance microphones; Auxiliary inputs (4); Sensitivity -22dB (0.06V); Impedance 100k ohms
- Outputs: Line outputs (4); Output level 0 dB (0.775V), Load impedance 100k ohms; Headphone jacks (2); Accept 8-ohm stereo headphones
- Dimensions: 17"(W)x18¾"(H)x9¾"(D) ■ Weight: 28 lb 3 oz



# SONY

**JACOBY**   
**KEMPTHORNE**

SYDNEY: 26 2651, MELBOURNE: 329 6986, ADELAIDE: 53 6117, BRISBANE: 21 0686, PERTH: 26 5726, LAUNCESTON: 26 322, Agents: CANBERRA: 47 8010, NEWCASTLE: 61 4881, PORT KEMBLA: 84 9022.

# electronics TODAY

JANUARY

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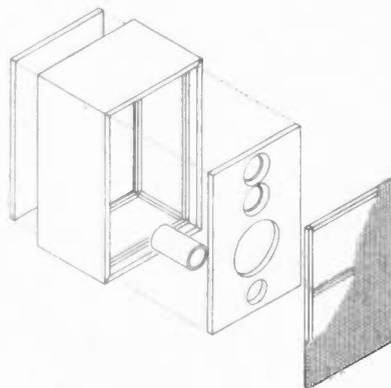
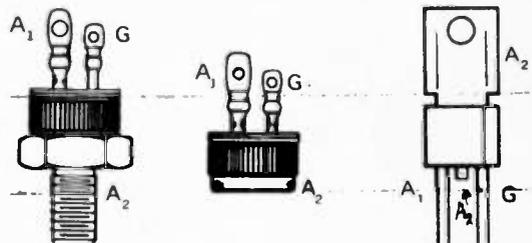
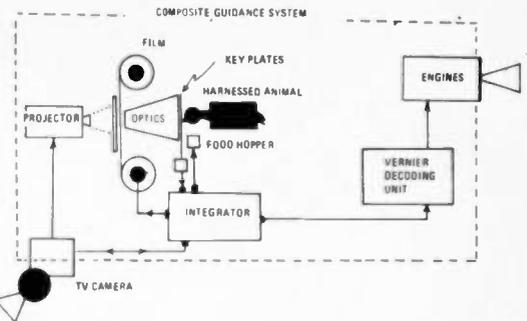
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COVER: Over 50,000 cars are stolen in Australia each year. Electronics Today's automatic car alarm (fully described in this issue) avoids the problems inherent in many existing designs.



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# SWIMMING POOL SAFETY CONTEST

A large number of entries have been received for this competition — which closed on November 23.

The competition invited entrants to design an effective and reliable system to provide audible warning of a child falling (or about to fall) into a swimming pool.

Entries have been of a surprisingly high technical standard. Most competitors developed systems that either detect a child approaching the pool, or respond to wave action caused by a child entering the pool, or register the sonic components of the splash via underwater transducers.

We are currently evaluating entries and will be asking finalists to submit working prototypes fairly soon.

Final evaluation will be completed as soon as possible — but may take longer than originally expected due to the extraordinarily high technical standard of many of the entries.

The results will be published as soon as judging has been completed. Details of the next competition in this series will be announced early in 1972.



Above — Sansui speaker system. Response 30 - 20kHz. 35 watts, 12" woofer, 6½" and 5" mid-range, two 2" horn tweeters, one 1-3/8" super tweeter. Left — Stereo headphones — response, 20Hz - 20kHz. Model AU-666 stereo amplifier — 10Hz - 40 kHz — 35 watts per channel rms.



## FIRST PRIZE \$1000

WORTH OF HI-FI EQUIPMENT  
FROM

## SIMON GRAY

Pty. Ltd.



Sansui turntable — two speeds, four pole synchronous motor. Magnetic cartridge with 0.5 mil. diamond stylus.

EXAMPLES OF HI-FI EQUIPMENT AVAILABLE FOR THE WINNER'S CHOICE AS PART OF \$1000 FIRST PRIZE PRESENTED BY SIMON GRAY PTY. LTD.

RUNNER-UP PRIZES TO BE ANNOUNCED LATER

# solid state humans next ?



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Kim Ryrie*

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*Ron Farley  
Technical Draughtsman*

**O**UR leading article this month — describing how the US and the USSR are actively experimenting with disembodied animal brains as bionic computers in missile guidance systems — is frightening in its implications.

Already scientists are openly discussing the feasibility of enhancing human and machine intelligence by organic links. Dr. R. M. Page, director of the U.S. Naval Research Laboratory in Washington, has discussed publicly a system in which human thoughts are fed automatically into a computer store as a basis for machine decision-making. A Rand Corporation study confirmed that this system could eventuate within our lifetime.

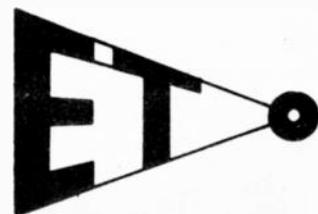
In a recent successful experiment, Professor Robert White, of Cleveland's Metropolitan General Hospital, cut the brain from a rhesus monkey, discarded the body, and then — by hooking up the brain's carotid arteries to another monkey — kept the disembodied brain alive for five hours. Other monkey brains have been kept alive for days at a time, using machine blood-cleansing techniques.

A member of Professor White's team states unequivocally: "The brain activity was largely better than when the brain had a body . . . I even suspect that without his senses he can think more quickly. . . ."

In his brilliant book 'Future Shock', Alvin Toffler says "As the brain surgeons and the neurologists probe further, as the bio-engineers and the mathematicians, the communication experts and robot-builders become more sophisticated, as the space men and their capsules grow closer to one another, as machines begin to embody biological components and men come bristling with sensors and mechanical organs, the ultimate symbiosis approaches".

For these techniques are not necessarily confined to non-human life. Professor White has gone so far as to state — albeit chauvinistically — "The Japanese will be the first to keep an isolated head alive. I will not, because I haven't resolved as yet this dilemma: Is it right or not?"

A very good question.



# magraths

## CHRISTMAS GIFT SUGGESTIONS

### A & R BATTERY SAVERS

Permits A/C mains operation of 6 V battery powered equipment. Approved by electrical supply authorities. PS64 — for Tape Recorders \$14.95

PS82 — for Transistor Radios \$9.92

PS104 — Output voltage 4.5V, 6V, 7.5V, 9V and 12 V. D.C. by selector plug. Max. current 0.5A. \$27.79

### CHASSIS PUNCH KITS

In wooden carry case \$7.50

### PRECISION SOLDERING IRONS

The iron is available for 6-volt or 12-volt operation. The element is situated within the lower part of the shaft, enveloped by the skirt of the bit. This provides efficient heat transfer and thus obviates the need for excessive element temperatures. Reliability is insured by completely sealing the element to prevent oxidation and by use of a special shock absorber which protects the element during everyday use in factory or workshop. \$4.15

Replacement Bits 55c each. No. 2 3/32". No. 3 5/32". No. 4 3/16"

### HAND NIBBLING TOOL

Cuts round, square or irregular holes. Capacity steel to 18 gauge aluminium or copper to 16 gauge. Punching bakelite plastics, etc. \$6.50

### SCOPE SOLDERING IRONS

Scope Deluxe ..... \$7.58  
Scope Standard ..... \$6.94  
Mini Scope ..... \$6.56  
Vibro Scope ..... \$5.51  
Transformer for above ..... \$8.52

### PANBRAKE METAL FOLDER

Invaluable for design prototypes, model shops and hobbyists in every field where light sheet metal work is used. Folds — aluminium to 13 gauge, mild steel to 21 gauge. \$25.80

### COILMASTER

This hand-operated coil-winding machine will produce self-supporting universal and honeycomb coils. Also solenoid, single-layer, etc. Three cams, 1/8in. 3/16in. and 1/4 in. throw, are included with each. Using these in various combinations with four gears supplied and using different sizes of wire from No. 22 to No. 40 many types and sizes of coils can be made. \$15.95

### RADAR CAPACITOR DISCHARGE IGNITION SYSTEM

**KIT FORM**  
Kit contains Detailed assembly instructions, all components including cables and circuit diagram for 12 volt neg. earth. \$29.50

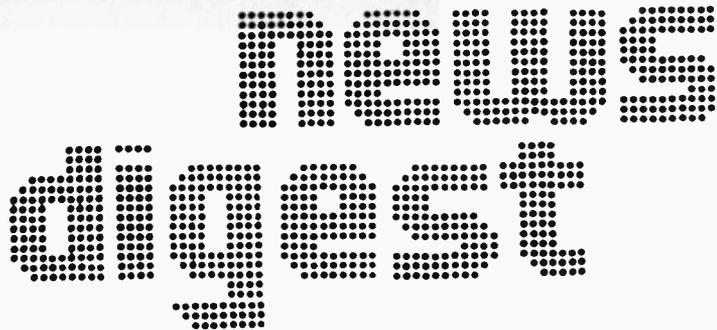
**BUILT UNITS**  
CD1 — 6V ..... Neg. Earth.  
CD1 — 12V ..... Neg. Earth.  
CD1 — 12V ..... Pos. Earth.

\$35.30

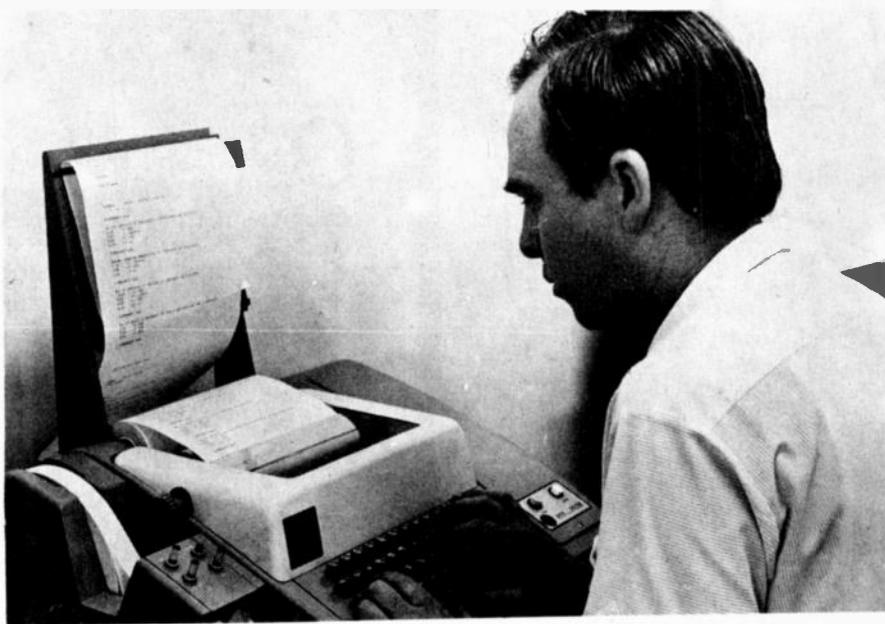
Specify Pos. or Neg. Earth.  
EVERYTHING POST FREE

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## ELECTRONICS TODAY INSTALLS COMPUTER TERMINAL



Whilst researching an article on computer time sharing this year, two members of our technical staff attended Honeywell's programming course.

We were so impressed by the versatility and capabilities of the system that we have now installed our own computer terminal within our project laboratory.

The terminal will be used in data evaluation, project development, and in the preparation of a number

of tables and nomographs that we feel will be of valuable assistance to engineers and technicians. The first of these tables appears elsewhere in this issue.

Our companion magazine 'Modern Motor' will also use the Honeywell system for the preparation and evaluation of road test data — enhancing yet further their reputation for the most comprehensive and accurate reports published today.

## PAGE APPOINTS MARKETING DIRECTOR

PAGE Communications Engineers Pty. Ltd. have announced the appointment of Mr. L. Larsen as Marketing Director.

The company is part of the world-wide PAGE organisation established in America in 1947 and incorporated within the Northrop group in 1959.

Page provides a wide range of services within the field of telecommunications. These vary from feasibility studies to systems and engineering design in the fields of propagation, microwave techniques and information distribution, switching and control. Their capability extends from VLF through SHF and encompasses broadcast,

tropospheric scatter, point-to-point, cable and satellite earth station communication techniques.

Mr. Larsen was previously Assistant General Manager of IRH Industries Ltd.

## FIFTY DAY TIMER PROJECT

An unprecedented demand for 'E' Cells created by our December 50 day timer project has temporarily exhausted supplies.

The sole suppliers, Plessey-Ducon, report that further supplies from Plessey International Inc. are expected to be available early in January.

# Variations on an original theme... with Silcron!

Although it's only two years since the very first Silcron turntable was released, this economical and noise-free belt driven turntable has captured a substantial percentage of the Australian hi-fi market. The original Silcron Mk III appeals to the hi-fi enthusiast who demands perfection yet is cost-conscious without doubt it is the finest turntable available at the price.

Like all engineers who are also perfectionists, the designers of the original Silcron turntable have recognised the need for a deluxe model. And so we release the new Silcron Mk. IV "Isophonic" Series. It combines all the proven attributes of the Mk. III with new design and engineering features which make it the most outstanding turntable available in Australia today... no other turntable offers as much performance for relatively low cost.

## FEATURES OF THE SILCRON TURNTABLES:—

### SILCRON MK. III.

- Sealed 12 pole synchronous motor.
- Belt drive... noise-free.
- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33 $\frac{1}{3}$  and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Only 3 moving parts.
- Anti-static mat at no extra cost.
- Height above motor board — 2".
- Precision engineering throughout.



### SILCRON MK. IV "ISOPHONIC" SERIES.

- New sealed 8 pole 750 r.p.m. synchronous motor.
- Belt drive... noise-free.
- Wow and flutter — less than 0.04%.
- Lightning fast speed change.
- Two speeds — 33 $\frac{1}{3}$  and 45 r.p.m.
- Dynamically balanced cast aluminium turntable platter.
- Four times the power of the Mk. III.
- New centre bearing shaft assembly.
- Acoustically insulated turntable platter and pick-up assembly which eliminates acoustic feedback.
- Tone arm tracking is constant.
- New vibrator absorbent anti-static mat.



## CHOICE OF MODELS —

### SILCRON MK. III.

- Basic turntable only, unmounted.
- With motor board and timber base.
- With independently sprung motor board, dustproof perspex cover, professional tone arm and magnetic stereo cartridge.

### SILCRON MK. IV

- Basic turntable, unmounted.
- With professional quality tone arm.
- With attractive oiled teak base.
- With professional tone arm and attractive oiled teak base.

Note: Dustproof perspex covers and spring mounted timber bases are available for both Silcron models.

## ASK FOR A DEMONSTRATION!

See your franchised Simon Gray dealer. You'll find it costs very little to step up to Silcron! Service facilities are available in all states and spares if ever required.

Australian National Distributors:

**Simon Gray Pty. Ltd.**

Head Office: 29 Elizabeth St., Melbourne, Vic. Tel. 63 E101 • Telex: 31904  
 Sydney Office: 53 Victoria Ave., Chatswood, N.S.W. Tel. 40 4522  
 Canberra Office: 25 Molonglo Mall, Fyshwick, A.C.T. Tel. 99 652E  
 Adelaide Office: 301 South Terrace, Adelaide S.A. Tel. 23 6219

INTERSTATE REPRESENTATIVES:

N.T.: Pflüger's Music House, Smith Street, Darwin. Tel. 3801  
 Q'land: Sydney G. Hughes, 154-158 Arthur St., New Farm, Brisbane. 58 1422  
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Your records and tapes  
will never know which  
headphone  
you're using

➔ But your  
ears will.

Goldring headphones fill your ears with a full depth of sound, reducing outside noise interference to a minimum. Thick soft earpads cushion every distraction; separate volume controls give you the perfect balance you require; long cord length gives you freedom.

If your hearing is acute enough you might hear the difference in our 3 models.

**1. GOLDRING GR102** —with separate volume controls.

Frequency Response 20-20,000 Hz; Matching Impedance 4-8 ohms; Maximum power rating 0.2 watts; Cord length 15'; Nett weight 15 ozs.

**2. GOLDRING GR101**

Frequency range 150cps-15Kcs; Matching Impedance 4-16 ohms; Maximum input 0.2 watts; Cord length 7'; Weight 11 ozs.

**3. GOLDRING GR100**

Frequency range 200cps-12Kcs; Matching Impedance 4-32 ohms; Maximum input 0.2 watts; Cord length 6'; Weight 10 ozs.

# GOLDRING

## Engineering (A'asia) Pty. Ltd.

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**Victoria:** 162 Pelham Street, Carlton 3053. Telephone 347 5177. **Queens-**

**land:** 32 Balaclava Street, Woolloongabba 4102. Telephone 91 4972.

**South Australia:** 207 Flinders Street, Adelaide 5000. Telephone

23 3488. **Western Australia:** 32 Northwood Street, Leederville 6007

Telephone 8 4988.

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clip coupon and post to your nearest Goldring office.  
I require further information on  
the Goldring headphones

Name \_\_\_\_\_  
Address \_\_\_\_\_

## A SAFE BET



First of the selling machines designed, developed and made by A.W.A. for the Totalizator Agency Board of New South Wales is now in operation.

This equipment at the William Street (Sydney) TAB branch, together with telephone betting machines, is part of a \$3 million contract placed by the Board with A.W.A.

With the new TAB betting system, less than three seconds elapse from the time a bet is recorded on the machine until a ticket is issued. This includes the time taken to transmit the information, processing by a centralised computer and transmission back to the operator.

The A.W.A. installation at William Street consists of a number of branch input devices (BIDs) which record details of each bet, transmit it to a computer, where it is verified, and then prints a betting ticket which is handed to the customer.

The Company is supplying 925 of these devices.

The telephone betting machines, an adaptation of the branch input devices, are used to record wagers from telephone betting customers.

Several of the 85 of these machines which the Company has contracted to supply are already in operation.

## IREE AUDIO STUDY GROUP

The Council of The Institution of Radio and Electronics Engineers Australia gave approval at its meeting on November 17 for the formation of an IREE Audio Study Group.

This decision follows upon representations made to it by manufacturing, wholesaling and retailing interests engaged in the audio sector of the electronics industry.

An earlier meeting attended by representatives of these interests told executive officers of the IREE that the

Audio Industry is presently fragmented and now recognises the need for unity and for a group effort to stimulate and guide its growth and development both nationally and internationally.

A prominent member of the Audio Industry told the IREE representatives led by Mr. Angus Fowler, that the Institution has the credibility, the authority and experience necessary to support and ensure the success of an audio industry group movement.

Mr. Fowler said the structure of the IREE could conveniently enable the establishment of an audio group which in addition to engineering aspects could be concerned with other areas of interest to the industry including standards of performance, measurement standards and certification of equipment.

"Another main objective will be stimulation of interest in the audio field and a continuing awareness about and dissemination of information on new developments", Mr. Fowler added.

Adopting Mr. Fowler's recommendation for the formation of the group, the Council asked that immediate steps be taken to prepare a set of rules governing the Group's establishment and operation as a virtually autonomous body. A committee has been formed and work is proceeding with a view to a detailed announcement being made in the New Year.

## MITSUBISHI SETS EVR PRICE

Japan's Mitsubishi Electric Corp. has become the second Japanese licensee to set a firm price on its electronic video recording (EVR) player.

The company priced its player at 276,000 yen, or about \$800.

Earlier, Hitachi Ltd. went on the Japanese market with its player at 268,000 yen, or about \$975.

Tokyo Shibaura Electric Co. (Toshiba) has unveiled a combination EVR player/20-inch color TV receiver for just over \$1,000 and a separate player which it said would be priced between \$550 and \$850. They are to become available at year end.

Matsushita Electric Industrial Co. the fourth Japanese licensee of the EVR Partnership, London, has not disclosed its marketing or pricing plans to date.

All four Japanese licensees are expected on the U.S. market next year when Motorola loses its exclusivity as North American supplier. Motorola's license is direct from CBS, developer of the EVR system.



# STA

## ELECTRONICS P/L

Manufacture — Sales — Service

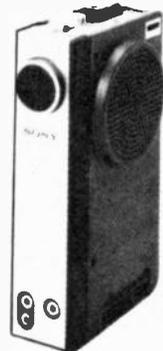
392 Centre Road, Bentleigh, Vic.,  
3204. Tel.: 97 4832 A.H. 97 5539



First Australian release of 4 channel headphones. You don't need four ears to listen to quadra-sonic or quadradial sound. Available in 3 makes from \$27.50.

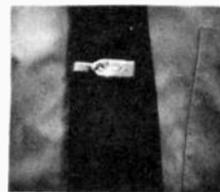
### IDEAL FOR THE TRAVELLING EXECUTIVE

- Handy, compact cassette-corder with "Swing-balance" mechanism ... perfect for people on-the-go.
- Small and light ... weighs only 1lb 11oz and measures only 1.15/16" x 7 x 4-3/8".
- Sensitive built-in Electret Condenser Microphone.
- "Swing-balance" mechanism for keeping tape speed constant and assuring stable performance even while the unit's in motion.
- Sony-O-Matic — automatic recording level control system.
- Four power sources — penlight batteries rechargeable batteries, auto/boat battery and household current.
- 400mW of power output from 2-19/32" speaker.
- Unique tape-end-alarm with Sony Auto-Sensor Cassette.
- Functional controls arranged for one hand operation.
- Meter for checking battery life and recording indication.
- Smart and handsome case with carrying strap.



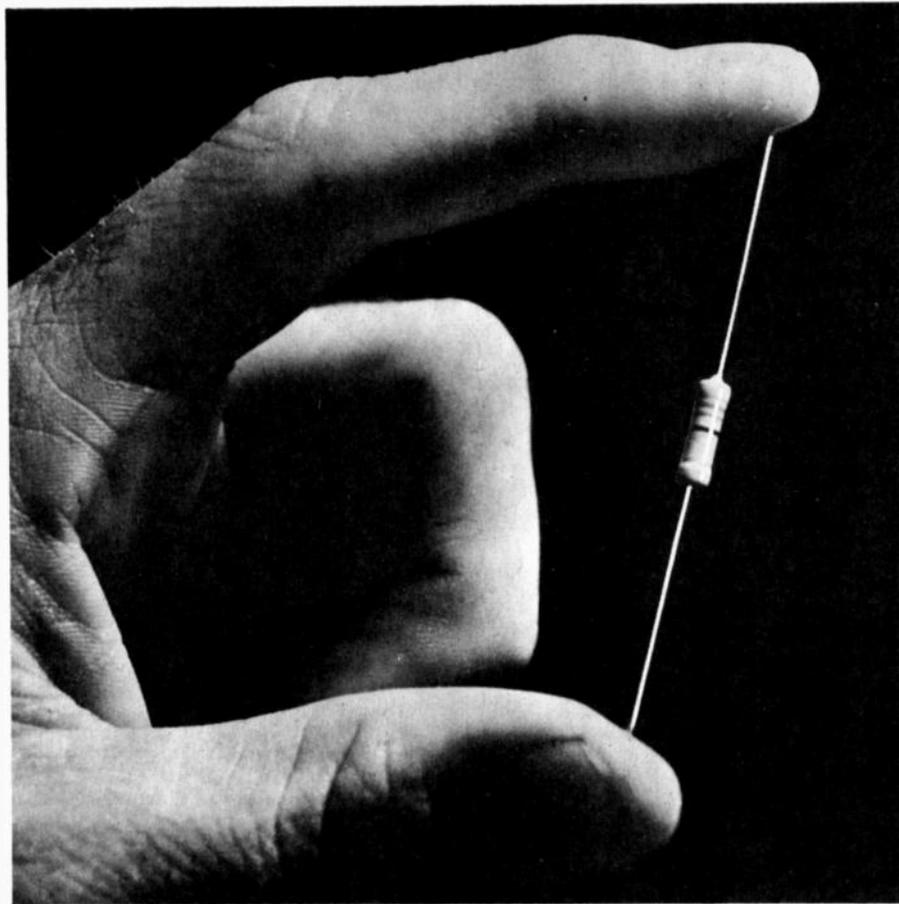
You can plug this microphone into most portable tape recorders and have your voice operate the on-off switch. As long as you talk the machine will record. \$19.00.

If you have a legitimate use for a miniature microphone like reporters or businessmen, this nicely finished tie bar unit is just the thing at \$3.75.



This is the jewel of them all. Gold plated cased micro miniature dynamic microphone. 50 ohm imp. with shielded 3ft. cable & 3.5mm plug. \$16.00.

# The Philips resistor.



□ **High stability** □ **Low noise** □ **Long life**

Why settle for moulded composition when you can get the superior quality of Carbon Film Fixed Resistors at even lower prices!

## THE ELCOMA DIVISION

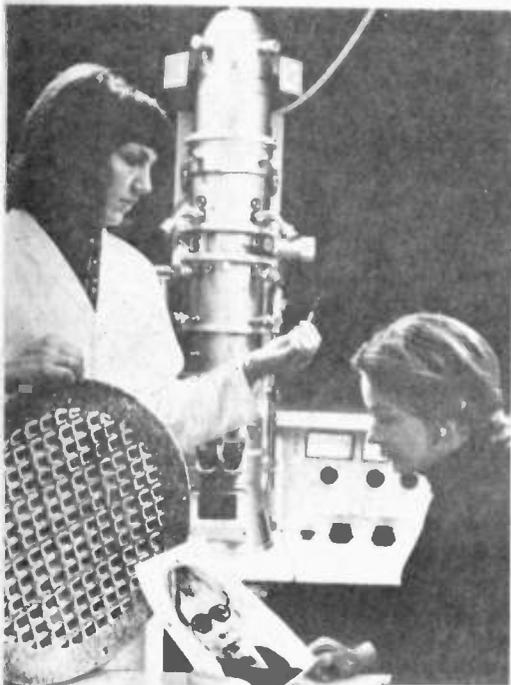
Electronic Components & Materials  
Philips Industries Limited.

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38.1402

# PHILIPS

MULTUM IN PARVO



The "waffle" is a 400-fold enlargement of an electron microscope's specimen carrier grid which contains information — texts or photographs — in extreme miniaturisation. The actual specimen carrier grid, measuring two millimetres in diameter, is held in a forceps by the girl in the white coat. The other girl is holding a portrait photo which has been converted from the reduced version.

Research being conducted by Siemens Berlin Laboratory of Electron Microscopy has yielded interesting developments in miniaturisation of data storage. An electron microscope "turned upside down" can capture a thousand bible-length books on a 25 square millimetre foil. This is achieved by an electron beam 1/100,000th of a millimetre in diameter which leaves traces upon a carbon foil, graphically duplicating the original. Conversion to legible form, faithful to the letter numbers and punctuation takes fractions of a second.

From this technique emerge remarkable possibilities for the future, but practical application for storing volumes of information still requires extensive development.

# Sydneys' LEADING HI-FI Specialist Centre presents

**\*SPECIAL SYSTEM\***  
at a Very Special Price

Treat yourself to a demonstration from the specialist staff.

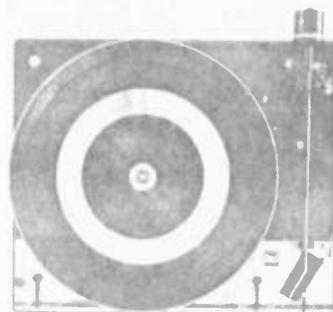
Open all day Saturday.

## Want a Stereo?

Then look at these unbelievable systems. Better still, come in and listen to these unbelievable systems from only

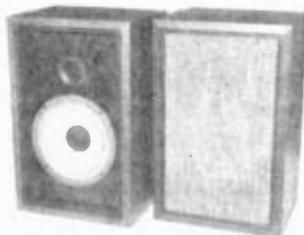
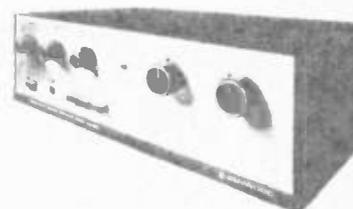
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**SONY-TEAC JOINT VENTURE**

Japan's Sony Corporation and TEAC Corporation have formed a joint company, in Tokyo, to develop and manufacture video equipment for the consumer and industrial fields.

Capital of the new venture is said to be about 400 million yen (approx \$1 million) of which Sony holds 51% and TEAC 49%.

Ario Morita, Sony president, will be chairman and Katsuma Tani, TEAC president, will be president of the new firm.

We understand that the new company's entire production will be sold to the two parent companies, but with Sony initially receiving practically the entire output. Eventually the joint company will produce equipment for marketing through TEAC.

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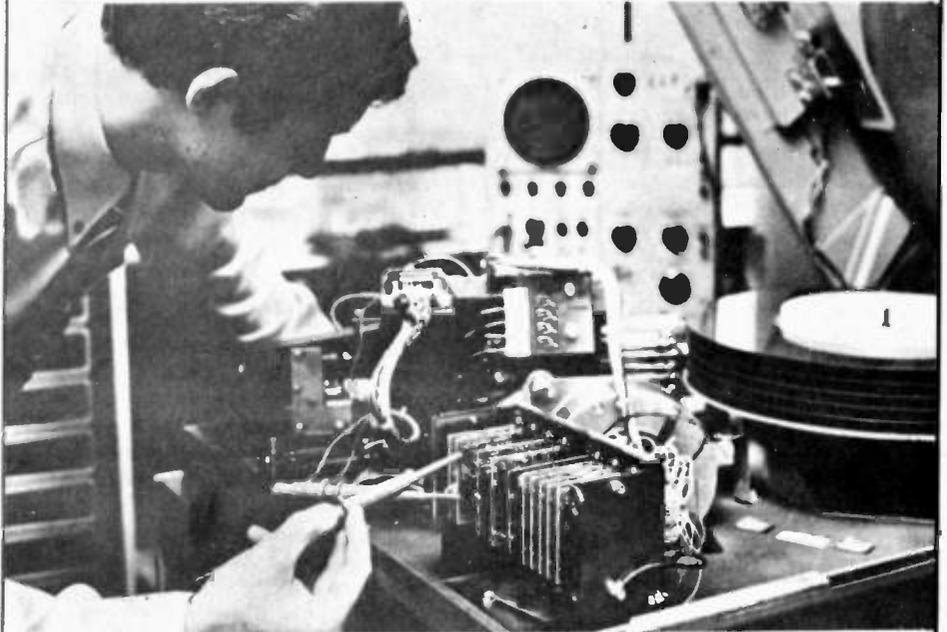


When the balloon carrying a Plessey Army loudspeaker burst at 80,000 ft., the transducer had racked up nine months of continuous service in the interests of science.

The University of Melbourne's Department of Physics R.A.A.F. Academy was using it as a sound source and receiver in scientific investigations of the lower atmosphere, which have already yielded information of great value to weather forecasters.

The photograph shows the gondola which was wrecked after hitting the ground at about 125 mph. The delicate "sound transducer" and its matching horn were in perfect working order and suffered only a slight dent to an aluminium alloy casting!

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## news digest



### TROUBLE-FREE RADIO LINK

Teleprinter messages and data of all kinds can be transmitted between continents over short wave radio links, but as these circuits are extremely interference-prone, special measures are required to ensure error-free transmission. The Elmux 1000 terminal, developed by Siemens, reduces the error rate in transmission of data over short wave circuits so that accuracy is comparable to that obtained in cable connections. The system incorporates automatic error correction. As soon as a wrong character is detected, the transmitting station is automatically requested to initiate a repeat transmission.

Because of its reliability this system is widely used by the various postal and telecommunications authorities in intercontinental telex traffic where radio circuits are still used.

### ANTI-TRUST SUIT AGAINST IBM

America's giant IBM Corporation has been hit by an anti-trust suit from the US-based Symbolic Control, Inc. The suit was lodged with the US Federal Court in mid-November.

Symbolic Control alleges that IBM has failed to 'unbundle' its hardware, software and maintenance packages in the field of numerically controlled machine tools — in which it has a 99% share of the market.

The complaint alleges that although software represents more than 35% of the total cost of an IBM numerically controlled machine tool package deal, IBM falsely tells its hardware customers that software and maintenance are 'free'.

Recalled in the complaint is a 1956 consent decree in which IBM was

prohibited from 'Conditioning the sale or lease of any IBM electronic data processing machine or device upon the purchase or lease of any other IBM electronic data processing machine'.

IBM is also charged with attempting to stifle competition by selling at less than cost and attempting to monopolize by getting lessees and purchasers to agree not to do business with IBM competitors. The alleged offenses add up to violations of the Clayton and Sherman Acts and sections of the California Business and Professions Code.

### AIRCRAFT SATELLITE ANTENNA

A new high-gain L-bank antenna for use by aircraft communicating with ground control has been designed and manufactured in Britain.

It would be fitted to subsonic and supersonic aircraft (Concorde), replacing high frequency radio (HF), which is often unreliable because of weather disturbance.

The Electronic and Space Systems Division of the British Aircraft Corporation, under contract to the U.K. Ministry of Defence, has developed the antenna to operate via geostationary satellites.

It consists of an array of elements and two antennae mounted on either side of an aircraft, such as on the tail fin.

The Royal Aircraft Establishment, Farnborough, is currently evaluating its reliability in a Hastings aircraft.

If fitted flush with the tail fin skin, signals received at each element of the antennae can be electronically adjusted so that the antenna beam can be steered without mechanical movement.

With a geostationary satellite system, the antennae will allow continuous high-quality communications, including data transfer, for airline use.

BAC is prime contractor with an international consortium which has been awarded a contract by the European Space Research Organisation to define the design requirements of satellites to set up reliable communication to aircraft in trans-oceanic flight.

### HO HUM

The US Government's FCC dept, responsible for policing radio usage, have dropped a large bomb into the plans of many companies actively promoting electronic video recording systems.

Many of these systems use low powered TV transmitters to couple the recorded signal into the TV input circuits. But, according to the FCC, most of these transmitters exceed permissible RF radiation limits, and would not be permitted outside a Faraday cage!

# THE ADVENT

## What they're saying about The Advent.

Although The Advent Corporation is new to the high-fidelity scene, its president is well known to anyone who has followed audio developments during the past fifteen years. Henry Kloss, a co-founder of Acoustic Research and later of KLH, is back with what promises to be an unusually diversified line of audio components. To no one's surprise, one of the first Advent products is a speaker system. It is more evolutionary than revolutionary in design, incorporating new materials and processes rather than new principles. The Advent speaker measures 25½" x 14¼" x 11½", and is suitable for use on the floor or on a bookshelf. It's a two-way system, with a newly designed woofer that has an effective cone diameter of 7½", although its overall diameter would usually cause it to be classified as a 10" speaker. The cone surround (outer suspension) is a specially processed polyurethane, quite different from the rubber-like compounds used with most speakers. The woofer's smallish diameter did not impair its low-frequency performance in the least, as our tests subsequently proved.

The tweeter is a direct radiator with a phenolic-resin cone 2 inches in diameter, also designed specially for this system. A three-position toggle switch in the rear of the cabinet selects normal highs, reduced highs, or extended highs, to suit one's taste.

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JULIAN D. HIRSCH

The shape of the curve above 6 kHz corresponds almost exactly to the calibration curve of our microphone . . .

We can't recall having heard another speaker in its price class that can match it . . .

We would consider that it ranks in sound quality with most speakers at twice its price.

### ELECTRONICS WORLD

The lows . . . remained strong and clean all the way down to 20 kHz with very low distortion . . . Without a doubt, The Advent is one of the smoothest and widest-range speakers we have had the pleasure of testing . . .

The tone-burst response was excellent throughout, ranking with the best we have seen from any speaker. **STEREO REVIEW**

. . . the frequency response was flat, with only ±3 dB variations over the major portion of its range. What is more important is that the 45-degree off-axis response follows the on-axis response to a remarkable degree, denoting excellent high-frequency power response . . .

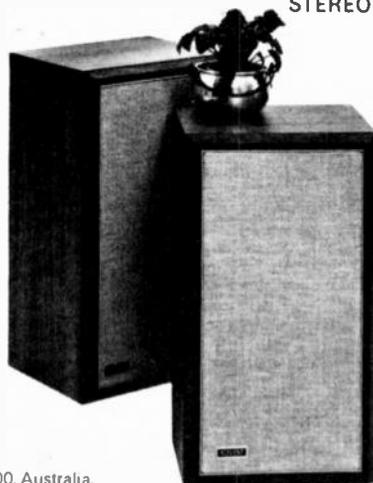
One could say that at twice the price The Advent speaker would be a good value.

### AUDIO

After several weeks of listening, we still hadn't found anything to complain about. They were, in fact, the least-coloured loudspeakers we have ever heard, and this includes the highest-priced systems currently available.

Probably for just that reason, The Advents proved eminently easy to live with. Dispersion was excellent and so, as a consequence, was the stereo imaging.

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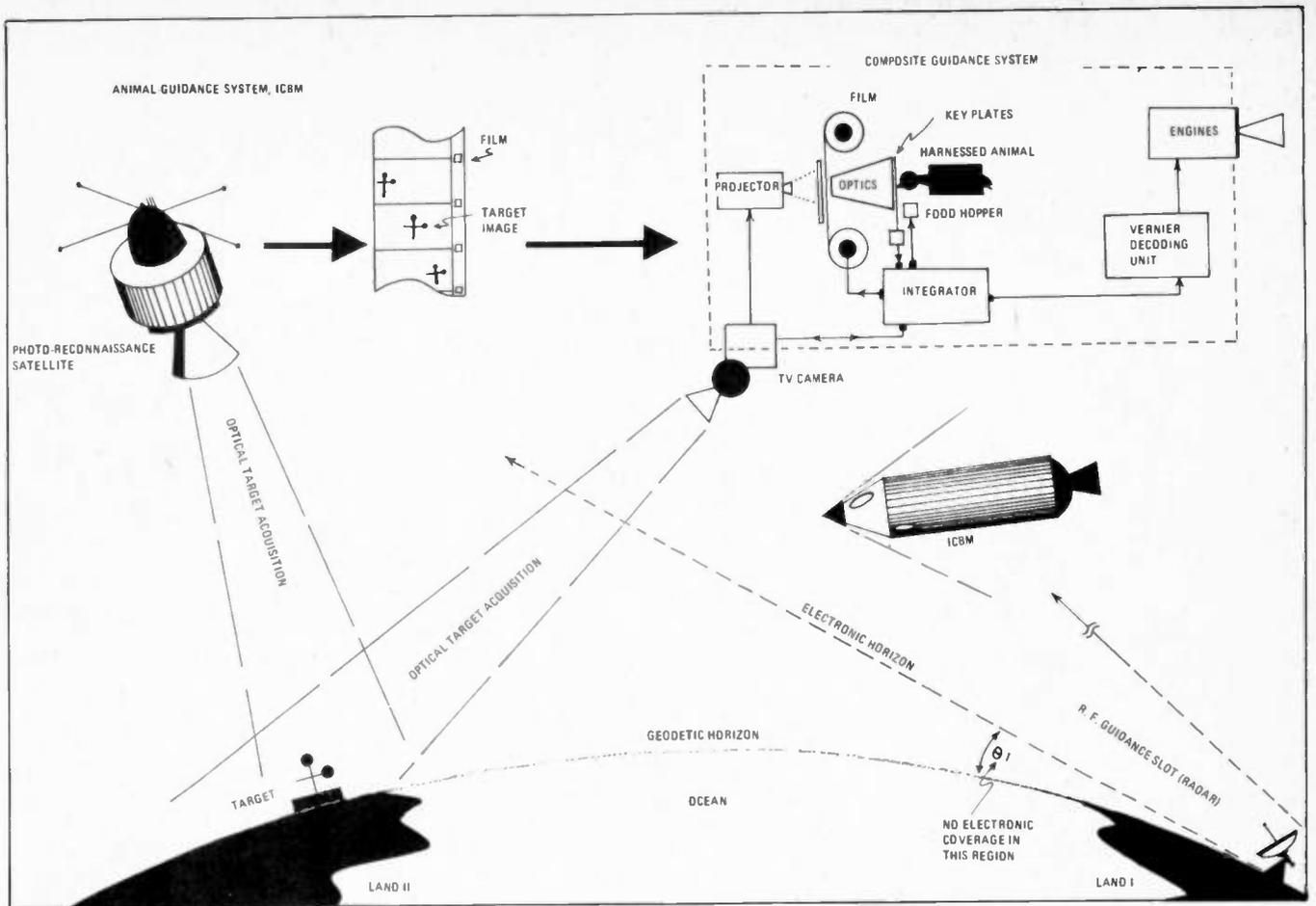


Fig. 1. Proposed animal-guidance system for ICBM. Initial target data is acquired by photoreconnaissance satellite. System operates with superimposed images and can't be jammed.

# ANIMAL GUIDANCE SYSTEMS

Both the USA and the USSR are actively experimenting with live animals in nuclear missile guidance systems. Will man be next? Electronics Today questions man's ethical right to conduct these experiments and feels that details of this work should be published.

by L. George Lawrence

IN a relatively short period of time, electronics-based weapons and their delivery systems have assumed a formidable role in the defense apparatus of the great powers. Now *Rand Corporation's "Soviet Cybernetics Review"* has reported an odd variation: Russian technologists, says *Rand*, are studying the feasibility of training cats to pilot air-to-air missiles right to their targets!

Although such possibilities are acknowledged both here and abroad, their application to armed conflict is startling. Provided that suitable instruments, including support electronics, are available, small animals can be trained to execute near-perfect control of production equipment and non-jammable guidance of weapons. But such duties, alien as they are, also pose the ethical question of our right to convert a lower creature into an ill-paid labourer or unwitting hero.

## SKINNER METHODS

Almost any sentient creature can be trained in the Skinner box, diagrammed in Fig. 2. A typical unit

consists of two chambers, one of which constitutes the actual training area (for a pigeon, in this case) and the other containing the various control, cue, and feed mechanisms for reinforcing the animal's learned behaviour." This arrangement was developed by behavioral psychologist Dr. B. F. Skinner, an outstanding authority on human and animal learning processes.

To make our living example (the pigeon) suitable for training, it is first fed a minimal diet until its weight is reduced by 20 percent. It is then put into the training box where an ample supply of water is always available.

Training begins by flashing one of the two key lights behind the key aperture. Now, after a time, the pigeon will peck the key (a microswitch), thereby activating the solenoid which pulls up the food tray to the simultaneously lighted food aperture. Thus, the animal learns to associate light of a given color with pecking and a consequent reward — food.

Once these initial steps have been learned, the Skinner box can be programmed — either manually or by computer — for the execution of more complex tasks. For example, the pigeon can be taught to peck only when the light is red or to expect to be fed only after it has made two or more bodily turns in the cage, etc.

As the training situation becomes more complex, the animal becomes aware of incidental cues — such as the ticking of clocks, external noises, and

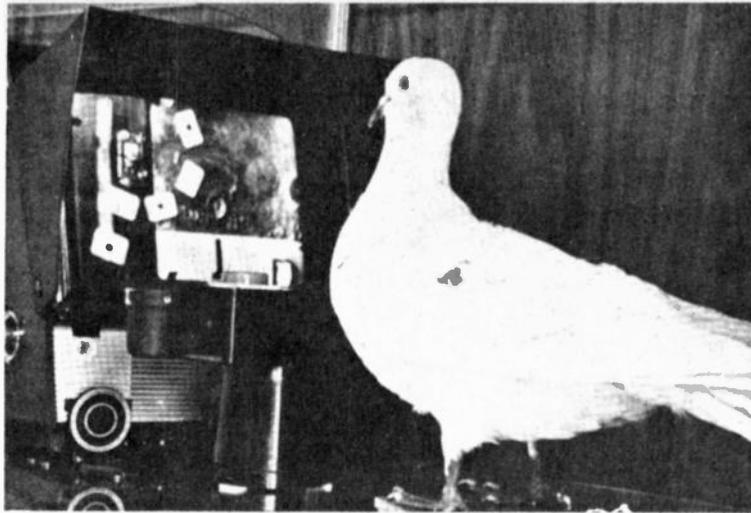


Fig. 3. Training station using TV-type display methods. Optical images are picked up and superimposed by TV camera which scans prepared pictures and cues; then bird reacts.

the like. Here, the internal volume of the Skinner box can be acoustically neutralized by radiating into it *white noise* at low levels. Also, if the pigeon makes errors in, say, tasks involving pattern recognition, it is "punished" by suddenly turning off a white *shock light* inside the chamber.

Figure 3. shows a television-type training arrangement confronting a "postgraduate" bird. Developed by the author for demonstration purposes, the display shows stationary and/or moving objects which contain a set of visual cues and superimposed images. The reinforced reward situation is maintained and expanded when the animal makes its peck at the control key (thereby receiving food).

It is on the basis of these and similar techniques that a massive set of skills can be taught to a pigeon — here assuming the form of an *organic computer* of enormous reliability, yet costing \$1.50 or less.

## CONTROL AND GUIDANCE PERFORMANCE

In 1964, Drs R. J. Herrnstein and D. H. Loveland performed experiments to determine complex visual concepts in the pigeon. (These birds are superb all-around subjects — hence their selection.) The test series showed clearly that pigeons had the unique ability to look for and react to the images of people. The birds were

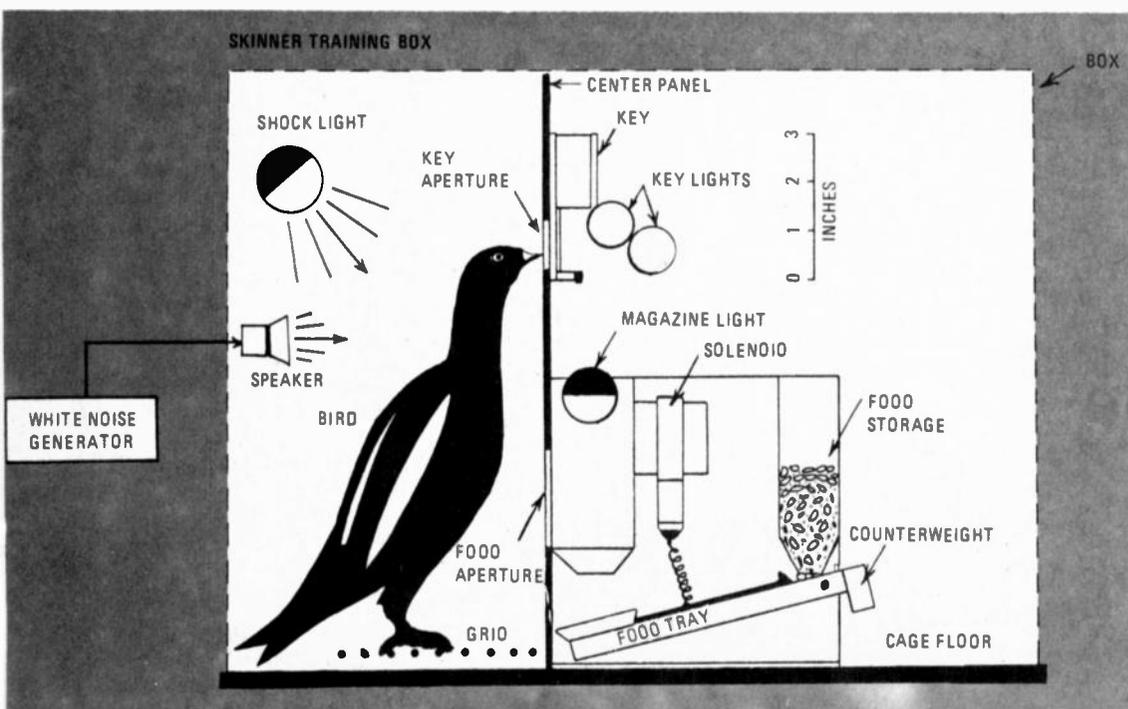


Fig. 2. Typical Skinner training box. Feeding and cueing mechanism are housed in one side of the box while the bird lives on the other side. White noise masks out environmental disturbances. Lights are used in various ways to give cues.

# ANIMAL GUIDANCE SYSTEMS

allowed to look at projection slides in which human beings were obscured by cars, trees, window frames, and the like. This fascinating experiment, which also involved tasks of categorizing and complex rules for sorting out pictorial elements, produced evidence of animalistic conceptualization. But this experiment does not stand alone. Even in the study of instinctive behaviour with creatures low in the phyletic scale, there is overwhelming evidence of discrete sorting and generalizing.

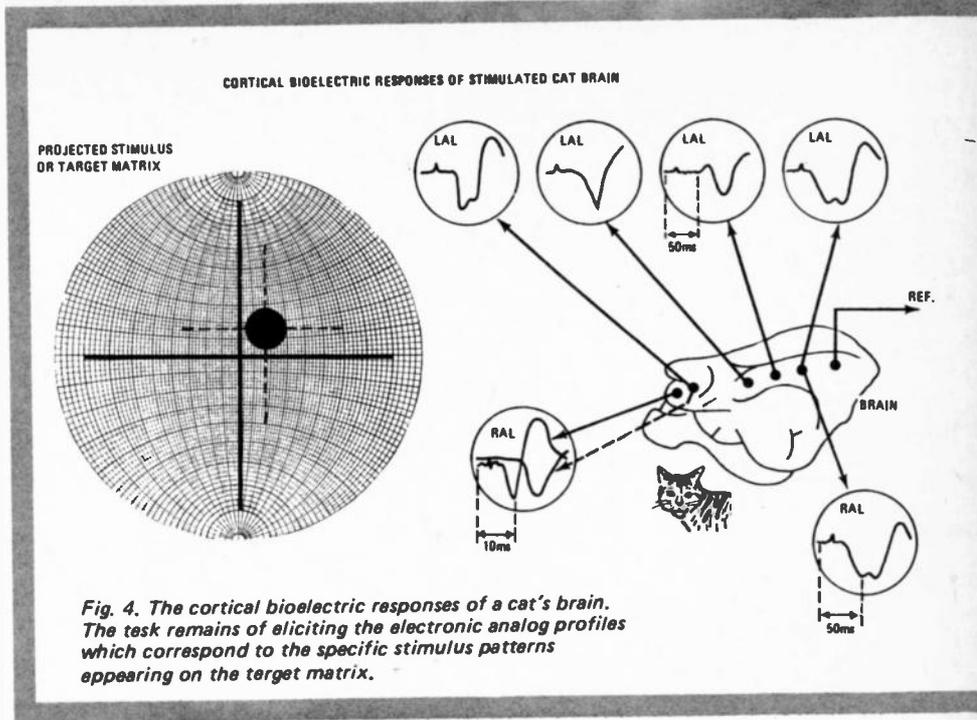
Visual conceptualization and the motor activity triggered by it is one of the most sought-after goals of computer designers. Unfortunately, at present, this type of artificial electronic intelligence has eluded designers and remains an innate capacity of living organisms.

Dr. T. Verhave's experiments are a good case in point. Working for a large pharmaceutical company as a psycho-pharmacologist, he conceived the idea of using pigeons as quality-control inspectors. The company made gelatin drug capsules — about 20 million units per day — and sorting out "skags" or defective capsules was an involved and costly process.

The drug capsules were brought into the bird's view by means of a moving belt and, through inspection windows, examined for defects. Skags made up about 10 percent of all the capsules on the belt. Reinforcement (feeding) was applied only when the bird made an appropriate number of pecks on the window-key. Wrong pecks, either misses or false alarms, were not rewarded and caused a 30-second blackout inside the pigeon's work box. However, although results were excellent, Verhave's concept was not adopted. Fears of adverse publicity (sic. — Ed) and similar interferences kept it from being used on a routine basis. The problem, it seems, is that the average layman thinks of inspecting birds as animals scratching with their feet in a pile of drug capsules, picking one up now and then.

Some 30 years ago, one of the strongest scientific objections raised against animal-equipped missile-guidance systems was that of adequate feedback control. Further, it was thought that in an actual combat situation, an animal-type weapons pilot would become irritated (perhaps get airsick) and, thus, doom the mission.

Most of these objections have now



been overcome. Toward the end of World War II, Skinner and his assistants initiated a research programme called "Project Pigeon." It had a peacetime counterpart at the Naval Research Laboratories as "Orcon" — an acronym of the words "organic control." Both of these programmes have now been declassified.

Skinner's was a kind of majority-vote bombardiering system directed against ships. The missile, a simple airborne vehicle named "Pelican," was designed to use three harnessed pigeons trained by his methods. Three animals were to be used on the theory that at least two would peck correctly on the left or right of a target screen. Again, in spite of excellent results, the system was never put into operation. The Manhattan Project and its atomic bomb came along, which eliminated — as it seemed at that time — the need for pinpoint bombing. However, the fact remains that animal-guided weapons systems cannot be jammed, either electronically or by other conventional means. Once trained, as Skinner implies in his reports, a given animal tends to retain its "data" so well that it can be recalled at will even if the creature has been freed from its laboratory environment and is allowed to go on free flight again. There is no "obsolescence."

It is for these and other reasons that dynamic combat schemes, such as that shown in Fig. 1, have emerged.

This weapons system is best understood by considering it as a composite. Its principal components are (1) a photo-reconnaissance

satellite, (2) a radar system, and (3) an animal-guided ICBM.

The elements of target data are generated in peacetime and, more narrowly, in times of war. During overflights of enemy territory, the satellite uses infrared and other photographic methods to produce film of ground targets at a selected focal length. Then, by using Skinnerian conditioning techniques, the animal weapons pilot learns to recognize specific target features which are presented to him, together with moving-ground images, by means of superimposition in an optical display system. Thus, during actual target runs, the pilot will peck (in the case of a pigeon) the appropriate guidance keys until the vehicle makes suitable vernier manoeuvres to achieve perfect image superimposition or "target zero." As the target grows in optical magnitude, the superimpositions are kept in plane and, finally, a ballistic is selected which ensures a bulls-eye target run. At that time barometry takes over and senses the proximity of the target by evaluating the outside air pressure. Simultaneously, the chemical detonators are activated and, on command from the barometer sensor, initiate fission of the nuclear warhead.

As shown in Fig. 1, a weapon of this type is vulnerable to enemy countermeasures only as long as it receives initial guidance in the radar's guidance slot. Once the missile leaves the electronic horizon and enters the geodetic horizon under animal control, effective defense against it is no longer possible — at least not with the crude anti-missile weaponry available today. Indeed, it is one of the most

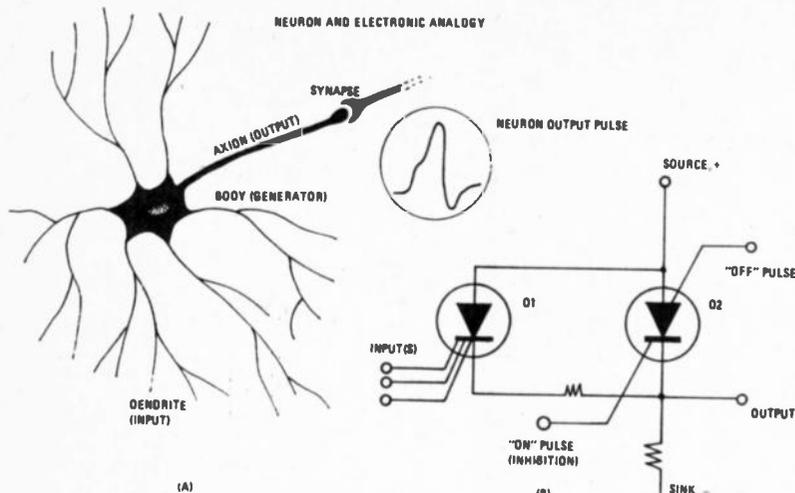


Fig. 5. Neuron and electronic analogy. At (A) the neuron cell receives inputs via dendrites. At (B) functions may be simulated artificially by electronic neuron cell. Refer to article.

formidable war machines the human mind can conceive — for better or worse.

## BIODYNAMIC GUIDANCE SYSTEMS

We mentioned the cat-guided missile scheme at the beginning of this article. It might appear, at first glance to be little else but science-fiction, but it is dangerously more than that.

Typically, when thoughts turn to animals and guidance systems, we are inclined to envision a complete living thing — body, legs, skin, and a complete set of internal organs. This holds true of a lightweight creature like a pigeon, or perhaps a rat or mouse. There is little difficulty in providing long-term or stand-by life support systems for them, even within the cramped space of an ICBM. But animals such as mature cats, dogs, pigs (excellent performers), horses, and other large creatures, have larger brains and neuronal network capacities. The large brain can be electronically manipulated and is less inclined to die rapidly if its nutrient bath becomes disturbed. Thus, the designer focuses on the removed brain only, rather than considering an animal's composite body and its requirements. But, as he works with neurophysiologists to determine specific centres of data storage and correlation within an animal's severed brain, he encounters the difficulty of having no motor responders to stimulus. Data is expressed in the form of electronic products, only typically in the form of rising and descending voltages as one finds in manmade computers. There also are so-called "artifacts" or

phenomena which are still unexplained.

Drs. Albe-Fessard and Rougeul provided excellent electronic data on the cortical responses of a cat's brain in 1958. However, it was most difficult to detect evoked potentials from non-specific areas of the cerebral cortex in awake animals. Further, it was difficult, and in some cases almost impossible, to extract signals from noise.

Fig. 4 shows a set of cortical responses. The animal was kept under light chloralose anesthesia. The entries LAL pertain to the left anterior leg, RAL identifies the right anterior leg. So-called secondary evoked potentials (SEP) disappear under barbiturite anesthesia — but, for reasons unknown, the application of chloralose has the odd effect of synchronizing and enhancing them. This brings us to the fine-constituents of organic brains and their synaptic transmission properties. What is desired here is that an animal brain's data-processing system can clearly recognize and provide responses when exposed to stimulus in a "target matrix" such as shown to the left in Fig. 4.

Living brains are composed of neurons. Shown in simplified form in Fig. 5A, the biological neuron is essentially a binary or digital threshold device whose output is "all-or-none" — 1, 0 respectively. Its inputs, of which there can be as many as several thousand, are called dendrites. Actual signal processing takes place in the neuron's central body.

Most dendrites are excitatory systems, that is, signals passed on by

them cause the central cell body to "fire." Other dendrites have inhibitory properties: signals appearing on them keep the cell from firing. Thus, the neuron's electronic status, "1" or "0" at any given instant, is determined by the combination of signals appearing on the dendrites. If there are enough excitatory signals present, the cell threshold is exceeded and the neuron fires. Likewise, if too many inhibitory impulses are present, more excitatory signals are required to exceed the firing threshold.

These electronic characteristics allow us to consider the binary analogue circuit shown in Fig. 5B.

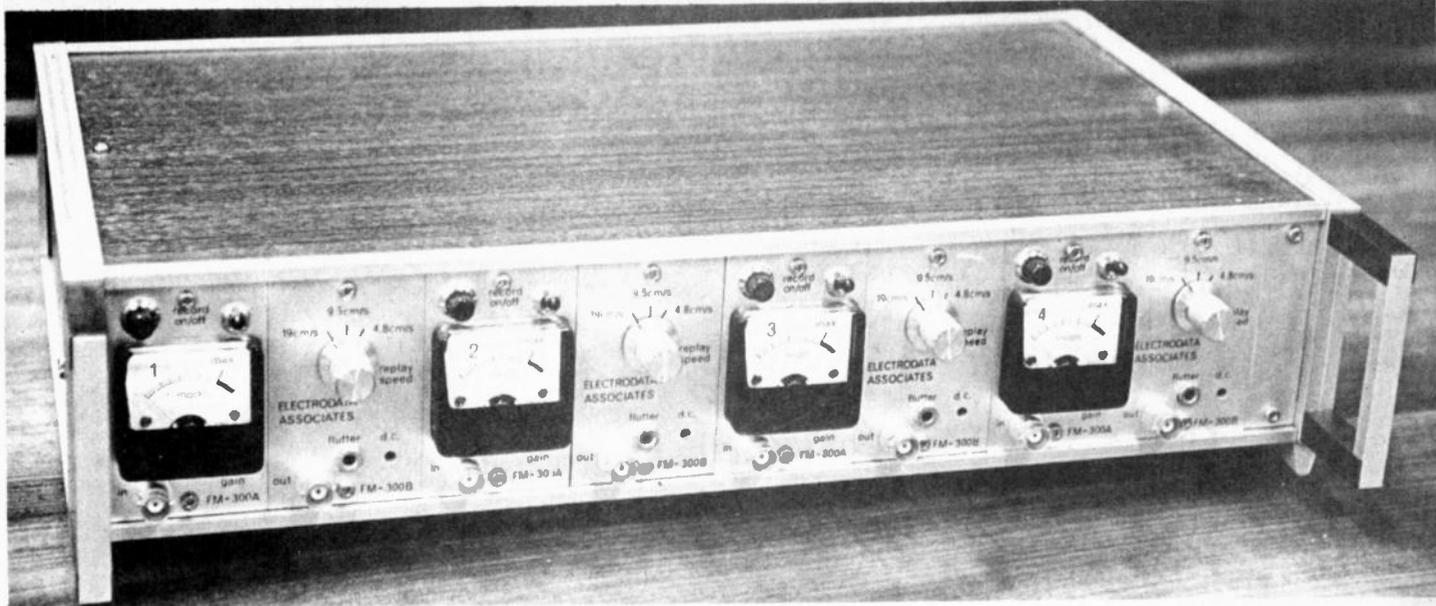
This "artificial neuron" is comprised of the multi-gate SCR, D1 and thyristor, D2. Because these diodes know no intermediate states of conduction like a transistor or normal vacuum tube does, the dynamic conditions of "on-off" can be established and maintained by applying appropriate trigger pulses to D1 and D2. Note that this is a simplified circuit in which zener-type threshold components have been omitted for clarity's sake.

However, although circuits of this type are being used in the relatively new field of bionics and represent progress in the art of self-organizing computer systems, it still is most difficult to transfer such analogies to real-life organic controls.

If we believe the principles set forth by St. Thomas Aquinas in his book *Summa Theologica*, true intelligence — be it that of machines or living organisms — must have these components: passive (intellectus possibilis); active (intellectus agens); and will. It is unfortunate for our experimental animals that only they, next to ourselves, have the features, which suggest their employment on behalf of man's survival.

In conclusion, it can be stated that we are on the threshold of a new if undesirable art. The Skinnerian methods are being refined and updated, typically by augmenting them with sophisticated electronic gear. However, it appears that the problem of using animals' brains directly in guidance systems have not yet been solved to the complete satisfaction of those who plan to use them. Organic brains without life-supporting baths and circulating nutrients (blood) tend to die within 10 minutes or less. Thus, until this problem and others have been solved, it is safe to assume that *Columba Domestica* — the common pigeon — will receive its draft call. ●

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Electronics World December 1971.



# VERSATILE FM RECORDER

*This Australian designed and built FM recorder will find many applications in industrial, scientific and medical research. A full technical appraisal by Louis Challis B.E. and Murray Wood B.E. BSc. M.E.*

**I**N our September issue we reviewed the Bruel and Kjaer F.M. tape recorder, type 7001. Since that time a wholly Australian-designed and built FM tape recorder system has been produced.

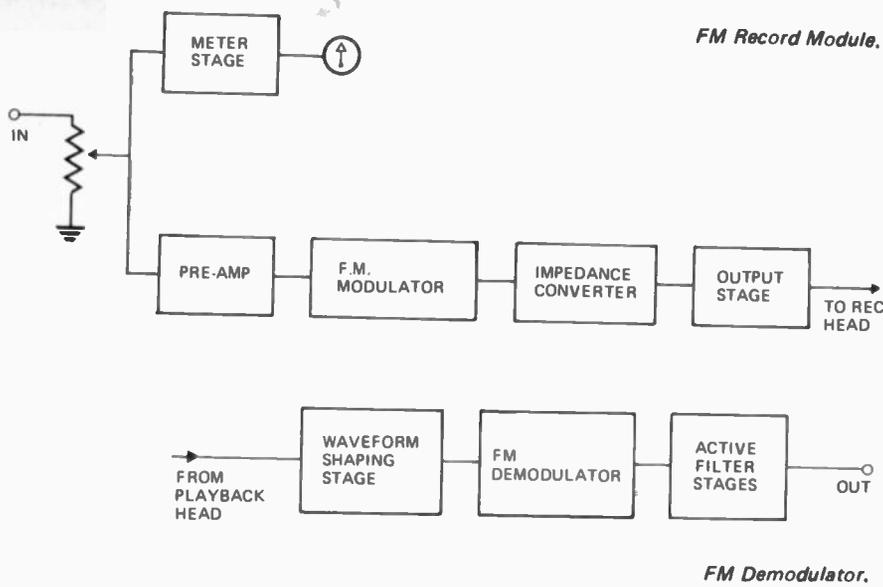
The Australian recorder is the Electrodata 300 FM tape recorder, manufactured by Electrodata Associates Pty. Ltd. The FM recorder is their first product, and it was specifically designed for use in the field of medical research. Because of manufacturing limitations it had to be designed around a commercially available tape deck (the Sony TC 366) pending the construction of their own recorder. This resulted in an unexpected advantage for Electrodata Associates for as the system is designed

to operate with a separate recorder this has resulted in a modular system which can be used with any moderately good conventional recorder. To prove this, we tried out the system with our battery operated Kudelski Nagra III recorder to obtain a portable system which could be easily used for field measurements — far more easily in fact than the Bruel and Kjaer unit, which weighs 85 lb. The combined system can be fully battery operated, which makes for even greater flexibility.

With the standard Electrodata unit the power supplies are built into the tape deck, allowing four channels of record and playback modules to be contained in one rack. Because the design called for four channels this resulted in the need for a simple

redesign of the standard Sony TC 366 deck to allow for the addition of the extra two channels, but since the production of the Electrodata FM tape recorder, several four channel tape recorders have been released. This will enable the production of a system with fewer modifications being required to the tape deck.

While there are many multi-track data recorders available — at a price — the design philosophy behind the Electrodata machine has been to produce a unit which is inexpensive compared with other FM recorders, yet with adequate flexibility to meet the needs of many users. The more expensive FM recorders offer many tape speeds of up to 100 inches per second, but the standard Electrodata



## HOW IT WORKS

The record module differs significantly from the Bruel and Kjaer recorder. Whereas the Bruel and Kjaer recorder uses a constant-frequency master oscillator for all its modulators and demodulators and subdivides the frequency to suit the speed, the Electrodata recorder generates its FM signal to the record module and the frequency is individually adjusted for each tape speed. This is done by a very ingenious circuit which consists of a variable constant-current supply to a flip-flop.

The easiest way to visualise this circuit is to consider the 'constant' current supply as resistors in the frequency determining components of the flip-flop. If the value of three resistors is decreased, the frequency of the flip-flop increases. The 'constant' current supply maintains the current independently of what happens at the flip-flop, but is controlled by two sources; one a resistor which is related to the selected tape speed, and the other the input signal voltage. Thus, if the input signal voltage is zero, the

machine offers only three speeds with a maximum  $7\frac{1}{2}$  inches per second. This means that the FM frequency response is limited to about 2kHz while the frequency translation available is only a factor of four (compared with the Bruel and Kjaer 7001, with a frequency response of 20kHz and a frequency translation ratio of 40). But modules are available for speeds up to 60"/second if the customer is prepared to pay the higher cost of a high speed tape deck.

miniature jack connection for flutter compensation. These jacks are notorious for their inability to withstand prolonged usage. We would have preferred to see a more positive form of connector — even at the expense of an extra switch.

## CONSTRUCTION OF THE UNIT

The heart of the Electrodata system is the rack of record and playback modules. The appearance of the unit as a whole is not as professional as one would normally expect for an instrument in this price range, but this is mainly due to the obviously domestic or consumer orientated design of the Sony TC 366 recorder. The FM modules are neatly constructed in a standard rack system. The record and replay modules are completely independent. The modules may be interchanged with the appropriate modules from other channels in the event of a failure.

The record module contains a record level meter which holds the peak signal level for some seconds. The only other control are a preset multiturn level adjustment and the input BNC connector.

The playback module has a speed selector switch, a preset multiturn dc offset potentiometer, an input/output miniature jack (similar to those used on transistor radio earphones used in conjunction with the flutter compensation), and a BNC output socket. The extremely simple controls make for the minimum confusion for the user whilst being quite adequate for complete control. The only adverse comment on the front panel arrangement is the use of the



*The Sony TC 366 tape deck is fitted with a four-channel head.*

# VERSATILE FM RECORDER

## SUMMARY OF MANUFACTURER'S MECHANICAL SPECIFICATIONS

Tape Speeds	7-1/2, 3-3/4, 1-7/8 ips
Channel Configuration	
Channel 1	FM or Direct (Using Sony circuitry)
Channel 2	FM only
Channel 3	FM or Direct (Using Sony circuitry)
Channel 4	FM only
Data Protection:	Normal Sony Record Interlock & Switch on Respective Record Module.
Head Configuration:	2 Record, 2 Playback Channels 1 and 3 on one head Channels 2 and 4 on second head.
Phase Error	less than $\pm 2$ m/sec between the two heads less than $\pm 0.1$ m/sec between two channels on the same head.
Performance in Direct Mode	
7 1/2 ips	20Hz to 12kHz $\pm 3$ dB
3 3/4 ips	20Hz to 6kHz $\pm 3$ dB
1-7/8 ips	20Hz to 3kHz $\pm 3$ dB

See also measured performance on page 24.

nominal carrier frequency is generated; while at any other voltage the frequency is shifted. If the voltage is positive, a higher frequency is generated, if it is negative a lower frequency is generated. A change of one volt in the input produces a frequency deviation of 40% about the carrier frequency. This system is much simpler than that used in the Bruel and Kjaer recorder, but is capable of providing excellent results provided that the equipment has been correctly adjusted.

The signal from the modulator is passed (via a very small capacitor) to an integrated circuit which is

essentially an unstable amplifier. A very small positive voltage pulse results in the amplifier saturating at one polarity while a similar negative voltage pulse results in it saturating at the other polarity. The small capacitor produces very little loading on the flip-flop but provides a pulse of sufficient amplitude to change the direction of saturation of the amplifier. This amplifier, in turn, drives a pair of transistors which, in their turn, drive the record head.

In the oscillogram (shown in Fig. 1) the square wave signal to the record head is shown with the sinusoidal input signal superimposed. The

changing of pulse width with amplitude can be clearly seen. The signal which is fed to the record head has a sufficiently high amplitude to completely saturate the tape. This is common to most FM recorders where, because the waveform is not important, the larger the signal, the better the signal-to-noise ratio. This saturating of the tape also eliminates the need for an erase head, and eliminates some circuitry.

The playback circuit consists of a high-gain pre-amplifier, which tends to overload with the signal level from the head. This starts the squaring process and ensures well defined crossovers.

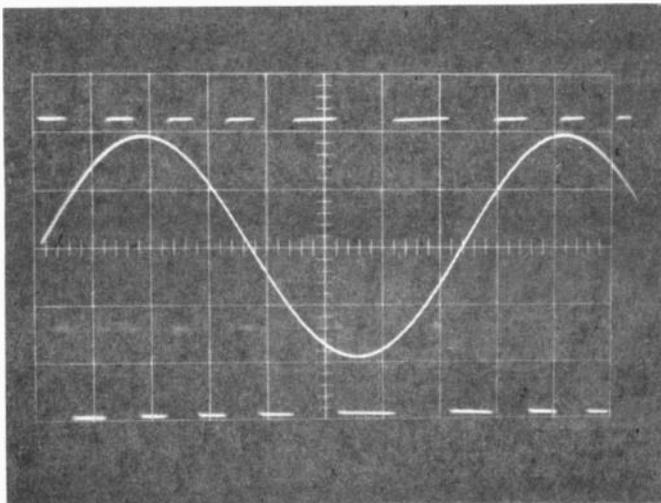


Fig. 1. (a) Square wave signal to record head of Electrodata FM 300.  
(b) Sine wave input

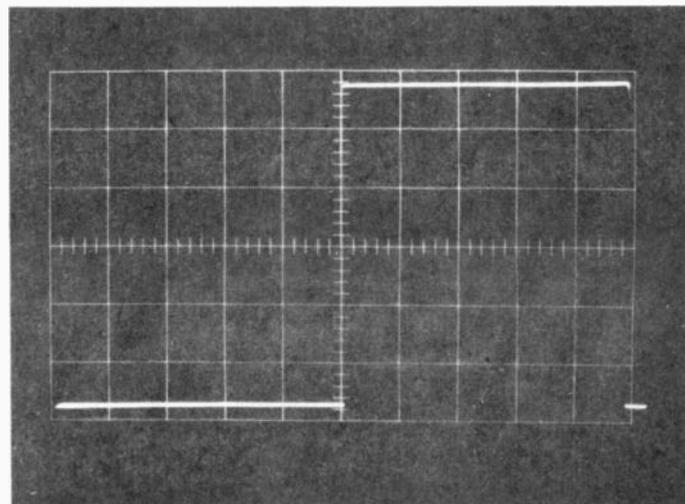
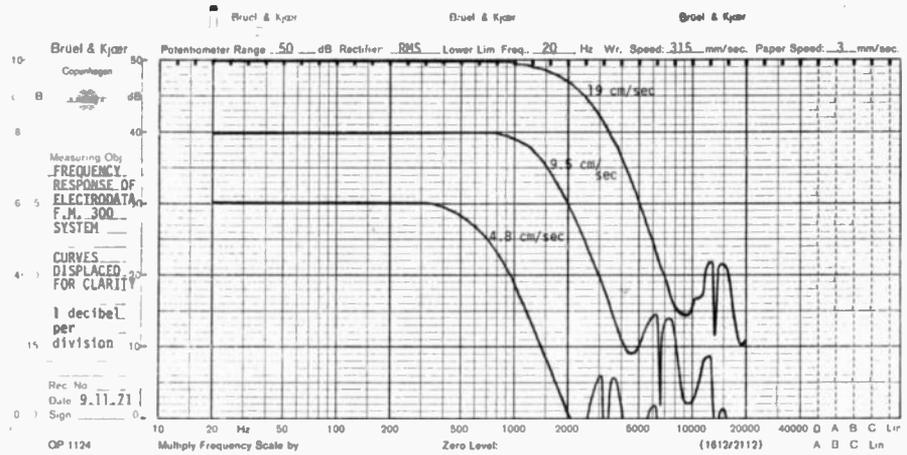


Fig. 2. Input Signal (200Hz) fed to the two FM recorders.

This signal then drives a Schmidt trigger. A Schmidt trigger is a circuit which produces square waves of constant amplitude corresponding in this case to the zero crossings of the input waveform. The signal from the Schmidt trigger then drives a bistable stage. The two outputs from the bistable oscillator are differentiated, and combined to produce a series of pulses the positions of which are related to the zero crossings of the input waveform from the tape head. These pulses are used to drive a monostable multivibrator whose output consists of a series of pulses with an exact pulse width, but spaced according to the input signal. The average voltage of these pulses is proportional to the spacing between them. Close spacing produces a high average voltage, while a greater spacing produces a lower voltage. The averaging is accomplished by two stages of active filters. These are designed to produce a roll over at about 2.5kHz at 7½ ips. The output from the filter is backed off against a dc voltage corresponding to the frequency of the unmodulated carrier.

The last filter stage also provides for the introduction of a flutter compensation signal. This signal is the output of a recorded but unmodulated channel. This signal on the tape has undergone essentially the same frequency changes as the desired signal, therefore any spurious signal normally introduced as a result of flutter is contained on this channel. By subtracting this signal from the signals on the wanted channels it is possible to reduce the effect of the flutter signal. We found that a reduction of 20 decibels, or 90%, was obtainable using this facility. The best results are obtained if the signal from the same tape head is used, i.e., channels 1 and



3, or channels 2 and 4, for optimum compensation. The price one has to pay is one less data channel available for recording. This feature is very necessary for the best response when data is recorded from a moving object or alternatively when the recorder has a significant amount of flutter and wow.

### THE POWER SUPPLY

The power supply which was built into the tape deck, uses an integrated circuit type regulator driving a power transistor in each supply leg. Since the FM performance and stability directly depend upon the precision of the power supplies, the availability of these integrated circuit regulators with their high performance, combined with current overload protection, simplified the task of Electrodata in designing a power supply with high precision.

As a safeguard a crowbar protection circuit is used. This provides almost absolute fail-safe operation. If the voltage or the supply rails to the modules exceeds a preset limit, a silicon controlled rectifier connected across the supply to the regulator

switches on and stays on. This short circuits the dc supply dropping it to a few volts and causes an extremely high current to flow through the fuse. The fuse blows and allows the protection circuit to reset. All this takes place before the voltage rises high enough to cause any damage, except possibly to the component that was the cause of the problem in the first place.

The complete record playback system makes use of eight diodes, eight transistors, ten operational amplifiers and many resistors and capacitors per channel. The design appears to be very stable and capable of producing good results for many years without the need for frequent realigning or service.

We felt that one weakness in the system, was the power supply. In the unit supplied for test this was mounted in the tape deck where ventilation may not be sufficient. Since the supply voltages govern the accuracy of the FM circuitry, a separate enclosure would probably reduce the thermal drift with time (as the recorder and power transistors achieve operating temperature).

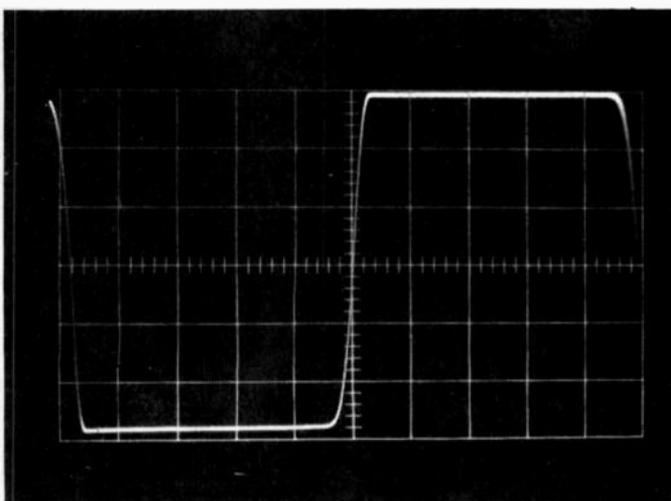


Fig. 3. Record/Replay Response of Electrodata FM 300 to 200Hz square wave.



Fig. 4. Record/Replay Response of Bruel & Kjaer 7001 to 200Hz square wave.

# VERSATILE FM RECORDER

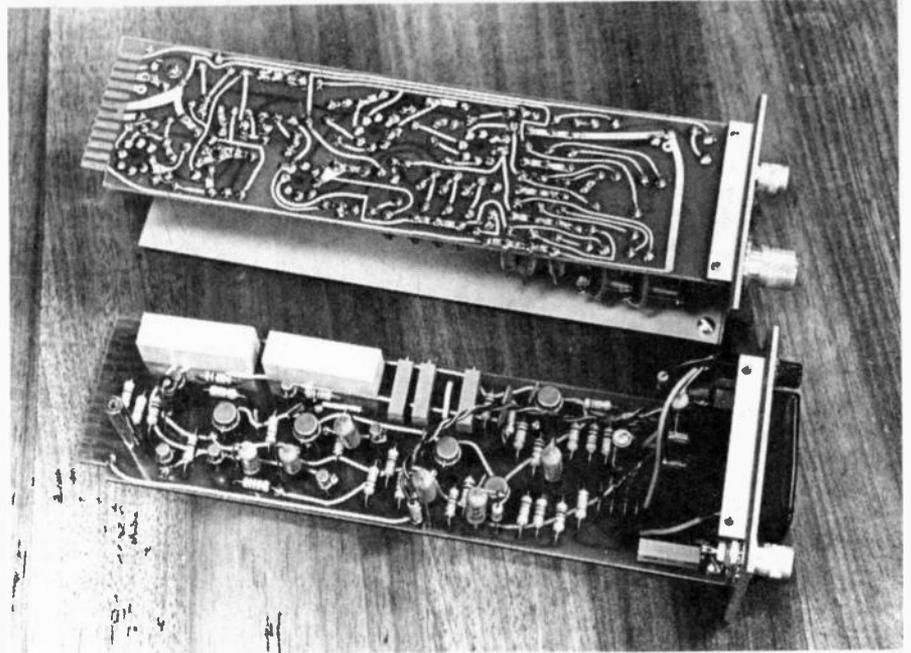
## HOW THE SYSTEM PERFORMED

Having looked at the design of the recorder, we put it through its paces on the test bench. In all departments it performed within the specifications stated by the manufacturer and was comparable with most units costing many times its price.

A significant difference between the Bruel and Kjaer 7001 and the Electrodata 300 is the frequency response design philosophy.

The Bruel and Kjaer recorder, being primarily designed for use with other Bruel and Kjaer spectral analysis equipment has been designed to produce an extremely flat frequency response to the upper frequency limit and then to rollover rapidly after this point. While this rapid rollover maintains the accuracy required for spectral analysis it does not reproduce the waveform accurately.

The Electrodata FM recorder on the other hand is designed to provide the optimum presentation of a waveform rather than the optimum frequency response. It therefore has a smooth rollover, and is 3dB down at the upper limiting frequency. To illustrate this, we fed a 200Hz square wave into both recorders, with an upper frequency limit of 2kHz. The Electrodata recorder has an upper frequency limit of 2kHz at 7½ ips and the Bruel and Kjaer recorder has an upper frequency limit of 2kHz at 6 ips. As can be seen from Figures 2, 3, 4 the waveform produced on playback by the two machines is completely different. The Bruel and Kjaer recorder produces a square wave with a marked ringing while the Electrodata recorder produces a wave form which is very similar to the original. The waveform



**BOTTOM:** Electrodata record module — **TOP:** Replay module.

distortion would be even more marked if the ratio of signal frequency to cutoff frequency was higher or the width of the signal pulse was narrower.

Because the Electrodata recorder uses standard tape speeds this enables some increase in flexibility. We ran a series of measurements, using the Electrodata recorder, that continued for over an hour. From this series of measurements we only needed to analyse in detail a few sections, lasting for approximately 10 seconds. To do this, we transcribed a section of the tape directly onto a tape loop on an ordinary recorder using the direct mode of the Sony. This meant that it was not necessary to connect from FM to AM to FM with the attendant loss of signal-to-noise ratio or, as is more normal in laboratories which cannot afford two FM recorders, the cutting of a tape loop from a good reel of tape and the consequent destruction of the original record.

## DATA TRANSMISSION

A further thought on the use of the Electrodata FM modules is their possible use for data transmission. With a few small modifications they could be used for high quality transmission of signals over a poor quality broad-band channel providing an improvement in the flatness of the frequency response together with a marked increase in signal-to-noise ratio. The multiplex units soon to be released by Electrodata are likely to find their way as much into this field as into the FM recording field.

The handbook provided with the Electrodata FM recorder was particularly well laid out. Consisting of 24 foolscap pages, it details the specification, method of operation, theory and design details, circuit diagrams and a complete parts list (including manufacturers and suppliers.) The handbook would allow anyone with a basic electronics knowledge to operate and maintain his own machine (with the aid of a few standard instruments.) This is a feature which is particularly worthwhile. As the user of many imported instruments, we are often frustrated by the need to wait up to three months to have a minor, non-standard component airfreighted to Australia. It is highly commendable that an Australian produced instrument should contain only components locally manufactured by large international companies such as Philips and Fairchild.

In all, the Electrodata FM 300 system appears to be well built and to function extremely well. What it lacks in presentation is more than compensated for by its ease of operation and performance per dollar.

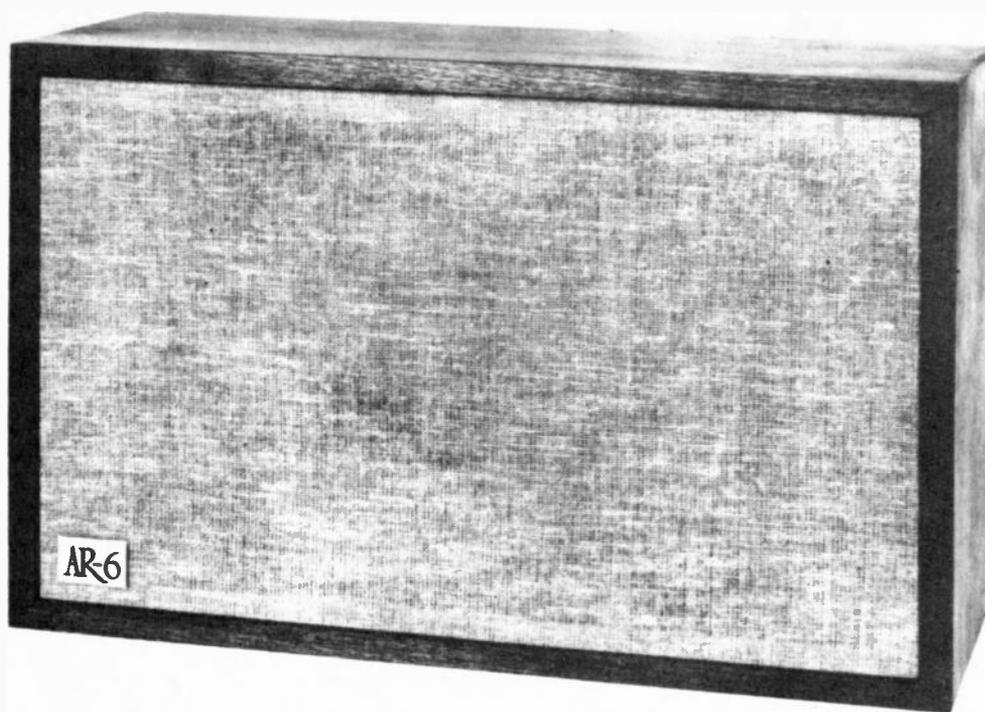
### MEASURED PERFORMANCE OF ELECTRODATA FM 300 SYSTEM

Module Serial No. 001 using BASF 35LH Tape and Sony Deck TC366.  
Serial No. 043366.

Frequency Response	+0, -3dB	+0, -6dB
at 7½ ips	dc to 2kHz	dc to 2.5kHz
at 3¾ ips	dc to 1.3kHz	dc to 1.8kHz
at 1-7/8 ips	dc to 600Hz	dc to 750Hz
Distortion	-40dB (1%) for signal ±40% modulation	
Interchannel Cross Talk	-60dB	
Signal-to-Noise Ratio	(re 40% modulation) 40dB	
Input Sensitivity	100 mV for 40% modulation	
Temperature Sensitivity	0.1% per 0°F	
Flutter Compensation	20dB reduction in flutter signal on channel 1, when channel 3 used to provide flutter compensation.	

Total price of equipment as tested (including modified Sony TC 366 recorder) — less than \$2500  
Electrodata Associates Pty. Ltd., 8 Barry Ave, Mortdale, NSW.

# The AR-6 speaker system from Acoustic Research.



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

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

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

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

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

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

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

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

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

The AR catalogue and complete technical data on any AR product are available free upon request.



#### **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.

WD 21 FP

# Chromium

by I. Andriesson of BASF AG, West Germany



Figs. 1 and 2. Photo-micrographs of chromium dioxide (left) and conventional tape (x20,000)

OVER the last year, an increasing interest has been shown among professional tape recording engineers, as well as serious high fidelity enthusiasts, in what can be done with the new chromium dioxide magnetic tapes.

Although the first trials to use chromium dioxide as a magnetic material for recording tapes go back to the early sixties, the first tapes, showing the important advantages of this material, appeared not earlier than about 1966.

Today various tape manufacturers have developed good chromium dioxide tapes and a few manufacturers of quality cassette recorders are marketing cassette recorders which are optimised for the use of this new recording tape. Also discussions about the standardisation implications of chromium dioxide have already been started.

## CHARACTERISTIC PROPERTIES OF CHROMIUM DIOXIDE RECORDING TAPES

A main characteristic of the magnetic material, chromium dioxide, is that it is relatively easy to vary the coercivity (this is the ability to resist demagnetisation) over a wide range, which means that it is possible to

choose the appropriate optimal coercivity for a certain application. Also it is not difficult to maintain this chosen coercivity in production.

Another advantage is that the form of the single particles approaches more or less an ideal needle shape so that extremely good homogeneity can be obtained (Figs. 1 and 2).

Both of these properties result in a remarkable improvement in high frequency recordability, which means that the high frequency maximum output level (MOL) as well as the high frequency sensitivity are much better than those from conventional magnetic tapes.

To demonstrate this, Fig. 3 shows the maximum obtainable saturation output as a function of frequency (without HF bias), of a chromium dioxide cassette tape with a  $4\ \mu$  thick magnetic coating, compared to that of a modern "conventional" BASF LH cassette tape, having the same coating thickness. For simplicity reasons, the saturation output of the BASF LH tape is assumed to be flat (zero).

Of course, this kind of comparison has to be interpreted with some care, as the saturation output levels are determined without HF bias. Nevertheless, this presentation shows clearly the differences and advantages

of chromium dioxide tapes, compared with conventional tapes.

## COMPACT CASSETTES

The very high maximum output at high frequencies is of decisive importance for quality recording at very low tape speeds, such as the compact cassette tape speed of 1-7/8 ips.

As anyone, who has tried to make a good recording on cassettes knows, the major limitations of the compact cassette system are: poor background noise and critical high frequency recording (lack of brilliance), especially with music with much top (high frequencies). Cassettes mostly sound rather dull.

To understand this, it is necessary to look at the curves given in Figs. 4, 5 and 6 and to study their interdependence.

Figure 4 shows the maximum output level (MOL) as a function of frequency that is necessary to obtain high fidelity on a recording medium. This curve is the result of various analyses of the spectral amplitude distribution in different kinds of music, one of the primary criteria for high fidelity.

For correct understanding, it is emphasised that this maximum output level (MOL) as a function of frequency has nothing at all to do with the frequency response curve, which normally is given at low recording levels (far below maximum output level) and which is a measure of the transducing linearity of the recording system only. The maximum output level (MOL) curve as a function of frequency gives the tape output at either constant distortion, constant intermodulation distortion or constant compression from linearity of the signal (e.g. 5% THD or 1.5 dB compression).

If the recorded signal passes over this maximum output level limit, unacceptable distortion, intermodulation distortion or compression is unavoidable.

Independent of this MOL curve, the frequency response curve of the system (recorder plus tape) measured at a level far below MOL might be flat,

# Dioxide Tape

## ...Cassette recorders on the way to true high fidelity

because it is established by the recorder adjustment only, if a reference medium is used like the unrecorded portion of the DIN test tape. For reasons of simplification, it is usual in audio tape measuring technique to choose only two frequencies, one in the low part of the sound frequency spectrum, the second in the high part. At 1-7/8 ips tape speed measurements, it is convenient to use 333 Hz and 8000 Hz.

This simplification makes it possible to say that for true high fidelity it is a basic requirement that the MOL at 8000 Hz shall not be more than 10 to 12 dB down compared with the MOL at 333 Hz. This is already a compromise since, for professional studio recording techniques, the difference between high frequency and low frequency MOL is normally not more than about 2 dB.

Now we look at Figs. 5 and 6 where the measured MOL curves at 333 Hz and 8000 Hz as a function of HF bias are given for the two tapes previously mentioned. It is immediately clear that if the 10dB hi-fi criterion as mentioned before is applied, the HF bias adjustment for the "conventional" tape would be so low

1. What are the characteristic properties of chromium dioxide recording tapes?
2. What are the advantages of chromium dioxide tapes, if used in compact cassettes?
3. In what respect are cassette recorders optimised for chromium dioxide tapes, different from conventional cassette recorders?
4. Are chromium dioxide cassettes usable on normal cassette recorders, that is to say on recorders which are not optimised for chromium dioxide tape?
5. Is it possible to meet the DIN hifi requirements if chromium dioxide cassettes are used for chromium dioxide optimised cassette recorders?
6. Are there additional advantages if chromium dioxide cassettes are used on recorders using an electronic noise suppressing system like the "DOLBY B" system?
7. Is it worthwhile to modify reel to reel domestic recorders for chromium dioxide magnetic tape?
8. Is chromium dioxide tape important for musicassettes?

This article provides the answers . . .

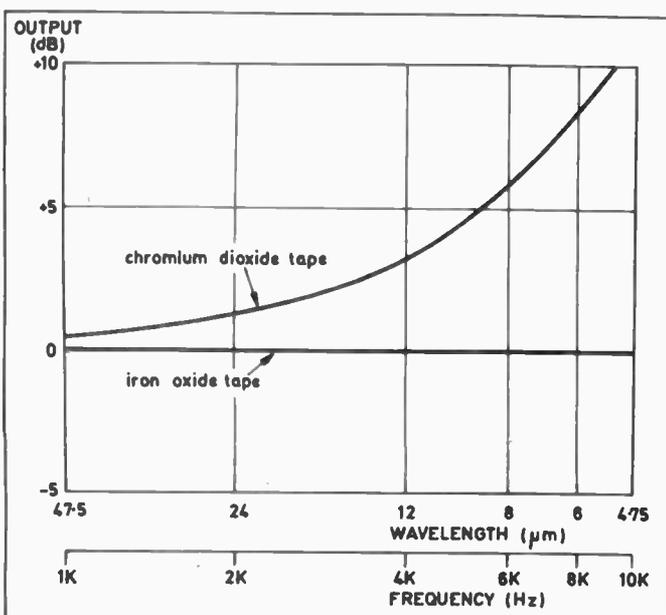


Fig. 3. Comparison of maximum high frequency saturation output of chromium dioxide and iron oxide tape (assumed to be 'flat')

that the low frequency MOL would be very poor, resulting in a poor signal-to-noise ratio. According to DIN requirements, the S/N has been defined as the ratio between MOL at 333 Hz and the noise in dB measured according to DIN 45405 (weighted, quasi-peak).

Also the drop out sensitivity increases at low HF bias. This implies that, although from a theoretical point of view the hi-fi MOL difference between 8000 Hz and 333 Hz can be reached with conventional tapes, the HF bias adjustment would mean a critical utilisation of the tape from a practical and engineering point of view.

In practice most cassette recorder manufacturers utilise nearly all available low frequency MOL of the tape, which requires a relatively high HF bias setting, in order to obtain a

# Chromium Dioxide Tape

good signal-to-noise ratio. However, in such cases the loss in high frequency sensitivity is compensated by using a very strong preemphasis in the recording amplifier (often more than 14 dB at 10,000 Hz) to give a flat frequency response at very low recording levels. However, the loss in high frequency maximum output level (MOL) cannot be compensated and the increased danger of high frequency intermodulation distortion or compression is avoided by connecting the VU meter (output meter) following the preemphasis in the recording amplifier circuit. This safeguards the user against high frequency distortion, etc., because if the music contains much top this top establishes the VU meter indication (rather than the bass) so that the user will tend to record at a lower level.

On paper this looks healthy enough, but, extremely strong preemphasis (over 14 dB at 10,000 Hz) means that the actual recording level will be mainly determined by the top part of the music, resulting in a rather significant discrepancy between the signal-to-noise ratio at measurements relative to MOL at 333 Hz and that obtainable in practice with music. Also, one should recognise that too high a preemphasis does not help hi-fi very much because the required LC active filters cause serious oscillations, resulting in square wave form distortion. This is clearly shown if one observes the overall 1000 Hz square wave performance of such a recorder.

Figure 6 shows the same MOL curves as a function of HF bias for chromium dioxide tape. It is obvious that the situation is much better here; because the chromium dioxide tape allows a good balance between high and low frequency MOL, namely 10 to 12 dB difference at a HF bias setting which guarantees a good utilisation of the tape properties from an engineering point of view.

It should also be said that chromium dioxide is a low noise oxide, which implies that, at the same background noise level as obtained from modern "conventional" tapes, a remarkable improvement in high frequency output (MOL) is available, whereas the signal-to-noise ratio improves because the MOL at 333 Hz can be better utilised. This gives the chromium dioxide cassettes their superior dynamic range and their exceptional brilliance and transparency.

(We have found that chromium dioxide tapes produce at 1-7/8 ips tape speed, the same sound recording

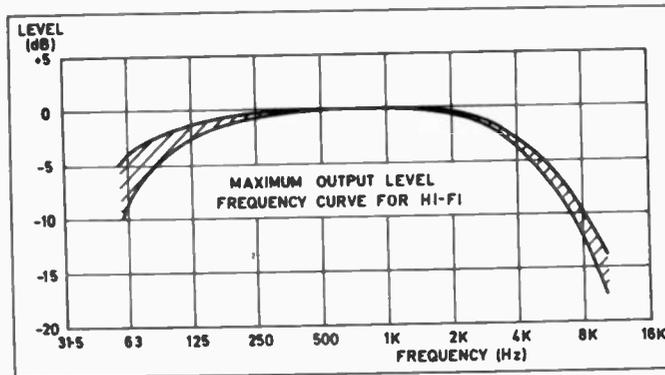


Fig. 4. Maximum output level (MOL) for high fidelity reproduction of music.

quality as conventional tapes at 3 3/4 ips - Ed).

All considerations made so far have been based on the assumption that the replay part of the cassette recorder will not be changed. But in practice it is expected that cassette recorder manufacturers will use at least a part of the high frequency MOL advantages of the chromium dioxide tapes to improve the signal-to-noise ratio of their recorders.

The key to this is the replay equalisation time constant. If this constant (which has been standardised internationally at 120 $\mu$ s) could be reduced to a lower value, the background noise would be reduced more or less in proportion. However, this can only be done at the cost of the beautiful MOL frequency curves because at least a part of the high frequency output is lost.

It is still an unanswered question, where the economical optimum lies, for, it is clear that an improvement of the signal-to-noise ratio of cassette recorders is very desirable.

An additional complication is the fact that many cassette recorder manufacturers have solved the noise problem by means of electronic noise suppression systems. A very good and well known example is the DOLBY B system, by means of which the signal-to-noise ratio of cassette recording systems can be improved by approximately 9 dB.

It would probably be ideal if the noise problem with compact cassette hi-fi recorders could be solved by means of one or another of the electronic noise suppression systems, so that the advantages of chromium dioxide tapes can be fully used to improve the brilliance. (See review of Advent and TEAC recorders in the November and current issues of ELECTRONICS TODAY).

## DIFFERENCES BETWEEN CRO<sub>2</sub> AND CONVENTIONAL RECORDERS

As chromium dioxide tape has a significantly higher coercivity than

conventional cassette tape, it is necessary for correct utilisation of this tape, to increase the HF bias current. This is shown by Figs. 5 and 6.

For the same reason, an increase of the erasure capacity is required. Also, less preemphasis should be applied, however, should the replay time constants be changed, it might be possible that the recording preemphasis need not be altered.

How great these modifications will be, depends strongly on the actual recorder circuitry, and this varies considerably from one manufacturer's product to another.

In order to be able to give at least some data, the measuring results, obtained at the DIN HF bias adjustment, are considered. (DIN HF bias equals 2.5 dB sensitivity fall off, over maximum sensitivity at 6300 Hz.)

With the chromium dioxide tapes, this bias setting method results in a 2 to 2.5 dB HF bias current increase relative to the bias of the conventional tape. The LF sensitivity at 333 Hz of the new tape is about 2 dB lower, which means that the recorders have to compensate this to make sure that the recording level meter reading corresponds with the available MOL of the tape at this frequency.

Thanks to the fact that the relative sensitivity at 8000 Hz is about 6 dB higher, the preemphasis at the same frequency can be reduced by the same amount, and the erasure capacity of the recorder has to be increased by about 40%.

So it is clear that chromium dioxide tapes are not *fully* compatible with modern conventional tapes, and that cassette recorders will only *completely* utilise the advantages of the new tape if some of the recorder functions are modified accordingly. In practice it is expected that chromium dioxide cassettes will automatically operate the necessary switches of the special chromium dioxide recorders, for instance, by means of a similar device to that now used to prevent undesired erasure of prerecorded cassettes.

## CHROMIUM DIOXIDE CASSETTES ON NORMAL CASSETTE RECORDERS

Here the situation is a little more complicated and we must distinguish between Replay, Recording and Erasure.

### REPLAY

The reproduction of pre-recorded cassettes with chromium dioxide tape is simple because it is easy to take care of the different properties during the duplicating process. Should cassette recorders or reproducers change to a new replay time constant, and pre-recorded cassette manufacturers follow this change, the reproduction of such cassettes on conventional cassette recorders will give an increase, and possibly even an over-emphasis of high frequencies. However, on recorders with tone controls this can easily be compensated. In addition there will be a noise improvement.

### RECORDING

From a theoretical point of view, the different recording properties of new chromium dioxide cassettes could be expected to cause problems during recording.

However, as already pointed out, many recorders have such a high HF bias adjustment that they are practically right for chromium dioxide tape. A bias setting which gives maximum output at low frequencies on conventional tapes is more or less optimum for chromium dioxide tape. (See the MOL curves as a function of bias, Figs. 5 and 6).

For that reason in most cases, it will

not be the bias setting which causes incorrect recording, but the relatively strong pre-emphasis in the recording amplifier, resulting in an over-emphasis of high frequencies. However, during reproduction on good equipment this can be compensated just as simply as in the case of cassettes, prepared for modified replay characteristics, by using the tone controls.

### ERASURE

The erasure of chromium dioxide tapes on conventional cassette recorders remains the only real problem.

Erasability is directly proportional to the coercivity of the tape (about 40% lighter on chromium dioxide tape).

The erasure capacity of different cassette recorders varies very strongly. We found extreme cases where the erasure capacity was scarcely enough for conventional tapes (less than 50dB!) Even within one make there are big differences. Many tests in our laboratories have proved that most of the recorders tested, have enough erasure capacity to erase the chromium dioxide tapes at standard working voltage, (e.g., with fresh batteries). This is logical because battery cassette recorders in particular need a certain over-capacity in erasure capacity in order to compensate the decrease in voltage over the life of the batteries. Nevertheless it remains a fact, that on quite a number of the recorders tested, the erasure of chromium dioxide tapes was insufficient, varying from 48 dB down to 20 dB!

## CHROMIUM DIOXIDE CASSETTES AND DIN HI-FI REQUIREMENTS

The existing DIN hi-fi requirements for tape recorders (DIN 45500) are again under discussion. It is expected that the new standard will require a signal-to-noise ratio of 47 dB at 3% THD from a 333 Hz signal. Further requirements like wow and flutter, tolerance of tape speed, tolerances for replay and overall frequency response, are of no significance here.

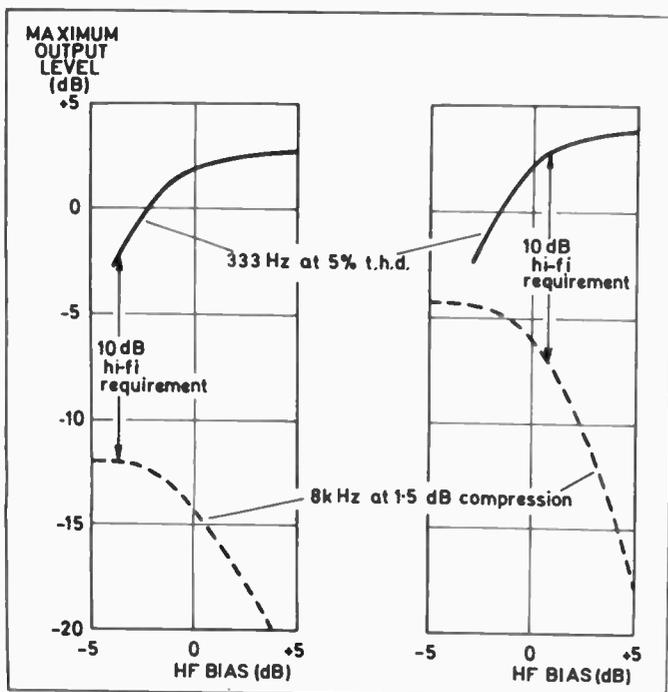
The requirements of 47 dB at 3% THD is about the equivalent of 50 dB at 5% THD, which has been the tape measurement criterium up till now.

On compact cassette equipment, the mono tracks have a width of 1.5 mm, whereas on stereo equipment this 1.5 mm is divided in 2 x 0.6 mm and a separation track of 0.3 mm. So the DIN requirement has to be met by means of the 2 x 0.6 mm tracks, totalling 1.2 mm. At the testing track width of 1.5 mm, the chromium dioxide tape produces at least 53 dB S/N at 5% THD which means approximately 52 dB at 1.2 mm trackwidth.

So, in principle, it should be possible to realise DIN standards although there is very little room for recorder electronic tolerances. Therefore it is understandable that, if no electronic noise suppression is used, a part of the excellent high frequency properties of the chromium dioxide tape will be used to improve the noise. In this connection a replay characteristic modification from 120  $\mu$ s to 70  $\mu$ s is under discussion and this will bring a noise improvement of about 3 dB. In a way the DIN hi-fi requirements are a little irrelevant for tape recording because they do not consider any requirement for maximum output level at high frequencies, which is of basic importance for high fidelity; as we have already shown.

## CHROMIUM DIOXIDE TAPE WITH ELECTRONIC NOISE SUPPRESSION

On recorders with effective electronic noise suppression (mostly the more expensive recorders) the noise problem has already been solved. For example, recorders having the DOLBY B noise suppression system easily reach about 57 dB S/N (which is much better than the DIN requirements). On such recorders the chromium dioxide cassettes are an ideal medium because there is no need at all to give some of the high frequency advantages away in order to improve signal-to-noise. And so the tape will show its full brightness and brilliance even in loud passages with much treble. It is even expected that such recorders may surpass the quality of good LP records because the tape



Figs 5 and 6. Comparison of MOL curves at 333 Hz and 8,000 Hz as a function of bias for conventional tape (left) and chromium dioxide (right).

# Chromium Dioxide Tape

will not show the usual end groove distortion, record clicks and other surface noises.

## CHROMIUM DIOXIDE AND REEL-TO-REEL RECORDERS

Figure 3 has shown clearly that the main advantage of chromium dioxide tape is produced at high and very high frequencies. That is why it is so effective at low cassette tape speeds.

Most reel-to-reel recorders are designed in such a way that they produce good sound quality at high tape speeds, e.g., 7½ and 3% ips. At such speeds the difference between chromium dioxide tape and conventional tape, is negligible. Even at 3% ips the advantage is still relatively small, especially taking to account the recorder circuitry

switching necessary to utilise this advantage; and the higher costs of chromium dioxide tapes.

Only in professional audio applications will it be worth using chromium dioxide tapes at 3% ips because there it is still possible to choose optimum working conditions.

## CHROMIUM DIOXIDE TAPE IN MUSICASSETTES

There are no technical objections at all against the use of chromium dioxide tape for musicassettes. All differences in recording properties can be easily taken care of during the duplicating process. It is also easy for musicassette manufacturers to follow any future change in replay characteristic of the cassette recorders and reproducers.

As it is, musicassettes with chromium dioxide tape will give an immediate quality improvement, at least in brilliance and thanks to the higher recording level which can be utilised,

also in dynamic range. On "Dolbyised" musicassettes (as produced for instance by Decca), chromium dioxide will be an excellent combination.

Chromium dioxide magnetic tape is of great importance if we are to obtain good sound quality within the compact cassette system.

On recorders with optimised adjustments hi-fi quality can be obtained. On most conventional cassette recorders a significant increase and improvement in high frequency reproduction will be apparent, though there might be erasure problems. Musicassettes will show an immediate improvement in brilliance and dynamic range.

Chromium dioxide tape is especially effective on recorders having electronic noise suppression, because LP record quality and brilliance can be obtained in loud music having a strong high frequency content. ●

# RESISTANCES IN PARALLEL



This table — computed by Electronics Today's Honeywell computer time-sharing equipment — shows 325 parallel resistance combinations.

The table indicates the value of any resistors that need to be paralleled to provide non-standard values.

To use, simply relate the values shown in the vertical and horizontal columns, e.g. a combination of 220 ohms plus 27 ohms will result in a resistance of 24.05 ohms.

	10	12	15	18	22	27	33	39	47	56	68	82	100
10	5.00	5.45	6.00	6.43	6.88	7.30	7.67	7.96	8.25	8.48	8.72	8.91	9.09
12	5.45	6.00	6.67	7.20	7.76	8.31	8.80	9.18	9.56	9.88	10.20	10.47	10.71
15	6.00	6.67	7.50	8.18	8.92	9.64	10.31	10.83	11.37	11.83	12.29	12.68	13.04
18	6.43	7.20	8.18	9.00	9.90	10.80	11.65	12.32	13.02	13.62	14.23	14.76	15.25
22	6.88	7.76	8.92	9.90	11.00	12.12	13.20	14.07	14.99	15.79	16.62	17.35	18.03
27	7.30	8.31	9.64	10.80	12.12	13.50	14.85	15.95	17.15	18.22	19.33	20.31	21.26
33	7.67	8.80	10.31	11.65	13.20	14.85	16.50	17.88	19.39	20.76	22.22	23.53	24.81
39	7.96	9.18	10.83	12.32	14.07	15.95	17.88	19.50	21.31	22.99	24.79	26.43	28.06
47	8.25	9.56	11.37	13.02	14.99	17.15	19.39	21.31	23.50	25.55	27.79	29.88	31.97
56	8.48	9.88	11.83	13.62	15.79	18.22	20.76	22.99	25.55	28.00	30.71	33.28	35.90
68	8.72	10.20	12.29	14.23	16.62	19.33	22.22	24.79	27.79	30.71	34.00	37.17	40.48
82	8.91	10.47	12.68	14.76	17.35	20.31	23.53	26.43	29.88	33.28	37.17	41.00	45.05
100	9.09	10.71	13.04	15.25	18.03	21.26	24.81	28.06	31.97	35.90	40.48	45.05	50.00
120	9.23	10.91	13.33	15.65	18.59	22.04	25.88	29.43	33.77	38.18	43.40	48.71	54.55
150	9.38	11.11	13.64	16.07	19.19	22.88	27.05	30.95	35.79	40.78	46.79	53.02	60.00
180	9.47	11.25	13.85	16.36	19.60	23.48	27.89	32.05	37.27	42.71	49.35	56.34	64.29
220	9.57	11.38	14.04	16.64	20.00	24.05	28.70	33.13	38.73	44.64	51.94	59.74	68.75
270	9.64	11.49	14.21	16.88	20.34	24.55	29.41	34.08	40.03	46.38	54.32	62.90	72.97
330	9.71	11.58	14.35	17.07	20.63	24.96	30.00	34.88	41.14	47.88	56.38	65.68	76.74
390	9.75	11.64	14.44	17.21	20.83	25.25	30.43	35.45	41.95	48.97	57.90	67.75	79.59
470	9.79	11.70	14.54	17.34	21.02	25.53	30.83	36.01	42.73	50.04	59.41	69.82	82.46
560	9.82	11.75	14.61	17.44	21.17	25.76	31.16	36.46	43.36	50.91	60.64	71.53	84.85
680	9.86	11.79	14.68	17.54	21.31	25.97	31.47	36.88	43.96	51.74	61.82	73.18	87.18
820	9.88	11.83	14.73	17.61	21.43	26.14	31.72	37.23	44.45	52.42	62.79	74.55	89.13
1000	9.90	11.86	14.78	17.68	21.53	26.29	31.95	37.54	44.89	53.03	63.67	75.79	90.91

# A PRACTICAL GUIDE TO ZENER DIODES

## PART II

The Zener diode is generally associated with dc applications, such as the control and regulation of dc power supplies. Most Zeners are in fact used for this purpose but nevertheless they have many uses in ac, audio, rf, and ac control systems.

When supplied with alternating current and connected as a shunt regulator (Fig. 13), the Zener diode will limit both the positive and negative halves of the ac cycle. The diode conducts almost immediately after the signal passes through zero and into the negative segment. On the positive half cycle, the diode does not conduct until the applied voltage reaches the Zener voltage (Fig. 14). The result is a non-symmetrical square wave. Assymetry can be improved by using high input voltages, but can never be completely eliminated unless two shunt connected diodes are employed in a back-to-back configuration. (Fig. 15).

The Zener diode configuration shown in Fig. 15 is often used to provide stabilized filament supply voltages — especially to oscillator

circuits and dc amplifiers. When using Zeners in this application bear in mind the ratio of average to peak Zener current. A figure of 0.6 is satisfactory.

Zener diodes may also be placed in the primary side of a step-down (or step-up transformer). When connected in this manner the diodes will regulate all associated secondary windings. The arrangement does require high voltage rated Zeners and is sometimes rather costly — however it is often used when high voltage secondary supplies need rudimentary stabilization.

Where power consumption is a prime consideration on ac power circuits, the Zener load resistor (RS) can be replaced by an inductance or capacitance. The device selected should have a reactance approximately the same as the calculated value for RS at the supply frequency.

### OSCILLOSCOPE CALIBRATOR

A single Zener diode may be used as an inbuilt oscilloscope voltage calibrator that is independent of line voltage variations. Figure 16 shows how simply this facility may be incorporated in practically any

oscilloscope. A selected 10 Volt Zener may be used to provide a calibration voltage of one volt per division.

### ZENER NOISE VOLTAGES

As with neon regulator tubes, Zener diodes generate noise voltages. With Zener diodes, these voltages are associated with junction avalanche effects, and may vary between 10  $\mu$ V and 1 mV depending upon the Zener type and voltage rating.

But unlike neon regulator tubes — where the incorporation of parallel filter capacitors is an excellent (if unintentional) way of making a relaxation oscillator — a Zener diode may be suppressed by adding parallel capacitance of 0.01 to 0.1  $\mu$ F. This will reduce the noise voltage by a factor of at least 10 and yet maintain completely stable operation. (Figs. 17 & 18).

### THE ZENER DIODE AS A FILTER

The Zener diode will respond to ripple voltages in much the same manner as it does with slow voltage variations. It has a very low dynamic impedance and thus reacts in much the same way as a filter capacitor.

Excellent power supply filtering can be obtained by connecting a Zener diode (having a Zener voltage equivalent to the ripple trough) across the load. In most circuit applications this will be as effective as adding a smoothing capacitor of several

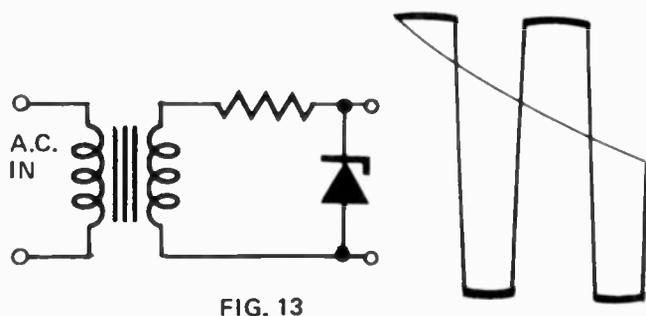


FIG. 13

FIG. 14

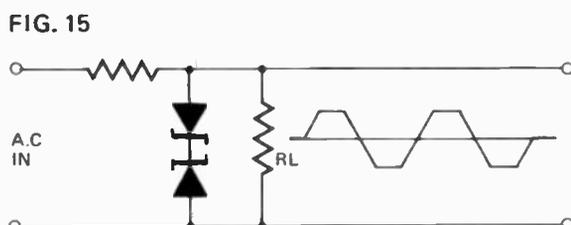


FIG. 15

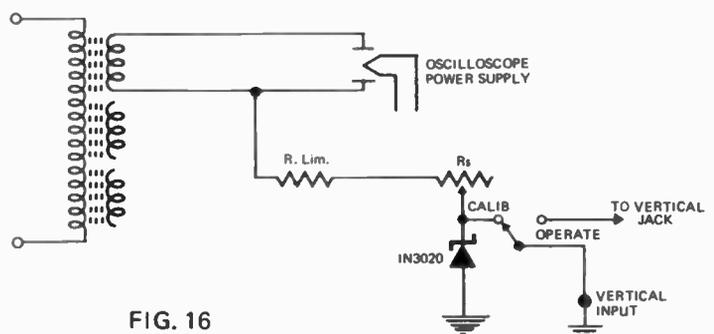
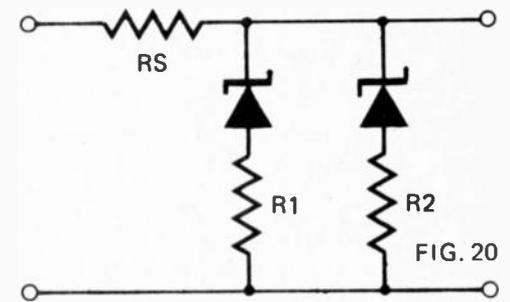
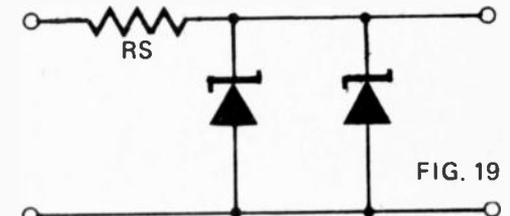
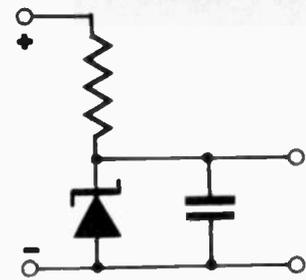
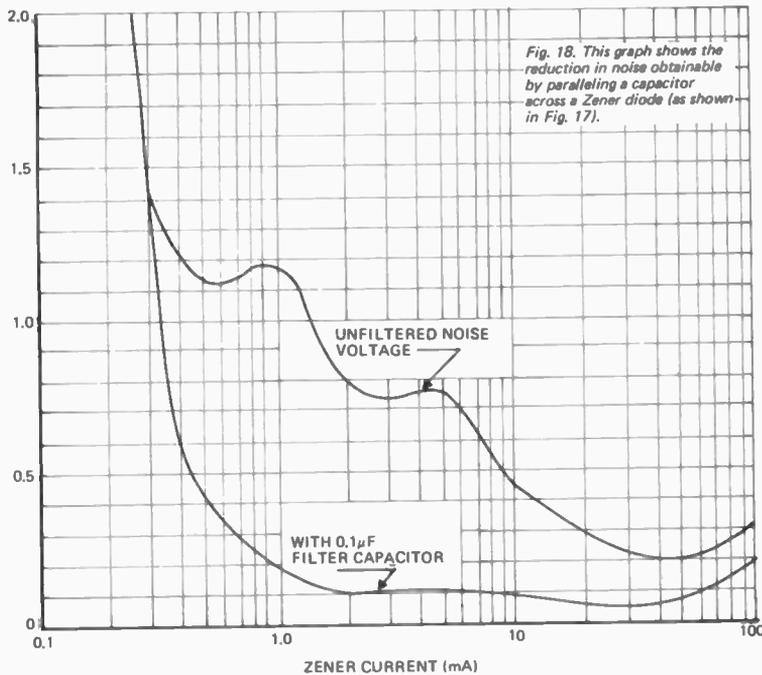


FIG. 16

# A PRACTICAL GUIDE TO ZENER DIODES



thousand microfarads capacity, and will provide a considerable reduction in the level of ripple superimposed on the dc output.

## INCREASING POWER HANDLING

Parallel connection is one way of increasing the power capabilities of Zener diodes. But a simple parallel connection (Fig. 19) is not practicable, for the Zeners will rarely be sufficiently well matched to conduct at exactly the same voltage. But by including very low resistance trimming resistors, the current levels can be matched so that both Zeners carry substantially equal amounts of the total current. (Fig. 20)

Although, as shown above, Zener diodes can be paralleled in order to increase their load carrying capacity it is usually more practicable to use a series or shunt transistor circuit with a Zener diode providing a voltage reference. This configuration will not only improve the power handling capability by a factor of ten or so, it will also improve the regulation of the circuit by an amount equal to the current gain of the transistor.

A simple Zener controlled shunt regulator is shown in Fig. 21.

The shunt regulator is very suitable for experimental and instructional use as it is totally short circuit proof. But, since maximum transistor current flows at zero load (and vice versa), it is also very inefficient, and for applications where power availability is limited the series transistor configuration is preferable.

A series regulator is shown in Fig. 22.

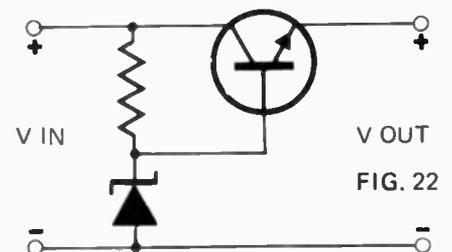
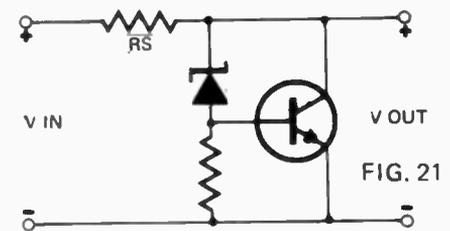
In this circuit the Zener diode establishes a reference voltage for the series transistor, which, in effect, operates as an emitter follower. Thus the emitter voltage is held within a few tenths of a volt of the base potential (which is determined by the Zener diode).

Thus the transistor acts as a series element to absorb voltage variations. All load current flows through this series transistor. The power handling ability of this type of supply is determined entirely by the number and type of transistors used (and the ability of the heat sink to remove heat). Figure 23 shows the regulation obtained from the simple circuit of Fig. 22 which uses a 4.7V ¼W Zener and a 1k series resistor. The regulation may be improved by a factor of 10 by substituting a low dynamic resistance 4.7V 3.5W Zener (we used an IR 1N1589) for the ¼W device.

This circuit (Fig. 22) can provide a variable voltage regulated output by connecting a 1k potentiometer across the Zener diode. The variable reference voltage is then applied to the base of the series transistor. However, this modification reduces the degree of regulation due to the shunting effect of the potentiometer. A better system is to switch different Zener diodes into the circuit for different voltage outputs.

## CONSTANT CURRENT REGULATION

A simple Zener-regulated constant current supply can be built using a single transistor as a variable series



resistor. Figure 24 shows how it is done. Two circuit paths exist; one through the Zener diode which is in series with the bias resistor, and the other through  $R_1$ ,  $R_2$  and the 2N301 series transistor. Any change in the current through  $R_3$  causes a change in bias, the series transistor thus changes resistance to correct the current flow. In operation the current will remain substantially constant (within about 10%) from a short circuit to a 400 ohm output load. A graph of the output characteristics is shown in Fig. 25.

## LOGIC CIRCUITS

In many ways a Zener diode

FIG. 23

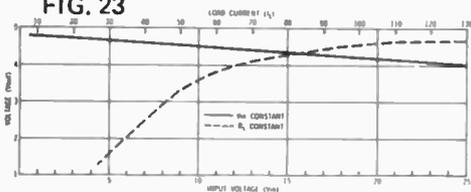


FIG. 24

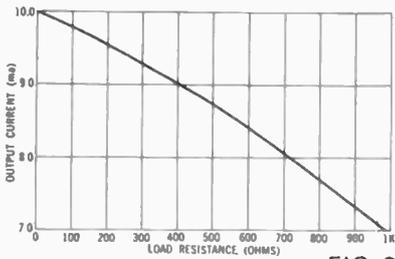
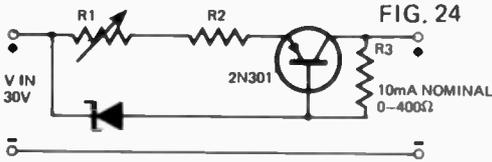


FIG. 25

resembles a switch, and is therefore often used in computer and instrumentation logic circuitry.

The advantage of Zener diodes for this purpose is their extremely rapid operation when switching around their avalanche point. Whereas germanium or silicon diodes are limited to data rates of less than 2.5MHz (due to storage of minority carriers) Zener diodes switching about their avalanche point have switching times practically equal to their relaxation time. For silicon this is  $10^{-9}$  seconds.

A typical AND gate, using two 6.8V Zener diodes is shown in Fig. 26. The positive 12 Volt bias is applied to both cathodes through the common load resistor, maintaining the diodes in avalanche condition. If a positive pulse is now applied to input A, the associated Zener will be gated out of the avalanche region. But due to the low impedance of the parallel connected Zener (associated with input B), the output (point A.B) remains clamped at 6.8Volts. The same circuit conditions apply if a pulse is applied solely to input B. However if a pulse arrives simultaneously at points A and B, both Zeners will be gated out of the avalanche region and the output voltage will rise from 6.8 Volts to the 12 Volt supply potential during the time that the pulse is coincident at the two inputs. Thus a positive pulse is produced coincident with the input pulse. Negative input pulses will not affect the circuit.

Figure 27 shows how a similar technique may be used to provide an OR function. In this configuration a pulse applied to either input will produce a pulse at the output.

## SORTING

In the circuit shown in Fig. 28 the relays will be progressively energized as the input voltage increases. This circuit is often used for voltage controlled sorting. The relay contacts may be arranged to open chutes and illuminate indicator lamps for rapid sorting.

## OVERVOLTAGE PROTECTION

The voltage sensitive characteristic of Zener diodes can be combined with the current sensitive characteristic of fuses to protect circuit components from overvoltage surges, whilst at the same time eliminating the 'nuisance' fusing that occurs when a fuse too close to the operating current is used.

By connecting a Zener diode of the correct voltage rating across the load, a fuse adequate to carry the normal load operating current for long periods may be used. But if the input voltage increases — and so exceeding the Zener breakdown voltage — the Zener diode will conduct. The sudden increase in current will blow the fuse practically instantaneously. (Fig. 29). A similar circuit may be used in conjunction with a circuit breaker rather than a fuse.

## UNDERVOLTAGE PROTECTION

In some applications it may be necessary to disconnect a load from the mains supply if the supply voltage falls below critical level. A simple circuit that will provide this function is shown in Fig. 30. The series resistance R1 is chosen so that at normal operating voltages the Zener diode is broken down and sufficient current flows to hold the relay closed. When the supply voltage falls below the desired level, the Zener ceases to conduct and the relay drops out. The addition of the Zener diode to this circuit provides an accurate reference point, increasing reliability and eliminating the need for specially selected relays for different voltages.

## DUAL VOLTAGE SUPPLY

Most logic circuitry needs a dual power supply — (one positive and one negative with respect to zero). The useful, but little known circuit shown in Fig. 31 can supply a dual output of balanced or unbalanced voltage from a single ended power supply. Zener diodes should be chosen to suit the voltages required.

Full details of operating characteristics of Zener diodes can be obtained from most semiconductor manufacturers.

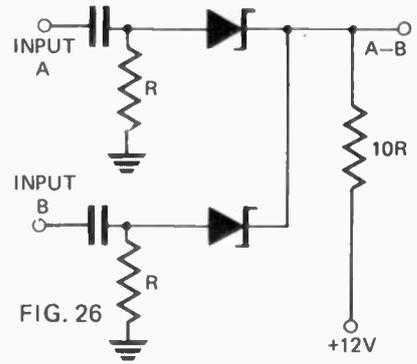


FIG. 26

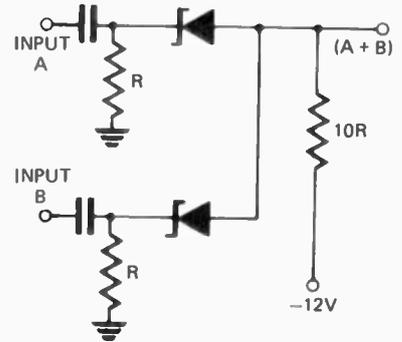


FIG. 27

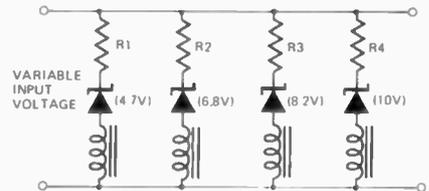


FIG. 28

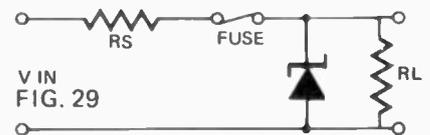


FIG. 29

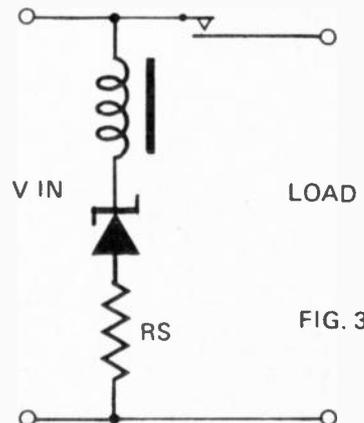


FIG. 30

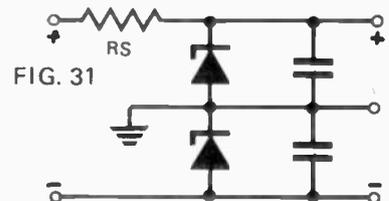


FIG. 31

The simple electronic puzzle presented in our September issue attracted a lot of interest. Many readers have asked us for more — so here's another — again designed by A.J. Lowe.

# SAFETY

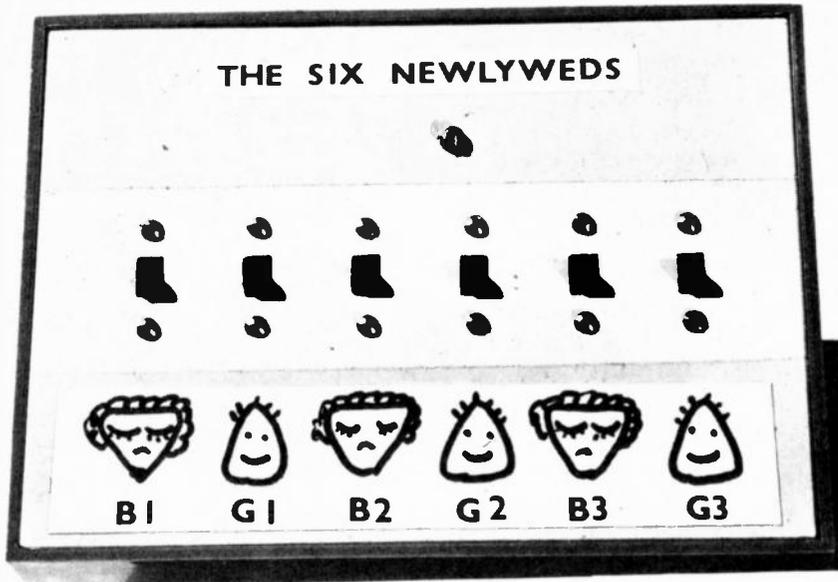


FIG. 1

**T**HIS story originated in the mind of Nick the Stutterer, better known as Niccolo Tartaglia, the Italian mathematician, who would be 472 years old had he lived. It goes like this:

Once upon a time, three beautiful blushing brides, and their handsome jealous husbands, arrived at a river they wished to cross. The boat, which was tied up there, would carry only two people. So, they had to work out how to get everybody across. But, this happened long before our present permissive age, and there were some restrictions. No bride was to be left in the presence of any other bride's husband, unless her own husband were there to protect her, or the other husband's wife were with him to stop any hanky panky.

Well, that's the problem, and in this project the people involved are represented by slide switches. (See Fig. 1), slide switches B1, B2 and B3 are the brides, and G1, G2 and G3 are the grooms, respectively.

The switches are moved to represent trips across the river in the boat. Nobody is allowed to swim, so the boat has to be rowed back and forth until all are over, with no compromising situations having been allowed to arise. If such a situation does arise, then an alarm goes off, and you've failed, and somebody's honour is imperilled.

The circuit is shown in Fig. 2. The somewhat bewildering array of switches is not so complex as it may seem at first. Each person is represented by a 3 pole 2 position slide switch. Thus Bride 1 switch includes B1a, B1b and B1c, all of which change over if B1 is moved across the river. The other people are similarly represented.

In a circuit diagram it is usual to join, with a dotted line, all switches which are linked together, but for clarity, these dotted lines have not been shown. All switches are shown in the starting position, that is, with all people on the near side of the river.

The alarm buzzer sounds only if a circuit is made between the left hand and right hand side lines. Thus, if B1 is left on the far side of the river with G2, the alarm will sound through B1a, G1a, G2b, and B2b, in the top line of

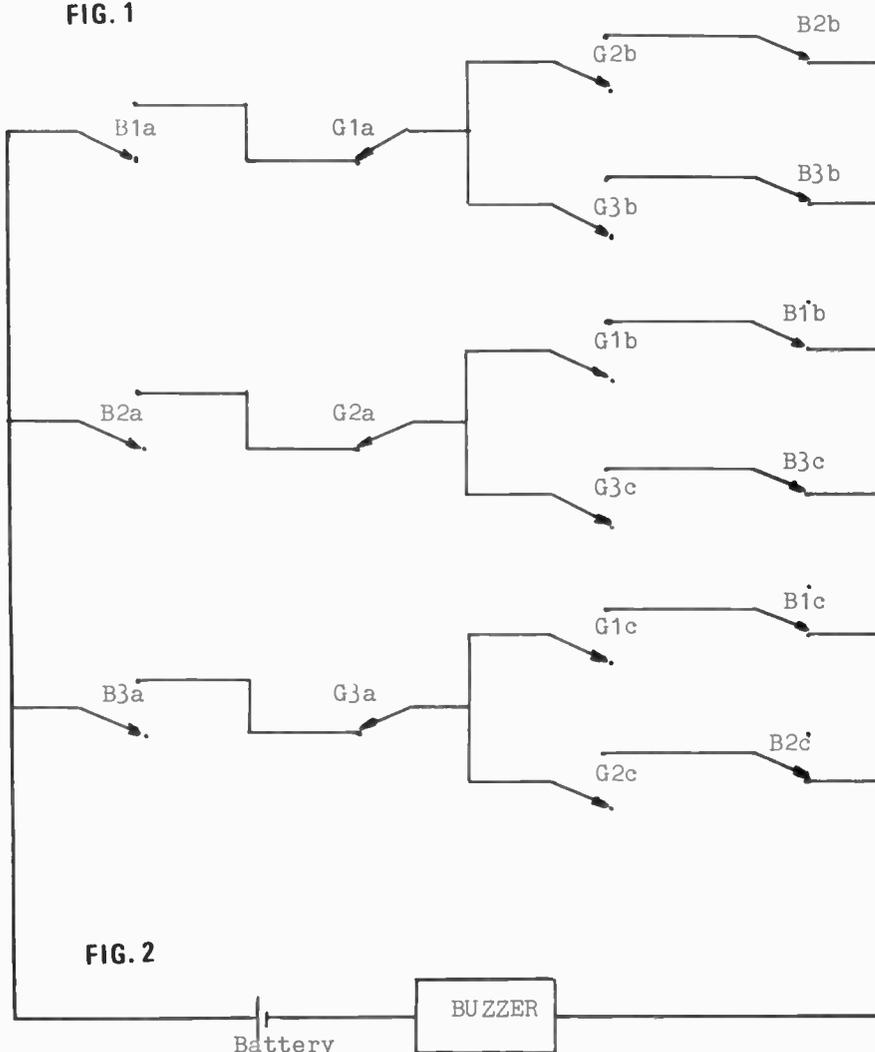


FIG. 2

# CROSSING

the diagram. However, if G1 is also at the far side of the river, to protect his wife, G1a opens and so the alarm is not raised. Similarly, if B2 is on the far side of the river, she controls her husband, and B2b is opened, and the alarm is not sounded.

The circuit can be followed through all the switches in this manner.

## CONSTRUCTION

All you need is a panel, six 3 pole change-over switches, a buzzer, a battery and some wire. The original was made in a plastic box 5½" x 4" x 3" deep. It was fitted with an aluminium panel. The wiring inside is shown in Fig. 3. The alarm buzzer and battery holder were taken as a unit from a bicycle horn, and this is quite an inexpensive way of buying these items. Any available buzzer and suitable battery would do just as well.

As quite a lot of wiring is involved it has been shown in two stages, in Figs. 4 and 5. These diagrams show the back of the switches so now the positions of the people are reversed from the top view in Fig. 1. That is, B1 is on the right in the underside views. Stage 1 of the wiring includes the connections which run more or less lengthways, down the middle. Complete this stage before starting on Stage 2, which includes wires running across switches.

Check the wiring carefully, then test the device by setting up all the compromising situations, on both sides of the river, and see that the alarm sounds in each case — and does not sound in any 'safe' situation.

It takes nine river crossings to solve the problem, and it's not too difficult for one person to work out. However, fun can be had at a party by asking six people, representing those in the problem, to work it out with the switches. With no one 'masterminding' the whole operation some real conflicts can arise.

### PARTS LIST ET510

Switches — six required A.B. Metals 'V' Type slider switch, from M.S.P.  
 One buzzer  
 One battery to suit  
 Battery holder  
 Wire  
 Suitable case.



FIG. 3

## ET PROJECT 510

FIG. 4 — WIRING STAGE 1

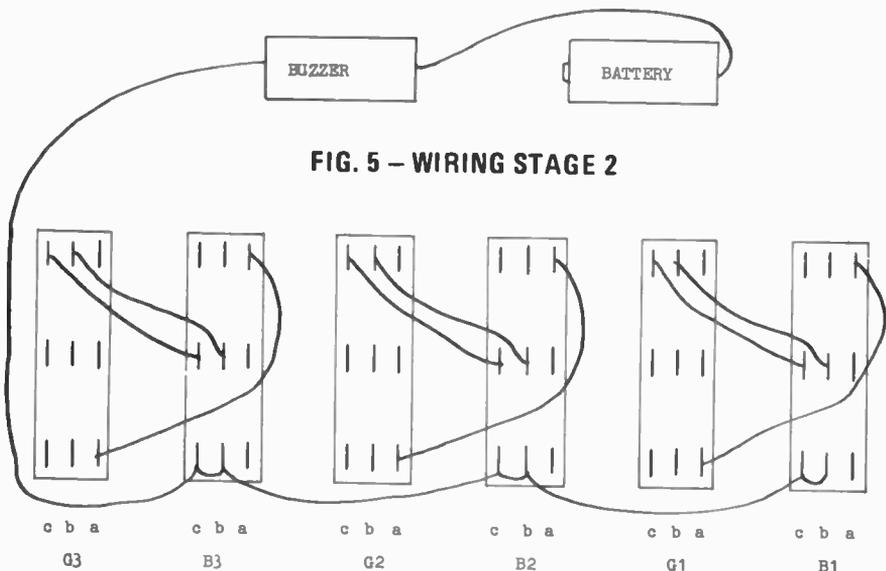
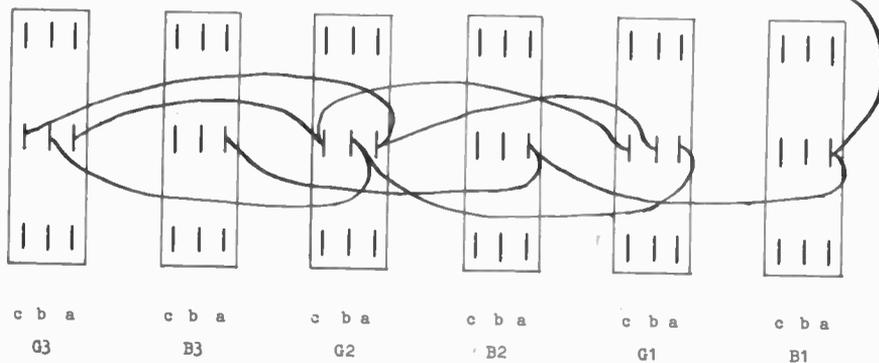


FIG. 5 — WIRING STAGE 2



# THE POWER AND THE GLORY



We test the McIntosh  
C26 Preamplifier and  
MC2105 105 watt power  
amplifier.

**A** MERICANS make things bigger, better and more powerful, than practically everyone else.

A good example of this is the McIntosh MC2105 amplifier and matching C26 preamplifier, for here is a stereo amplifier system that can deliver a cool 105 Watts, *average continuous power* from each channel into 4, 8 or 16 ohm loads, and provides superlative performance with apparent ease.

The McIntosh preamplifier is packed in three heavy cardboard cartons — inside one another — providing more than adequate protection.

Having unpacked the unit one cannot help but be impressed by the unusual appearance. A large black glass panel

stretches right across the front of the unit and this carries markings that are gold coloured when the unit is switched off, but which change to green when power is applied.

Each end of the front panel is finished by a chromed metal strip. All control knobs on the front panel are machined from solid aluminium and these are finished with a high lustre on the front face and have a knurled edge. The position of each knob is indicated by a slot neatly cut in its edge. The input selector switch, which is located in the top right hand corner, has six positions. These are:—

Auxiliary  
Tape 2  
Tape 1

Tuner  
Phono 1  
Phono 2

A selector switch, that provides every conceivable operating mode, is located adjacent to the input selector and has seven positions. These are, by clockwise rotation:—

1. Left channel input to left and right channel outputs
2. Right channel input to left and right channel outputs
3. Stereo reverse
4. Stereo normal
5. Mono, which adds the left and right inputs and feeds the combined signal to both output channels.
6. Left plus right input to left channel output only.
7. Left plus right input to right

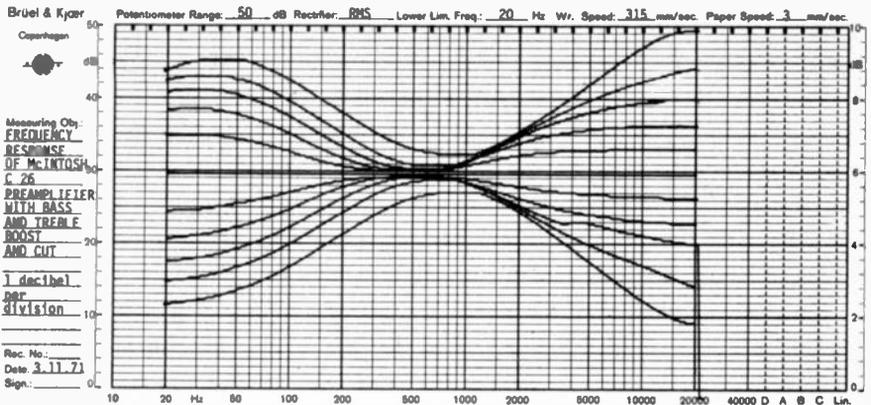
channel output only.

A set of six "push on" "push off" buttons are located below the input and mode selector knobs. These select Tape 1 or Tape 2 Monitoring, Low Pass and High Pass Filters, and Main and Remote Speakers. When all speakers are switched off, two 16Ω, 10W dummy load resistors are switched across the outputs. The make and model identifications of the preamplifier together with a red illuminated "power on" indicator strip and the volume control are located in the top right section of the front panel.

The volume control was the only part of the preamplifier, that in our opinion did not reflect the same level of thought and effort evident in the rest of the unit. This control doubled as an on-off power switch (at the fully anticlockwise position) and this could result in excessive wear of the potentiometer. Ideally, an additional "push on" "push off" button could have been included with the six buttons on the left hand side for switching the power on and off, or, alternatively, a pull to operate control potentiometer could have been used.

The bottom half of the right hand side contains the following controls:

- A loudness control which is variable and independent of the volume control.



- A balance control.
- Dual concentric bass control knobs with five boost and five cut positions.
- Dual concentric treble control knobs with five boost and five cut positions.

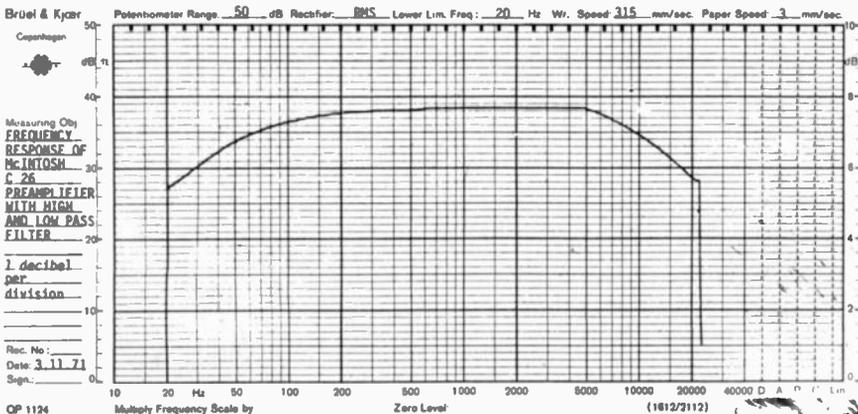
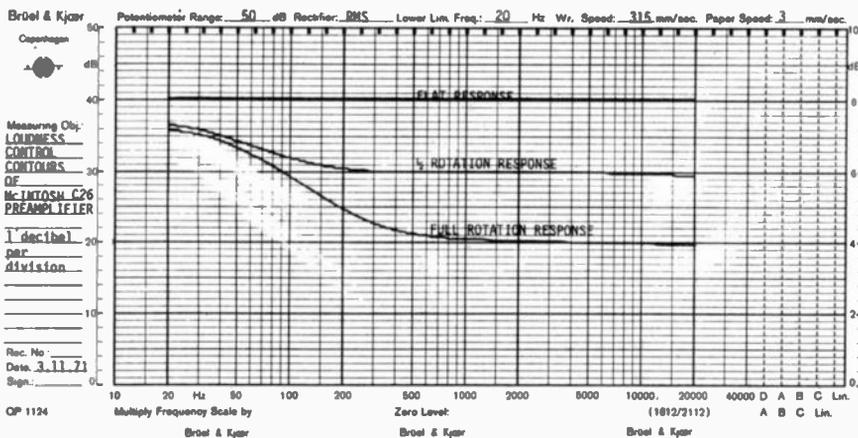
A ring tip and sleeve socket for headphones is located on the front panel between the push buttons and the loudness control knob. Two additional controls are located on a recessed panel in the top of the unit. One provides 180° phase shifting of the left channel, should the speakers be wired out of phase. The second is an independent volume control for the centre channel output.

Adjustment of the loudness control was rather time consuming for as you moved the loudness control from the "flat" position to the "maximum" position you reduced the volume of the mid range and high range components rather than boosting the bass end as is the normal practice. Because of this arrangement it was easier to adjust the bass and treble controls rather than to adjust the loudness control, correct the volume control, then readjust the loudness control and so on, to obtain the desired combination of control settings.

The preamplifier is supplied with mounting brackets which incorporate the PANLOC mounting system developed by McIntosh. This system consists of quick release buttons located on the front panel of the preamplifier, allowing the unit to be slid out of its case, thus providing access to the phase and centre channel controls. In this position an engraved aluminium panel is revealed. This carries a block diagram of the preamplifier circuitry and performance specifications.

## THE CONSTRUCTION

The back panel of the preamplifier contains all the input and output terminals. These consist of three sets of four spring-loaded terminals, one set for the power amplifier input, one set for the main speaker output and one set for the remote speaker output. (The speaker outputs are wired back to the preamplifier from the main amplifier unit) Six pairs of R.C.A. type coaxial sockets are provided for the following inputs; Auxiliary, Tape 2, Tape 1, Tuner, Phono 1 and Phono 2. Four pairs of R.C.A. type coaxial sockets are provided for Tape 1 and Tape 2 outputs and for two main amplifier outputs. A single R.C.A. type socket is provided for the centre channel output. Four 2-pin power sockets, one switched, three unswitched, are provided to energize auxiliary equipment.



## THE POWER AND THE GLORY

The internal layout and metal work is exceptional. All components and printed circuit boards are mounted on a heavily chromed plated mounting panel. The main circuitry is contained on three printed-circuit boards horizontally mounted at the left hand end. The smallest board contains the power supply and centre channel circuitry. The other two boards contain the preamplifiers for each channel. These two boards have been laid out with all components laid parallel to an edge or an end of the board. The only difference between the two boards is an additional capacitor and resistor on the left channel preamplifier board, which are used to shift the output signal 180°. Each circuit board has its own serial number stamped on it and quality control markings can be seen at various places on each board.

All transistors are colour coded in addition to the normal type numbers and are soldered onto pins located on the printed circuit boards. This

arrangement minimises the chances of overheating the transistors during soldering and simplifies the removal of any transistor for replacement if required. The circuit utilizes emitter-follower configurations with negative feedback to reduce noise and distortion.

The power transformer is fully enclosed in a metal housing to provide maximum shielding. All wiring is fully colour coded and made up in harnesses, shielded where necessary. All the wiring terminations on the boards are also made via stand-off pins.

The preamplifier is supplied with a 16 page glossy "Owners Manual", a Service Information leaflet and an "If You're in a Hurry" card. The "owners Manual" covers the following topics:—

- Guarantee
- Installation
- How to connect (graphically illustrated)
- What the controls do
- Listening to your stereo system
- Performance limits and charts
- Technical description and block diagram.

The service information manual includes

- a) Detailed circuit diagrams with voltage levels and component details.
- b) Printed circuit board layouts
- c) Component parts lists with manufacturer's part numbers.

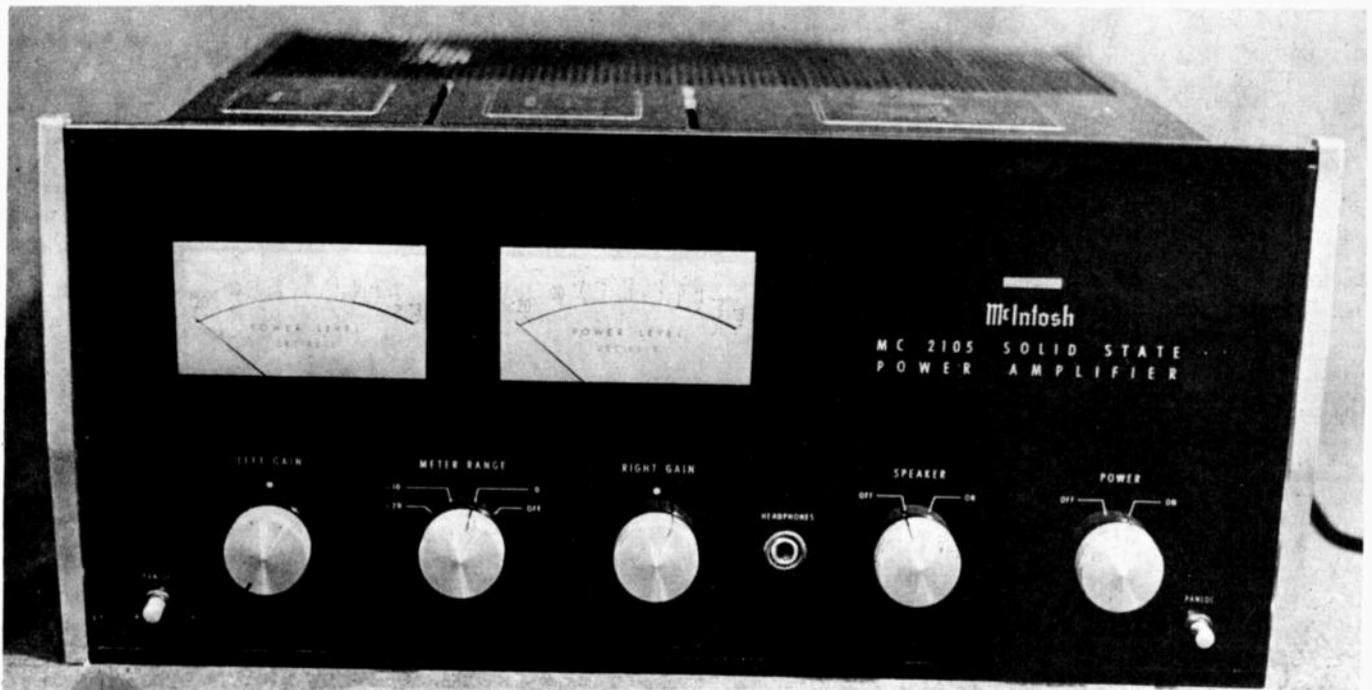
The "If You're in a Hurry" card gives concise instructions for external connections and for operating the various controls.

The McIntosh Guarantee, we believe, is unique for any preamplifier or amplifier, and states that, "should the performance of these units exceed the published performance limits specified, during the first three years from date of purchase, then McIntosh will restore the unit to its original performance free of charge, with the exception of transport costs". The recognized Australian distributors are service agencies.

Our laboratory tests showed that the measured performance was equal to, or better than, the manufacturer's performance limits in all parameters.

The total harmonic distortion was considerably better than the stated limits, being 0.04%.

The frequency response rose less than ½dB from 20Hz to 25Hz, and was then flat from 25Hz to 20kHz.



THE McIntosh MC2105 solid state power amplifier is very similar in appearance to the preamplifier. The external finish is identical, with a black glass front panel with chromed trims at each end and machined aluminium knobs.

The front panel contains two large

illuminated power-level meters in the top left hand corner. These are balanced by the make and model identification in the top right hand corner. Five aluminium knobs arranged across the bottom of the front panel provide the following facilities — from left to right:—

- a) Left channel gain control.
- b) Meter range switch with four positions, namely OFF, -20dB, -10dB & 0dB.
- c) Right channel gain control.
- d) Speaker "on-off" rotary switch.
- e) Power "on-off" rotary switch.

A ring tip and sleeve headphone

**MEASURED PERFORMANCE McINTOSH MODEL C26 SOLID STATE STEREO PREAMPLIFIER SERIAL NO. 5031.**

Frequency Response 20Hz to 20 kHz $+0$ dB $-\frac{1}{2}$ dB	Total Harmonic Distortion 100Hz 0.04% 1kHz 0.04% 6.3kHz 0.04%	
Hum & Noise with Respect to Rated Power Auxiliary Input 89dB Phono Input 75dB		
Bass Control 15dB boost at 50Hz 16dB cut at 50Hz	Treble Control 17dB boost at 10kHz 18dB cut at 10kHz	
Loudness Control Maximum of 14dB boost at 50Hz		
High Pass Filter 4dB cut at 10kHz	Low Pass Filter 5dB cut at 50Hz	
Channel Separation at Rated Output Auxiliary Input 42dB Phono Input 39dB		
Input Sensitivity for Rated Output		
Input	Main Output Level	Tape Output Level
Auxiliary 0.25V	2.7V	0.25V
Tape 1 0.25V	2.7V	0.25V
Tape 2 0.25V	2.7V	0.25V
Tuner 0.25V	2.7V	0.25V
Phono 1 2 mV	2.7V	0.25V
Phono 2 2 mV	2.7V	0.25V
Dimensions 5-7/16" high, 16" wide, 13" deep Weight 17lb.		

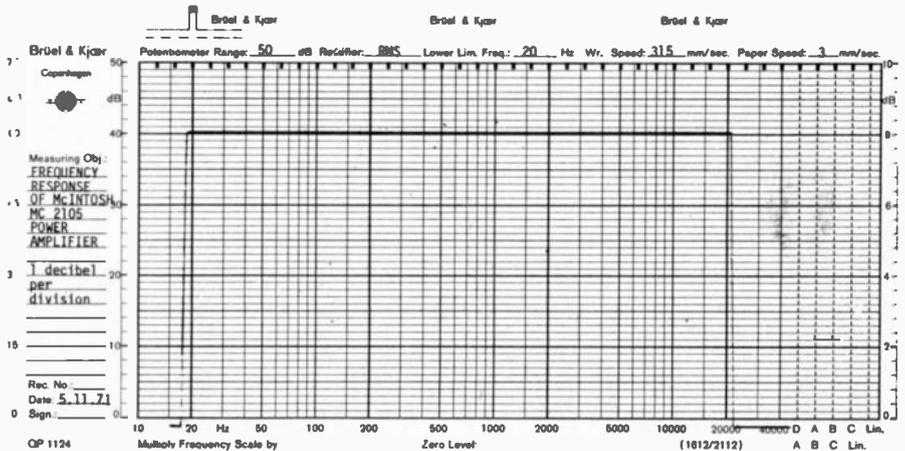
socket is located between the right channel gain control and the speaker "on-off" rotary switch. Two push buttons, one in each corner at the bottom are the quick release buttons for the PAN LOC mounting system. This is the same system as that used in the preamplifier. Two R.C.A. coaxial signal input sockets, and two speaker output terminal strips are located on the mirror finished chrome-plated back panel that is part of the main mounting board. The speaker output terminal strips have four terminals marked: common, 4 ohm, 8 ohm and 16 ohm respectively. These outputs are fed back to the preamplifier "power amplifier" input terminals, so that all functions can be controlled at the preamplifier once the gain controls on the power amplifier have been set. The speakers are then connected to the speaker terminals on the preamplifier.

The internal layout of the power amplifier is finished to the same degree of quality as the preamplifier. The

*This graph shows the extraordinarily flat frequency response of the McIntosh Power Amplifier.*

power transformer, measuring 4½" x 4½" x 7", is fully shielded in a metal housing and is mounted adjacent to the two line-output autotransformers which are also enclosed in metal housings. The three transformers are mounted in line directly behind the front panel.

The rear section of the amplifier contains four very large heatsinks on which the main driver and power transistors are mounted, two vertically mounted plug-in printed circuit boards, and two 39,000 µF capacitors. The two printed circuit boards are assembled with the same degree of detail and quality control which we observed on the preamplifier boards.



The construction of the autotransformers is quite intriguing; they are bifilar and penta-filar wound, or in general terms — scramble wound — to minimise the distortion inherent in standard transformer construction. The construction of the laminations is typical of the effort put into the transformer's design. These are tape wound and then cut and lapped optically flat. Once the windings are wound on, the laminations are then sealed together with a controlled air gap so that the desired response characteristics of the transformer are produced. This attention to details is necessary to maintain the very low distortion figures claimed (and achieved) by McIntosh.

The meter circuitry is an unusual innovation, it accelerates the movement of the meter when responding to a transient signal, thus compensating for the inertia characteristics of the meter, and then provides a slower decay so that the peak level may be more adequately determined. The manufacturers claim a peak reading accuracy within 2% of the true value. We found, during our tests, that impulses of 200 milliseconds duration, or greater, gave a true reading on the meter at the 0dB level, and impulses less than 100 milliseconds duration gave errors greater than 10% (ie - ½dB).

The unit came complete with an Owner's Manual, a Service Information leaflet and an "If You're in a Hurry" card, with similar information to that detailed for the preamplifier.

**MEASURED PERFORMANCE**

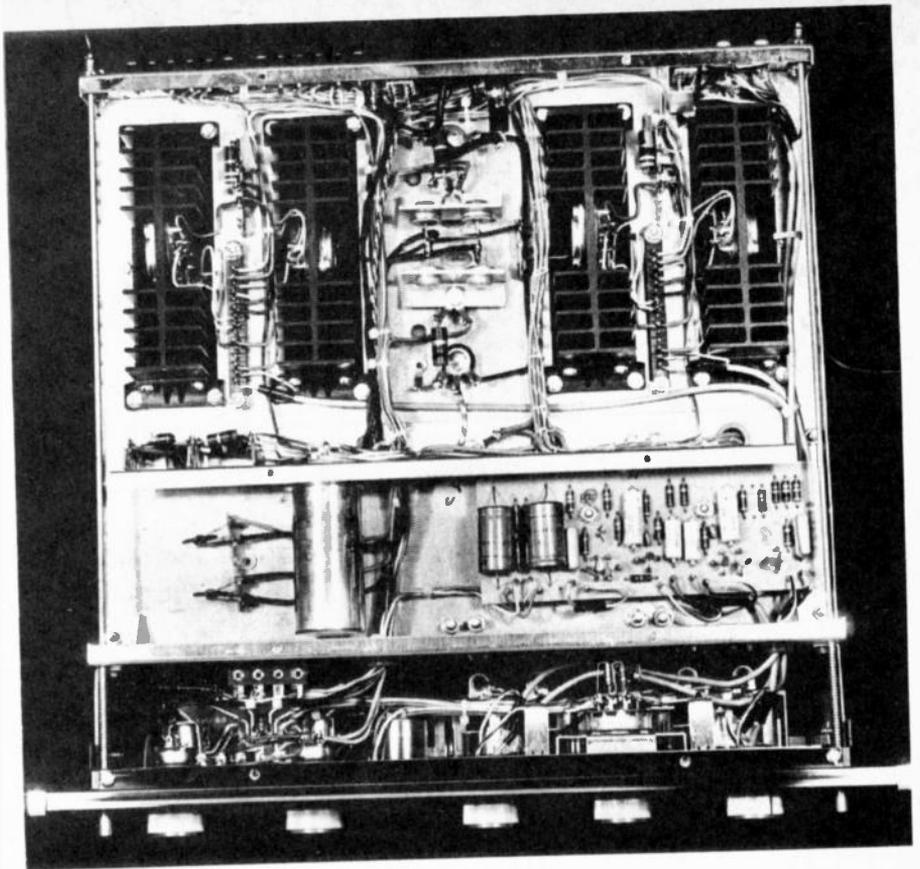
The measured performance of this amplifier can only be described as exceptional. At rated output of 105 watts per channel the frequency response was flat from 20Hz to 20 kHz ±0.1dB. With such a high output rating we were surprised when after two hours operation with one channel operating at 105 Watts and one at 250 Watts (that's right — 250 Watts), the temperature rise did not exceed 80°F

## THE POWER AND THE GLORY

above a 70°F room temperature on the overloaded channel heatsinks. At rated output the temperature rise of the heatsinks was only just noticeable.

Total harmonic distortion was particularly low, especially for an amplifier with transformers in the output stages, and above 40Hz was considerably lower than the limits stated by the manufacturer.

The left channel power level meter was sticking around the 0dB graduation, thus making it impossible to determine its calibration accuracy. However, we may assume that the calibration of the right channel power level meter is indicative of the order of accuracy to be expected. The calibration accuracy of this meter was better than 0.3dB over the graduated range, and its associated attenuator within ±0.2dB for the -10dB and -20dB range. With the meter range setting at -20dB the unit delivered ½



### MEASURED PERFORMANCE OF McIntOSH MODEL MC2105 — POWER AMPLIFIER SERIAL NO. 4978

Frequency Response		
	20Hz to 20kHz	±0.1dB
Total Harmonic Distortion at Rated Output		
	40Hz	0.25%
	80Hz	0.12%
	1kHz	0.17%
	6.3kHz	0.16%
At 1 Watt Output		
	100Hz	0.5%
	1kHz	.04%
	6.3kHz	less than .03%
Channel Separation		
	100Hz	67dB
	1kHz	50dB
	10kHz	40dB
Hum and Noise with Gain Control		
	At Maximum Setting	-85dB
	At Minimum Setting	-98dB
Power Output		
	105 Watts for 0.5V Input	
Input Impedance		
	200k Ohms	
Damping Factor		
	18 to 4 ohms output	
	13 at 8 ohms output	
	10 at 16 ohms output	
Dimensions 16-3/16" wide x 7-1/8" high x 14½" deep		
Weight 65 lbs.		
Price \$1626 for the combined units		

Watt when the meter indicated 0dB. At the -10dB meter range setting the output was 5 Watts at 0dB, and at 0dB meter range setting the output was 50 Watts at 0dB. A +3dB meter indication at 0dB range setting corresponded to a power output of 100 Watts.

The Power amplifier is designed with adequate controls so that it may be used on its own, driven by any suitable programme source (500mV at 50KΩ impedance.)

The McIntosh amplifier is the best amplifier we have ever tested — at \$1626 for the two units, it is also one of the most expensive amplifier systems that we have ever seen.

During subjective testing we found it impossible to use its full power capability, for our test speakers (50 Watt continuous rating JBL monitors) could not handle the power, nor could we withstand the sound levels created. Whilst most manufacturers of high powered amplifiers claim that the average home can easily use — or will benefit from such reserve power — we have always found the speakers to be the limiting factor with high level transients or sustained signals.

We consider that this amplifier system is best suited to professional applications, although — if used with suitable speakers — it will provide perfect performance for the most discerning, well-heeled domestic user.

# 3

# 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 — 33½ 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.  $\pm 1$  dB.  
20 Hz. to 20 kHz.  $\pm 2$  dB.

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

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:

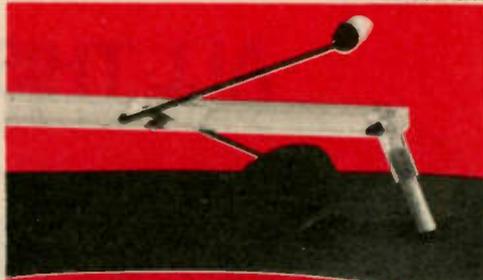
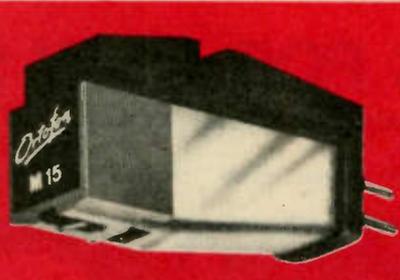
**THE WATTS "DUST BUG"** . . . which cleans the record, removing dust and static charges as the record plays. Surface noise is reduced considerably.

**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!"

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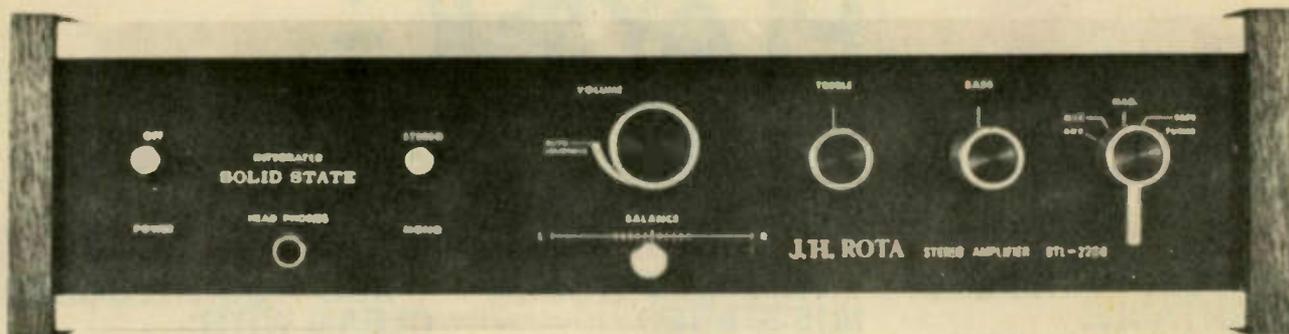
Please send me all the facts about: (a) Thorens turntables; (b) Ortofon cartridges; (c) Watts record cleaning equipment . . . and the name of my nearest franchised Simon Gray dealer.

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# INSTROL presents the new J.H. AMPLIFIER



*The only amplifier that combines the benefits of Australian research with Japanese Technology:—*

## The New **J.H. ROTA OTL-2200**

This amplifier has been designed utilizing both the Australian expertise of "J.H. Reproducers Co." and the technological facilities of the giant "Rota Corporation" of Japan.

### CHECK THESE FEATURES

- INPUTS:** Magnetic Cartridge (4MV); Microphone (5.5MV); tuner (200MV); tape (200MV); crystal or high output ceramic cartridge (200MV).
- TOTAL OUTPUT POWER:** 40 watts (2 channels) or 12 watts RMS per channel.
- TOTAL HARMONIC DISTORTION:** Below 1%; below 0.2% at 30 watts.
- OUTPUT IMPEDANCE:** 4-16 ohms.
- FREQUENCY RESPONSE:** 20-40,000 Hz  $\pm$  1 db.
- tone CONTROL:** Bass  $\pm$  10 db at 100 Hz. Treble  $\pm$  10 db at 10,000 Hz.
- S/N RATIO:** Mag. & Mic, better than 60 db. Aux. & Tape, better than 75 db. Tuner, better than 70 db.
- STYLING:** Attractive black aluminium fascia in polished walnut cabinet.

## ALL THIS FOR ONLY \$110.00

(MUCH LESS WITH TRADE-IN)

\* Amplifier will be despatched "freight free" within Australia.

# INSTROL

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Please send me a J.H. Rota OTL-2200 Amplifier.  
I enclose herewith my money order/cheque for

\$.....

NAME .....

ADDRESS .....

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T201

In Part 2 of this series, Roger Harrison describes various types of antennae.

The antenna is probably the most important part of a radio telescope and familiarity with the associated terminology and fundamental designs is desirable before attempting construction. We propose to cover these topics only briefly, as very detailed treatments can be found in such books as "The Radio Amateurs Handbook" (A.R.R.L.), "The Amateur Radio Handbook" (R.S.G.B.), "The VHF Handbook" (Orr & Johnson - Radio Publications), "The A.R.R.L. Antenna Handbook" (A.R.R.L.), "VHF Antenna Handbook" (Kyle - '73' publications) or similar publications. Excellent practical and design details are given in these books as well as in the specialised books on radio astronomy that we will include later in a bibliography.

Although antennae differ in shape, size and method of operation, their general characteristics are defined by the following terms:—

## Radiation Pattern or Direction Pattern

This refers to the pattern obtained when receiver antenna sensitivity is plotted in three dimensions (or the variation in power when a transmitter antenna field is plotted in three dimensions). The radiation patterns of a number of antennae are shown in Fig. 5 (a), (b) and (c).

The radiation pattern shown in Fig 5 (a) is of a simple dipole in space, it has a striking resemblance to a doughnut.

The pattern of a dipole and screen reflector is shown in Fig. 5 (b). Note the "side lobes". In practice these are reduced in amplitude as much as possible to prevent confusion in the interpretation of results. In the early years of radio astronomy many "new sources" turned out to be nothing more than side lobe responses from the antenna!

The pattern of a parabolic dish is shown in Fig. 5 (c). This is often called a "pencil beam" owing to its extreme narrowness.

## Beamwidth

This is the angle, measured in a chosen plane (generally the plane of the main antenna elements and at right angles to this plane), between the two "half power" points of the radiation

# RADIO ASTRONOMY FOR AMATEURS

*a series - by Roger Harrison VK3ZRY*

pattern. The half power points, of a simple dipole and a small Yagi antenna are illustrated in Fig. 6 (a) and (b). The radiation pattern is taken in the plane of the antenna elements in both cases.

## "Aperture" or "effective area"

This is a measure of the wavefront area from which an antenna can absorb power. It is generally expressed

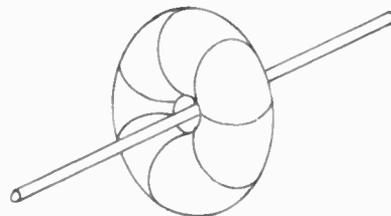


Fig. 5a. Three-dimensional field pattern of a dipole in space.

## WHY RADIO ASTRONOMY AS A HOBBY?

Galileo was the first man to make systematic observations of the skies using a telescope. An amateur scientist, he constructed his own telescope, kept systematic records and made some startling discoveries. He correctly concluded that the sun, not the earth, was the centre of the solar system, confirming Copernicus' earlier theorem. He was jailed for his opinion!

In 1936, Grote Reber, an amateur *radio-astronomer* constructed his own radio telescope and subsequently made a systematic series of observations of the skies which enabled him to complete a map of the *radio sky*.

Recognised as the world's first radio astronomer (and the world's *only* radio astronomer for more than ten years) Grote Reber's work stands as a pioneering and classical contribution to modern astronomy and astronomical physics. (Karl Jansky is credited with discovering the effect of cosmic radiations but did not persist with observations when his research contract was fulfilled).

All through the history of astronomy, amateurs have been able to make significant discoveries and contributions, alongside the efforts of professional scientists and scientific organisations. That this is so is no accident — it is generally the result of patient hard work and careful analysis.

Among those amateurs who have made their mark on astronomy are David and Johann Fabricius who observed the variable star Mira Ceti, Joseph Fraunhofer who discovered spectroscopic lines in the radiation of the sun, Heinrich Schwabe who discovered the 11 year sunspot cycle, Frederick Spörer who did much spectroscopic work and described the law of sunspot zones, John Carrington who did a tremendous amount of work on solar observations and techniques, and Joseph Lockyer who developed a method for observing the solar corona.

In the newer science of radio astronomy the work of Frank Hyde and John Heyington, both amateurs, has made significant contributions since radio astronomy became a science.

Interest in radio astronomy, as a hobby, is growing rapidly in Australia and many find it instructive and rewarding from a personal point of view apart from the chance to be able to make some contribution to science.

# RADIO ASTRONOMY FOR AMATEURS

Fig. 5b. Three-dimensional radiation pattern of a dipole and screen reflector.

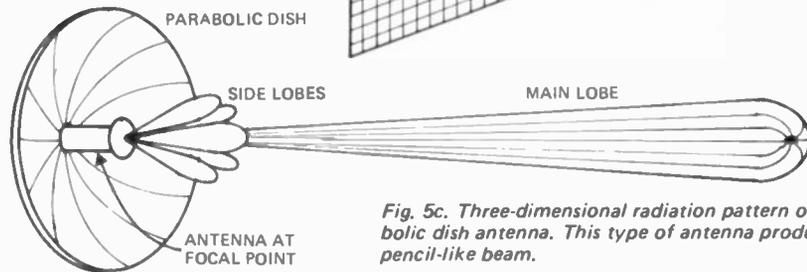


Fig. 5c. Three-dimensional radiation pattern of a parabolic dish antenna. This type of antenna produces a pencil-like beam.

as a fraction of the physical area of the antenna being considered. The value varies between 0.5 and 0.9. It is dependent on the direction of arrival of the wavefront, being at a maximum along the axis of the main lobe.

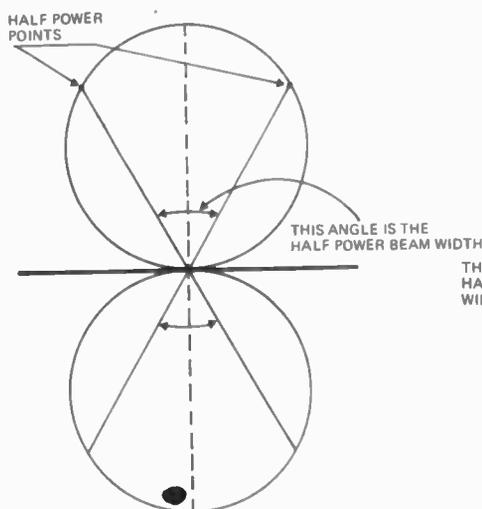
## Directivity

Directivity is the ability of an antenna to absorb more power (from an electromagnetic wavefront) along a particular axis, than any other axis. An antenna that absorbs power, from an electromagnetic wave, equally from any direction, is termed an *isotropic antenna*. It exists only as a mathematical concept and a convenient reference.

## Gain or power gain

Gain in an antenna system is a term used to express the increase in sensitivity of an antenna. For example, if a certain antenna produces ten times the voltage at its feedpoint, from a certain source, than that produced at the feedpoint of a dipole, then the voltage gain of the antenna is 20 dB.

Fig. 6a. Radiation pattern of a dipole, in a plane through the elements, illustrating half-power beamwidth.



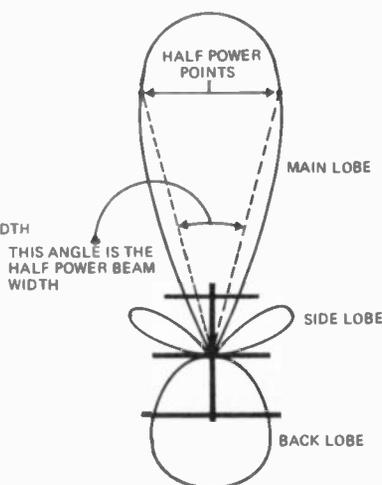
## Bandwidth

This refers to the frequency characteristics of an antenna. The gain of an antenna will vary with frequency, being greatest at the resonant frequency. The "half-power bandwidth" is the difference between the upper and lower frequencies at which the gain is half the maximum value (i.e. half the gain at the resonant frequency). Some antennae have a very broad bandwidth (e.g. log periodic, the helix) while some have a very narrow bandwidth (e.g. the Yagi).

## Feedpoint

The feedpoint of a receiving antenna is the place where a detector can be connected (usually via a transmission line) to achieve optimum reception of the power absorbed by the antenna. In a simple dipole, this is usually at the centre, but can be at the ends (this requires a special transmission line). A multi-element array may have only one feedpoint or many feedpoints connected together. The Yagi array has

Fig. 6b. Radiation pattern of a three-element Yagi antenna, in a plane through the elements, illustrating the half-power beamwidth.



only one feedpoint while the collinear array (or Kooiman array) has many feedpoints, all connected together.

The *feedpoint impedance* is a measure of the resistive and reactive components seen by an RF signal connected to the feedpoint. The feedpoint impedance varies with frequency and is generally a pure resistance (or nearly so) at the resonant frequency, depending on the antenna type and its particular characteristics.

Broadband or aperiodic antennas have a relatively constant feedpoint impedance over a wide range of frequencies. The rhombic and log periodic antennas are of this type.

## TRANSMISSION LINES

Antennae are rarely connected directly to the input of a receiver. To conduct the energy received by the antenna to the input of the receiver, a *transmission line* is used.

Transmission lines take a variety of forms, but the most commonly encountered are the coaxial line and the two-wire ribbon or open-wire line.

Coaxial line comes in three different forms: flexible, semi-flexible and solid. Flexible coaxial cable is made in a variety of ways but generally of the form shown in Fig. 7. The semi-flexible and solid variety are similar but for the arrangement of the outer and inner conductors. Soft copper is used for the inner and outer conductors of semi-flexible coaxial to allow it to be "formed" freely. Solid tubing is used for the inflexible or solid variety of coaxial transmission line. These two types are illustrated in Figs. 8 (a) and (b). Coaxial cable is referred to as "unbalanced" transmission line.

The two-wire flat ribbon type of transmission line is used extensively on T.V. antennas to connect the antenna to the T.V. receiver. The open-wire line is another form of two-wire transmission line, but has no solid insulator to maintain a constant distance between the two wires. Small insulators are placed at intervals along the line to perform this function. These two types of transmission line are illustrated in Figs. 9 (a) and (b). Note that two conductors are run parallel to one another in this type of transmission, which leads to it being referred to as "balanced" transmission lines.

All transmission lines have a *characteristic impedance* seen by an RF wave sent down the line. The characteristic impedance is a function of the diameters and the distance between the conductors and the dielectric constant of the insulation used in the transmission line.

Common impedances for coaxial lines are 50 ohms or 52 ohms, and 70 ohms or 75 ohms. Open wire or flat ribbon type lines are generally

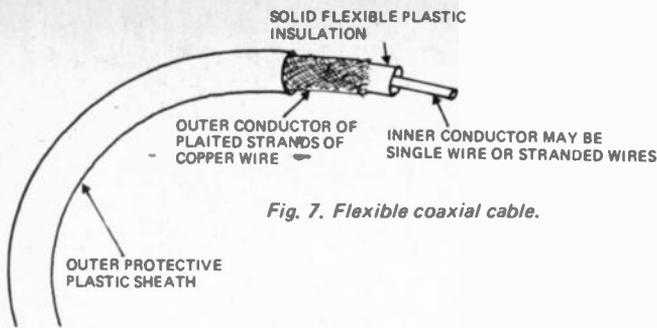


Fig. 7. Flexible coaxial cable.

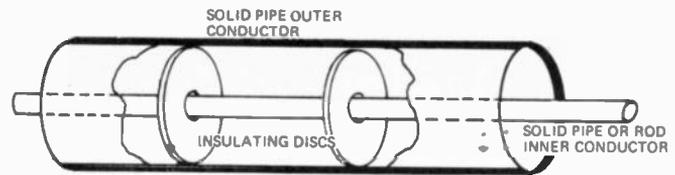


Fig. 8b. Solid coaxial cable. The insulating discs maintain the centre conductor in position.

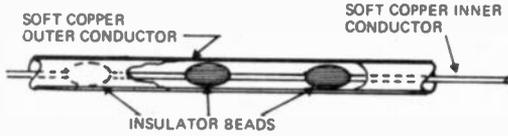


Fig. 8a. Semi-flexible coaxial cable; note insulating beads spaced at intervals along inner conductor to maintain inner conductor in place.

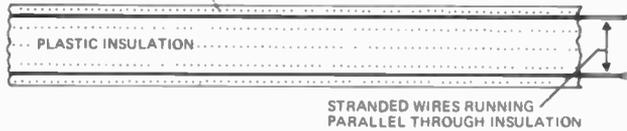


Fig. 9a. Two-wire flat ribbon transmission line.

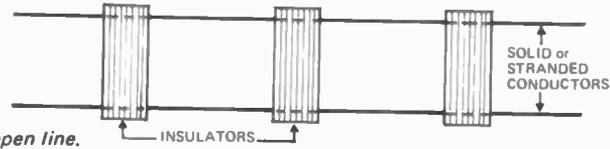


Fig. 9b. Two-wire open line.

available with an impedance of 300 ohms. Antennas are usually constructed so that the feedpoint impedance equals the transmission line impedance. If this cannot be readily accomplished, various methods are used to transform the antenna feedpoint impedance to the transmission line impedance so that they are "matched".

All transmission lines have a certain amount of loss due to the conductor resistance and dielectric loss. This is usually expressed as a loss of so many dB/100 ft. For radio astronomy it is best to use a transmission line which has the lowest loss obtainable and then only a short length. Long runs of transmission line reduce the sensitivity of a radiometer.

## ANTENNA TYPES

Many types of antenna are suitable for use in radio astronomy. Full constructional details of a few of these will be included later in this series of articles.

## DIPOLAS AND REFLECTORS

A simple dipole can be used to receive the emissions from Jupiter but an array of dipoles and reflectors is much more sensitive — and more versatile. Two half-wave dipoles, connected in phase with reflectors is shown in Fig. 10 (a). As shown this sort of array is easily made steerable.

An antenna for a drift interferometer is shown in Fig. 10 (b). It consists of two dipoles, connected in phase, above a screen reflector. These antennae are easily erected in a back garden. They are cheap and quite effective. They are generally used between 10 MHz and 50 MHz. In the VHF range and above, antennae with extra elements become practicable. For example a ten-element Yagi at 15 MHz would be about 150 ft. long and 30 ft. wide, but at 150 MHz it is only about 18 ft. long and 35 inches wide.

## THE COLLINEAR AND KOOMAN ARRAYS

The collinear array is similar to the array shown in Fig. 10 (a) but has a number of such arrays mounted one above the other. It is shown in Fig. 11 (a).

In the Kooman array all the reflectors are replaced by a large mesh screen (shown in Fig. 11 (b)).

Both these types are very useful, easy to construct, are not too critical in their dimensions and can be made fully steerable. They are most used at frequencies above 100 MHz. They become rather unwieldy when constructed for frequencies below this.

## THE YAGI

The Yagi is a very simple antenna to construct, has a very high gain, a good radiation pattern and is easy to erect.

An example is shown in Fig. 12. Arrays of Yagis are commonly used and give considerable gain when used in this fashion. However, feeding problems may cause complications.

Yagis are very narrow band antennae, but this does not necessarily limit their usefulness. Full constructional details of a five element Yagi for 140 MHz later will be included in this series.

## THE CORNER REFLECTOR

The corner reflector is another simple antenna yielding good gain and radiation pattern characteristics. It is relatively simple to construct and erect on a steerable structure. They have practicable dimensions even at frequencies as low as 30 MHz. Indeed a versatile corner reflector may be constructed from one reflector and a number of interchangeable dipoles (Fig. 13).

Fig. 10a. Two half waves in phase (steerable). This type of antenna is commonly used at frequencies between 10MHz and 50MHz.

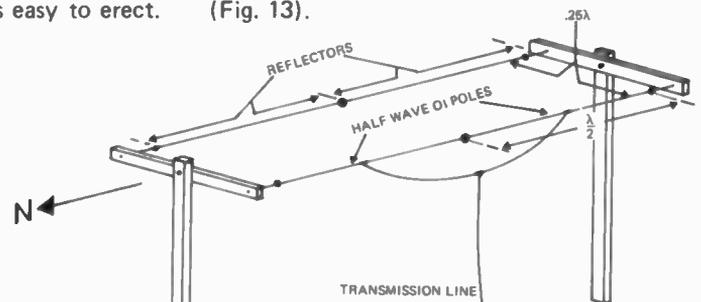
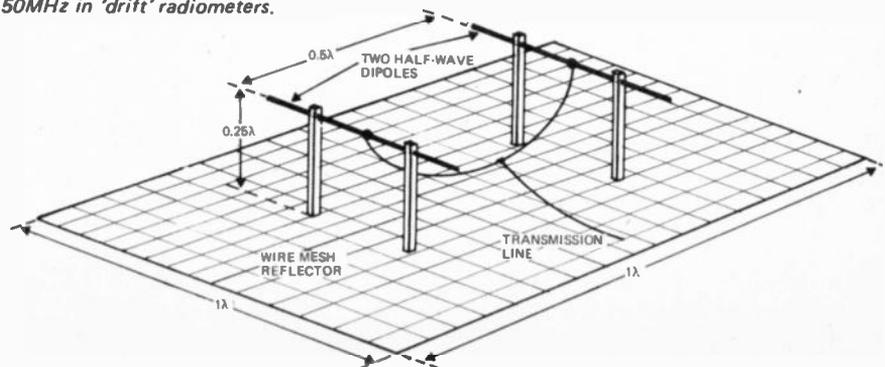


Fig. 10b. Two half-wave dipoles above a mesh screen reflector. Commonly used between 15MHz and 50 MHz in 'drift' radiometers.



# RADIO ASTRONOMY FOR AMATEURS

Fig. 11b. The Kooman array. In this type of antenna all the reflectors are replaced by a large mesh screen.

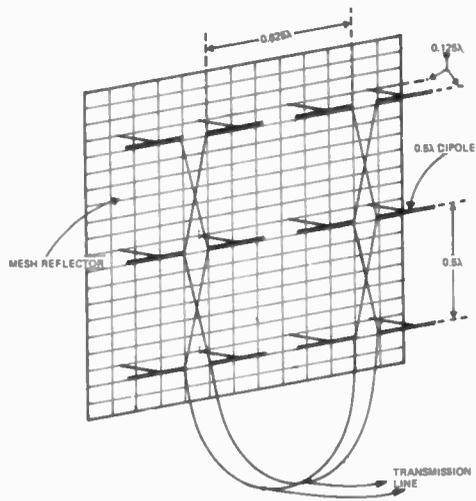


Fig. 12. A typical Yagi array.

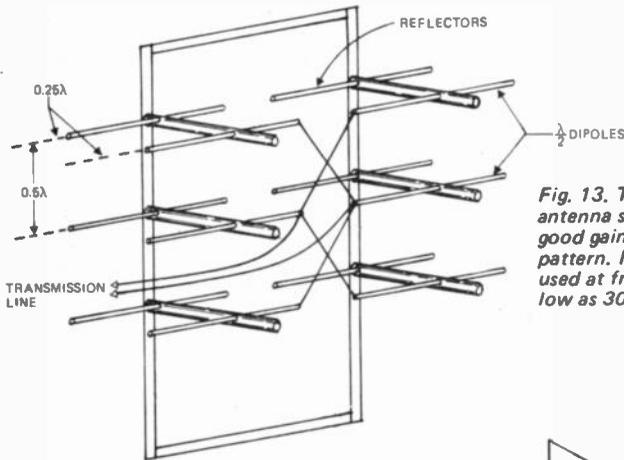
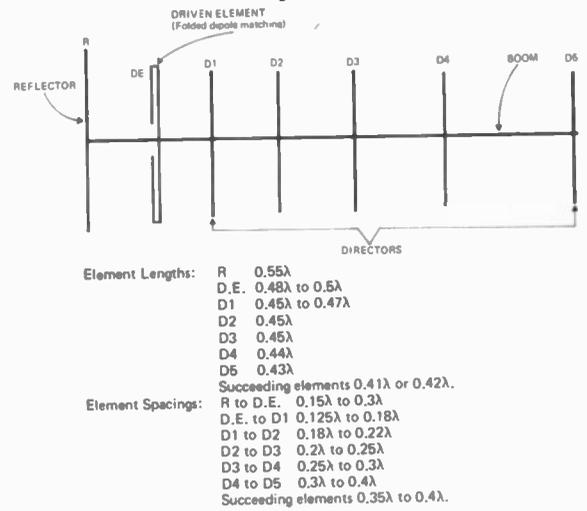


Fig. 11a. The Collinear array.

Fig. 14. The log-periodic antenna has a wide broadband. They are constructed in many different forms — this drawing shows the general characteristics.

## THE LOG-PERIODIC

This is a type of broadband antenna and can take many forms. They are relatively easy to construct, provide reasonable gain and have a good radiation pattern.

Many designs have been published over the years and we have illustrated the general form of one type in Fig. 14.

They are very useful for making observations over a number of widely separated frequencies.

## THE HELIX

This is also a relatively broadband antenna and has the advantage of being able to accept signals of any polarisation. It has good gain and radiation pattern and is relatively easy to construct. It can be made fully steerable quite simply. (Fig. 15).

## THE RHOMBIC

This antenna is a broadband antenna also. It suffers from the disadvantage of having the radiation pattern vary with frequency.

A rhombic for use at VHF frequencies can be very small and can be made fully steerable. Construction,

Fig. 13. The corner type antenna shown here has good gain and radiation pattern. It is often used at frequencies as low as 30MHz.

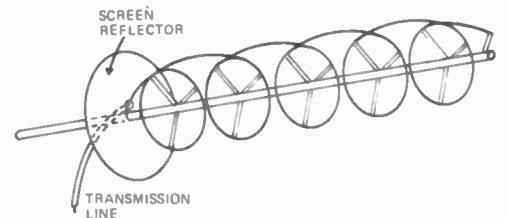
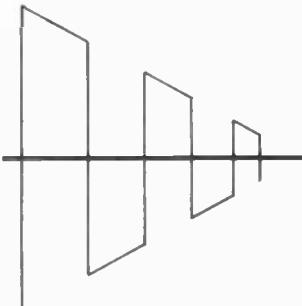
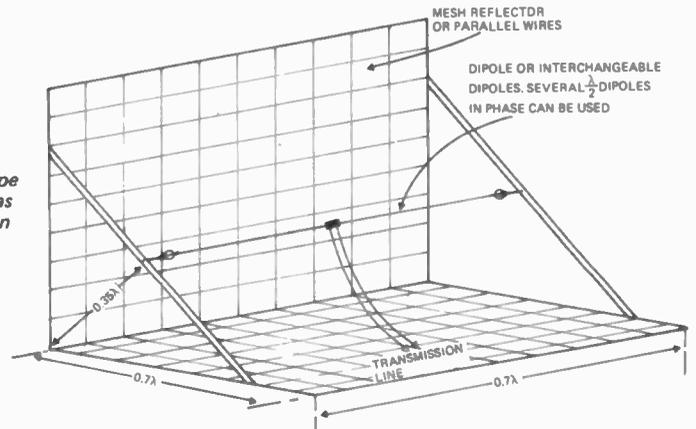


Fig. 15. The helix array can accept signals of any polarisation.

as can be seen from Fig. 16 is very simple.

## THE CYLINDRICAL PAROBOLA

The cylindrical parabolic reflector is much easier to construct than a parabolic dish and only a little more difficult than the corner reflector. A mesh screen (or parallel wires) is fitted over a parabolic frame. A number of dipoles or a single dipole can be put at the focus (which is a line parallel to the surface) and made interchangeable to increase its versatility.

This antenna is very useful for drift radiometers or drift interferometers. It can be made steerable in elevation just as readily as the corner reflector. Dimensions can be quite practicable down to 50 MHz.

## THE PARABOLIC DISH

This antenna employs optical techniques familiar to most people. It uses the same principle as the Newtonian telescope.

An antenna, generally a simple type

such as a dipole and reflector, is mounted at the focus of a parabolic dish so that all the energy collected by the dish is focused onto this antenna.

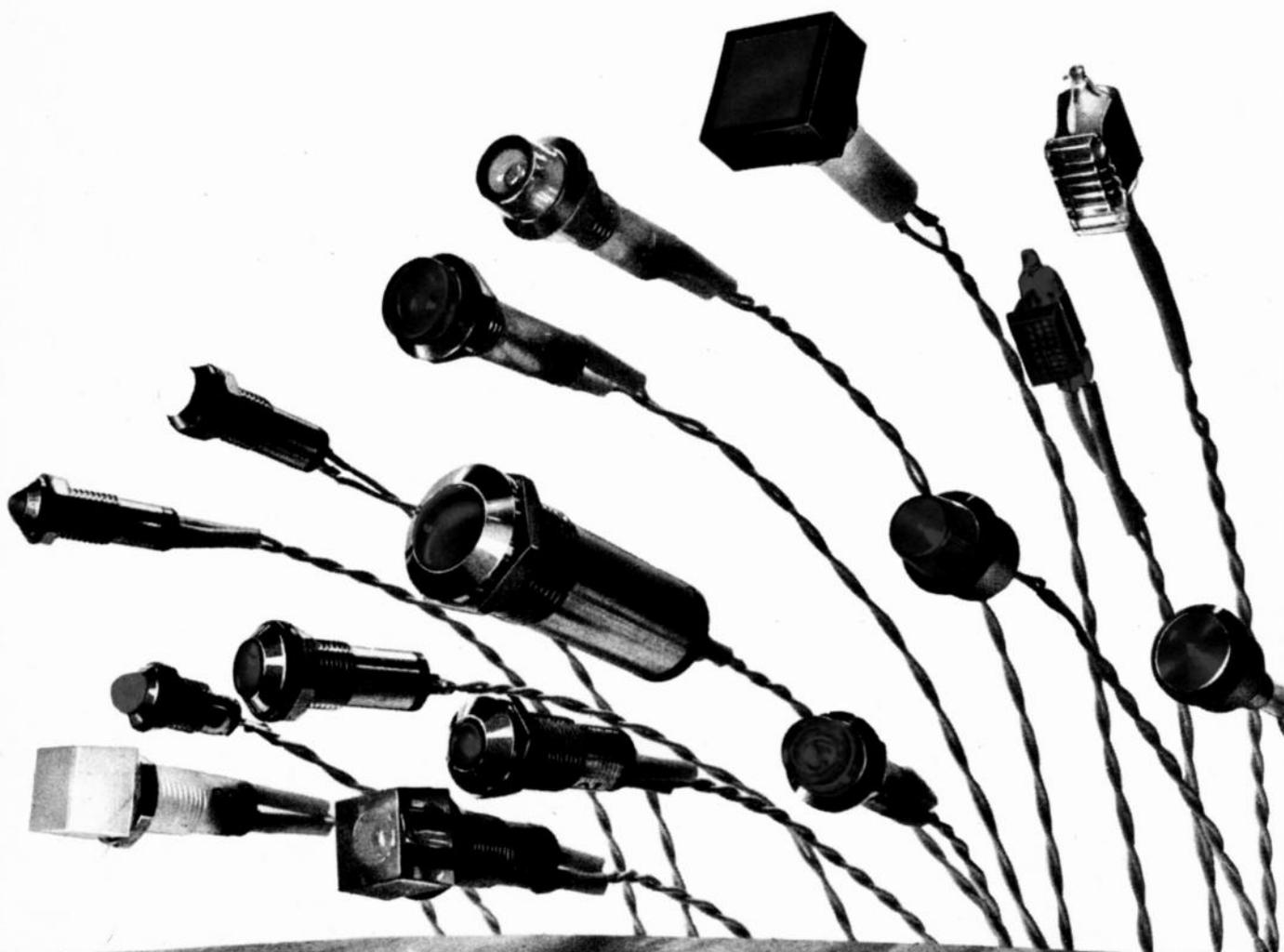
The parabola has very high gain but can be unmanageable if high gain at the lower frequencies is desired. However, a 30 ft. diameter dish at 140 MHz will give more gain than anything of similar proportions. Like the corner reflector, a number of interchangeable antennae can be used to improve its versatility. A "chicken wire" or screen mesh works well, even up to 500 MHz, but the dimensions and surface irregularities cause deteriorated performance with this type of construction at higher frequencies.

Small dishes (6 ft. to 10 ft. diameter) with metal gauze (fly-wire) reflectors give good performance at frequencies between 1000 MHz and 3000 MHz (centimetre wavelength band).

Large parabolic antennae are in use at Jodrell Bank (UK), Parkes (Aust.) and Owens Valley (USA).

(Continued on page 96)

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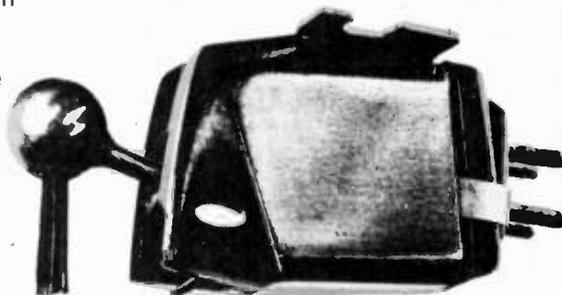
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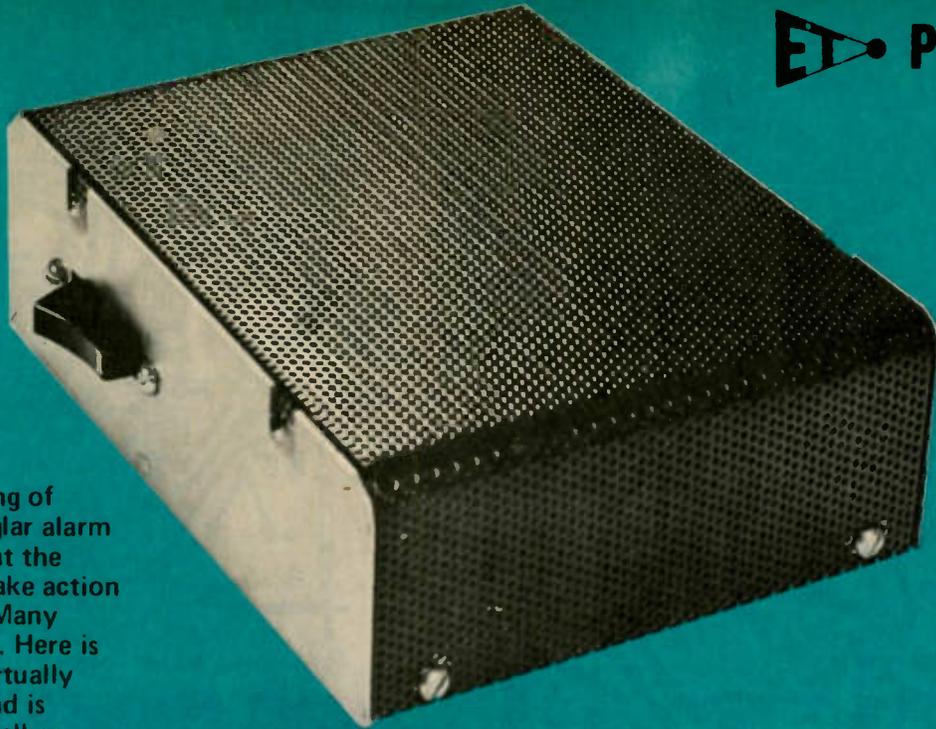
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A major failing of most car burglar alarm systems is that the driver must take action to set them. Many drivers forget. Here is one that is virtually automatic, and is simple to install as well.

# AUTOMATIC CAR-THEFT ALARM

*also protects trucks,  
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**S**OME months ago our companion journal 'Modern Motor', received a car burglar alarm for evaluation.

One day someone forgot to switch it on, and the car was stolen complete with the alarm.

Question. — Was this a good alarm system?

In our opinion emphatically NO — for just as some people steal cars — others forget to switch on alarm systems.

And so the Electronics Today alarm system is automatically set. This is

achieved by incorporating a circuit that 'arms' the alarm system some 30 seconds after the ignition is switched off.

The alarm is triggered by any drop in the battery supply voltage caused by an increase in loading on the vehicle's electrical system. Thus if a door is opened, this will activate the interior light, and the increase in electrical load will trigger the alarm.

This operating principle simplifies installation, for practically all vehicles have courtesy lights with actuating

switches installed in at least two doors — and it is fairly easy to install further switches in the rear door pillars if required. Both the boot and under bonnet areas may be protected in a similar manner — indeed many vehicles have lights already fitted in these areas, if not, it is a simple matter to incorporate them into the circuit.

Remember that these lights must be switchable at all times — not just when the ignition is on.

The alarm will also be actuated by anyone pressing the brake pedal — or if a light is fitted — by opening the lid of the glove box.

## DELAY CIRCUIT

The delay circuit built into the unit enables the driver to leave the vehicle without triggering the alarm.

As the alarm is triggered by an *increase* in electrical load, any doors or other protected areas may be closed at any time before or after the end of the time delay period, providing the doors are initially *opened* before the preset time. The subsequent *decrease* in load as the lights are extinguished will not trigger the alarm.

In the initial design stage we considered incorporating a second time delay to obviate the need for any external re-entry switches.

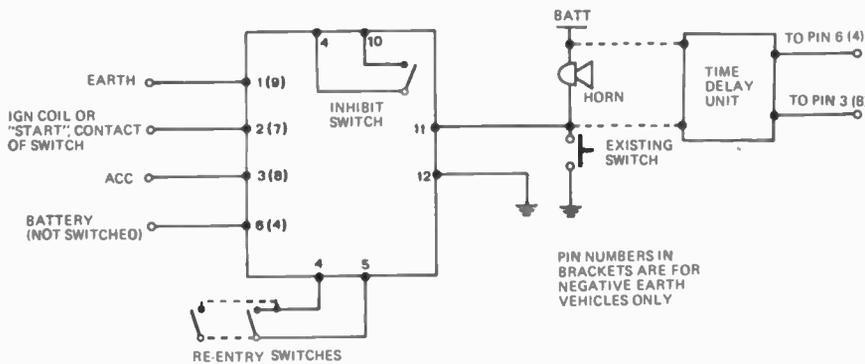
But as this would allow a thief quickly to break into a parked car and steal goods from the interior before the alarm was energized, we decided to use an instantaneous alarm and an external re-entry switch.





# AUTOMATIC CAR-THEFT ALARM

Fig. 5. This drawing shows how the alarm unit is connected into the vehicle's electrical system.



PIN NUMBERS IN BRACKETS ARE FOR NEGATIVE EARTH VEHICLES ONLY

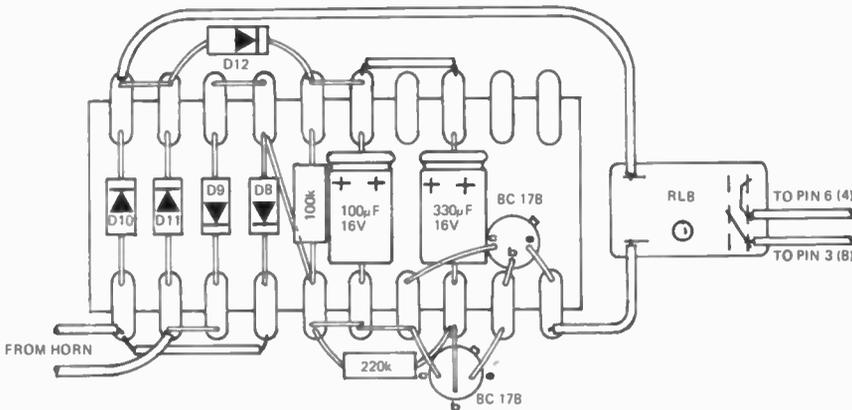


Fig. 7. Constructional details of circuit shown in Fig. 6.

potentiometer RV1 to maximum resistance.

## INSTALLATION

The completed unit should be installed out of sight, but in a fairly accessible place to enable the unit to be disabled when the vehicle is in for servicing.

Ensure that the alarm unit has been built to the correct polarity for the vehicle and that the electrical system is 12 Volt.

Solder leads onto the pins provided on the alarm unit and long enough to reach the points indicated on the installation drawing (Fig. 5).

Mount the alarm unit in the chosen location and run the wiring to the positions indicated on Fig. 5.

As explained earlier, the external re-entry switch, can with a little ingenuity, be built into the existing door locking mechanism. But make sure that the switch is operated only by the key and not when the door is opened from the inside.

If an external key switch is used it should either have a momentary contact mechanism (or if a normal type of switch is used it may be

momentarily turned on, then off again).

(If the vehicle has any fibreglass or alloy panels a reed switch may be used for the external reset function. Just mount the reed behind a convenient panel and actuate it externally by a small bar magnet).

As the unit is operated by a momentary drop in battery voltage, caused by lamps being energized, it is essential that all globes be maintained in working order. One advantage of this system is that any fault in the triggering mechanism is immediately obvious.

The function of the potentiometer RV1 is to provide a sensitivity control. During the early development of this unit we were plagued by false alarms at intervals of a few hours. This was finally traced to the electric clock

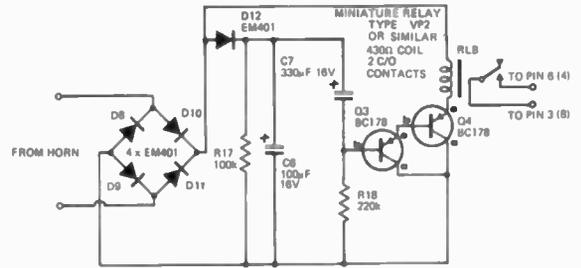


Fig. 6. This (optional) unit switches off and resets the alarm system after a preset time.

## PARTS LIST ET305

R1	— resistor 470 ohm, 1 Watt, 5%
R2	— " 1M, 1/2 Watt, 5%
R3	— " 1k, " "
R4	— " 2.2k, " "
R5	— " 2.2k, " "
R6	— " 1k, " "
R7	— " 100k, " "
R8	— " 100k, " "
R9	— " 33k, " "
R10	— " 47k, " "
R11	— " 47k, " "
R12	— " 3.3M, " "
R13	— " 22k, " "
R14	— " 1k, " "
R15	— " 4.7k, " "
R16	— " 1k, " "
RV1	— potentiometer 1M trimpot (large type)
C1	— capacitor 0.1 uF, 100V
C2	— " 100 uF, 16V, electrolytic
C3	— " 47 uF, 16V, " "
C4	— " 0.1 uF, 100 V, " "
C5	— " 0.1 uF, 100 V, " "
IC1	— integrated circuit uA 741C (metal can type only)
IC2	— integrated circuit uA 741C (metal can type only)
SCR1	— SCR type C106Y1 or similar
Q1a	— transistor 2N3643 or TT 3643
Q1b	— " 2N3638 or TT 3638
(note — Q1a for +ve earth vehicles, Q1b for -ve earth vehicles)	
Q2	— transistor BC178
D1	— diode EM401
D2	— " " "
D3-D8	— " 1N914
RLA	— relay — Associated Controls type E3201, 12V coil — single change-over.
PC board — ET019	
PC board pins — McMurdo type 5737 54 08, or similar.	
SW1 — single pole single throw switch	
Metal case.	

which had a mechanism that was electrically rewound at regular intervals! If this occurs then just back off RV1 meanwhile ensuring that the unit functions correctly when triggered in the normal way.

The vehicle's existing horn may also be used as the alarm horn — however it is well worth while installing a separate horn specifically for the alarm function. If this is done it should be mounted in an inaccessible position and the associated wiring carefully concealed.

Whilst not included in the basic alarm unit we have also shown a circuit (Fig. 6.) that will switch off the horn alarm at the end of a 90 second period. The unit then resets automatically and will be re-activated if any further attempt is made to re-enter the vehicle.

# HOW IT WORKS

The alarm circuit is best considered as a number of separate interconnected units. These are:—

1. Power supply.
2. Detector.
3. Initial time delay.
4. Inhibiting network.
5. One cycle oscillator.
6. Output stage.
7. Maximum alarm-time unit (optional).

## POWER SUPPLY

For vehicles with positive earth systems, the power supply is formed by Q1a, D1a, D2a, R1a and C1. (Components with suffix 'b' are used in the negative earth version.)

With the ignition key in the acc., on, or start positions, power is supplied to resistor R1a via D1a or D2a. If power is supplied to this resistor, Q1a is turned off and no power is supplied to the alarm circuit. When the ignition key is turned to the off position no power is supplied to R1a and so R1a turns on Q1a and power is applied to the alarm circuit.

The reason for taking power signals from both the ignition coil and acc. positions is that in many vehicles all secondary electrical loads are disconnected in the start position. This would otherwise cause the alarm to operate whilst starting the car.

## DETECTOR CIRCUIT

This is primarily an operational amplifier (IC1) with differential inputs. The inverting input (-ve) is Pin 2, and the non-inverting input (+ve) is Pin 3. If the input to Pin 2 is more than four millivolts higher than Pin 3, the output (Pin 6), will be within two volts of the *negative* supply rail. If Pin 2 is four millivolts, or more, lower than Pin 3, the output at Pin 6 will be within two volts of the *positive* supply rail.

A common centre tap, derived from R3 and R4, is used for both inputs. The voltage at the non-inverting input (Pin 3) is modified by feedback from the output, (Pin 6).

When the alarm is in the non-triggered state the output of IC1 is in the low state and the voltage at Pin 3 is between 5mV and 1V lower than the voltage at Pin 2 depending on the setting of RV1.

If a negative pulse occurs on the supply rail, this pulse is coupled to Pin 2 by C4. Providing this pulse is greater than the bias on Pin 3, the output of IC1 will go high and will be held in this state by the action of the feedback loop.

If the de-activating switch SW1 is in the off position, the negative pulse on the supply rail cannot be coupled into Pin 2. This will prevent the alarm from being triggered, but will

not stop the alarm once it is triggered.

## INITIAL TIME DELAY

When power is initially applied to the circuit, C2 charges via D4, R8 and R2. The charging current through R8 causes Pin 2 of IC1 to go higher than normal for the first 30 seconds, and during this time a negative pulse on the supply rail will not trigger the alarm. After 30 seconds or so, C4 is completely charged by R2 and has no further effect on the circuit.

## INHIBITING NETWORK

To enter the car without triggering the alarm it is necessary to make a momentary contact between the two 're-entry' terminals. When this contact is made, SCR1 latches on and pulls the voltage on Pin 3 of IC1 out of the range of the triggering pulse. This circuit is inoperative if the alarm has already been triggered.

## ONE CYCLE OSCILLATOR

This circuit causes the horn to pulse at one second intervals.

It is based on a second operational amplifier of a similar type to that used in the detecting circuit.

Increasing the value of R13 will decrease the pulsing frequency — and vice versa. If the output of IC1 is in the low state, the oscillator is inhibited and the output of IC2 is held high.

## OUTPUT STAGE

The output stage is simply a relay driven by transistor Q2 which in turn is driven by IC2. Diode D7 prevents reverse spikes from the relay damaging the transistor.

## MAXIMUM ALARM TIME UNIT

This is an optional unit and has not been included on the main printed circuit board. Details are shown in Fig. 6. The unit resets the alarm circuit after a preset time.

The unit is connected across the alarm horn which is energized when voltage is applied to the circuit. Capacitor C7 is charged via R18. Transistors Q3 and Q4 are emitter followers and carry the relay current. When voltage is high enough the relay closes and momentarily applies power to the accessories. This resets the alarm. The alarm will be retriggered if the vehicle's electrical system is again disturbed. The circuit values shown will provide a time period of approx 1.5 minutes, but this may vary with different relay coil resistances and capacitor tolerances. Increasing R18 or C7 will increase the time period and vice versa.

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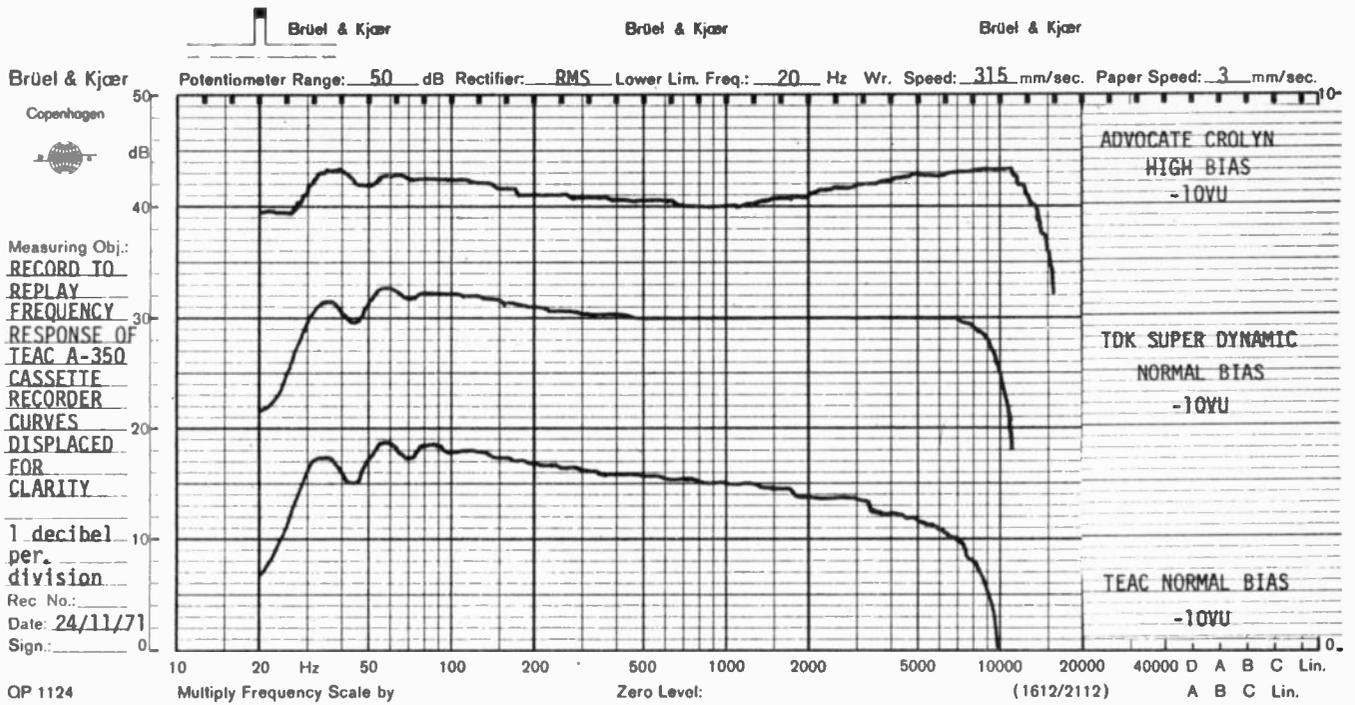
A-B TEST	A method of comparing two components, such as loudspeakers, by switching directly from one to the other.
AMBIENCE	Acoustic colouration caused by the reverberant characteristics of the listening room or concert hall.
ANECHOIC	Echo-less; without reverberation.
BASS	In hi-fi terms — the frequency spectrum below 150 Hz.
CARTRIDGE	Section of record-player pick-up arm consisting of stylus and associated mechanism, (usually detachable) — also a continuous loop magnetic tape package — usually having eight tracks.
CASSETTE	Preloaded container for use with cassette recorders, has four track magnetic tape — usually operates at 1-7/8" second.
CHANNEL	A sequence of units handling one specific signal.
CLIPPING	Distortion caused by severe overloading of an amplifier.
COMPRESSION	Reducing the dynamic range of speech or music by increasing the level of noisy passages.
CROLYN	Trade name of a magnetic recording tape with a chromium dioxide coating (made by Dupont in USA).
CROSSOVER	Circuit used for dividing amplifier output into selected frequency bands. The output from the crossover network energizes the appropriate loudspeakers.
DAMPING	The ability of an amplifier to stop the movement of a loudspeaker cone once the energizing signal has ceased.
DECIBEL	A decibel (dB) is a logarithmic unit representing ratios. Decibels are used for expressing wide-ranging numbers on a simple linear scale. A decibel figure is the logarithm of a voltage ratio multiplied by 20 (or the logarithm of a power ratio multiplied by 10.) The system is commonly used to imply actual sound levels — an orchestra playing flatout produces about 100 dB. This is an incorrect usage of decibel notation, but most people know what is meant.
DIN	German Standards for industrial items — generally refers in hi-fi parlance to Standards for plugs, sockets etc. but there are DIN Standards for tape recordings equalisation and hi-fi specifications. DIN is an acronym for Deutscher Industrie Normen.
DOLBY SYSTEM	A system for reducing noise on tapes and records, etc. It operates by compressing a signal before recording and expanding it on replay.
DRIVE UNIT	Loudspeaker unit — i.e. not the complete enclosure.
DYNAMIC RANGE	Total range of signal from the highest to the lowest found in any given programme material. The term is also used to indicate the range of signal level that a piece of equipment can handle.

# HI-FI TERMS

*Like most technologies, the evolution of hi-fi has brought with it a vocabulary all its own.*

*Most of the terms used are simple enough — once you know what they mean. Here is a listing of 38 of them.*

EIGENTONE	Acoustic room resonances produced by parallel surfaces.
FILTER	A circuit used to attenuate selected frequencies.
FLUTTER	Pitch variations above 10 Hz.
FREQUENCY	Rate of oscillation — number of complete cycles of oscillation in one second. Originally expressed in cycles per second — now in Hertz (Hz) One Hz equals one cycle per second.
FREQUENCY RESPONSE	The range of frequency that can be handled by a piece of equipment. To be meaningful this figure must be qualified by stating the decibel limits over which the frequency response specification applies.
HARMONIC	A multiple of a fundamental frequency. Thus, the second harmonic is a frequency twice that of the fundamental.
HARMONIC DISTORTION	Distortion in which harmonics are added to the original signal.
HERTZ	Unit of frequency.
INTEGRATED CIRCUIT	A circuit component in which transistors, diodes, resistors, etc., are formed on a microscopic chip of material. An integrated circuit 1/16" square may contain the equivalent of forty or fifty separate transistors.
kHz	One thousand cycles per second.
LOUDNESS CONTROL	A system by which bass and treble frequencies are boosted at low listening levels to compensate for associated hearing characteristics. Some hi-fi authorities dislike loudness controls on the grounds that they are unnatural. One wonders why they regard <i>music</i> as a natural phenomenon.
MONO	Single channel.
OCTAVE	Frequency interval of two to one.
PEAK-TO-PEAK	The magnitude of an electrical current or voltage measured between the extreme positive and negative excursions.
POWER	The rate at which energy is converted or dissipated — measured in Watts.
RANDOM NOISE	Noise generated in electronic circuits by random molecular movement.
RESPONSE CURVE	Graph of frequency response with frequency on a horizontal scale and signal level on a vertical scale.
RMS	Root Mean Square — the effective amplitude of an AC voltage waveform. It is equal to the DC voltage or current that would produce the same power dissipation in any given load.
SOLID-STATE	An electronic circuit that uses transistors rather than valves.
TWEETER	Loudspeaker used solely for reproducing high frequencies.
WOOFER	Loudspeaker used solely for low frequencies.



# TEAC A-350 DOLBY C



TEAC's new generation cassette recorder offers truly hi-fi performance.

**T**HE TEAC A-350 is the second cassette recorder that we have reviewed which incorporates the Dolby noise reduction system as an integral part of the recorder. It is the first with high density ferrite heads. Many more will be marketed in the near future, for the recent advances with chromium dioxide and other new magnetic materials, greatly improve the frequency response obtainable.

As with all TEAC equipment, the external appearance of the TEAC A-350 is pleasing to the eye. The control panel, which is moulded in a black plastic, is partially covered with brushed stainless steel panels and is fitted into an oiled timber base with high end panels. The left side of the

deck contains the tape compartment, a set of six piano-type function keys, an index counter, a tape run indicator, a record mode indicator and a tape eject button.

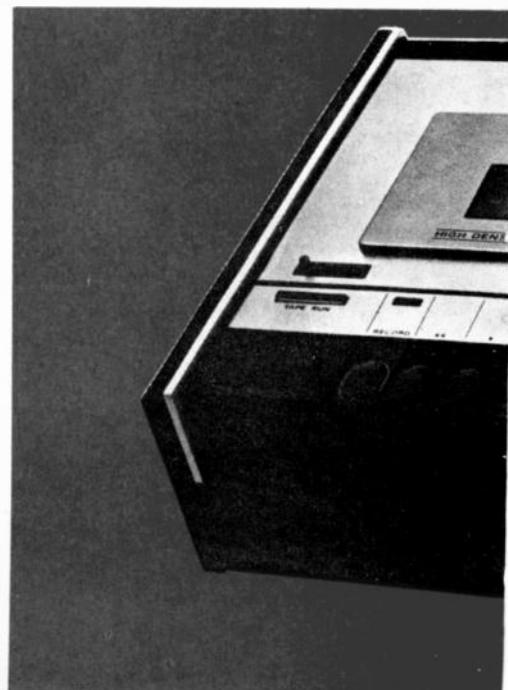
The design of the cassette carrier used in this recorder is unusual. It is in two parts — comprising a metal carrier onto which the cassette is placed, and a large dust cover. Normally these two components are combined, making it virtually impossible to clean the heads and difficult to clear should the tape get caught up on the pinch roller. Another good feature of the dust cover is the large viewing window, measuring 1-3/8" x 2-3/4" providing a clear view of the cassette. A counter, with reset button, is located on the far left, just below the dust cover. An orange strobe-type indicator, showing that the tape is actually running, is located just below the tripmeter. Six piano keys provided the following functions; from left to right:—

- Record, with an illuminated bezel strip above it.
- Fast reverse.
- Play.
- Fast forward.
- Stop.
- Pause.

The sixth (pause) key is particularly useful. This can be depressed first so that there is no tape movement,

particularly when selecting the record mode. All keys, with the exception of the pause key, are interlocked so that the stop key has to be operated each time before another function can be selected, thus minimizing the chance of pressing a wrong key.

The right hand side of the machine contains two medium sized VU meters; slide controls for input and output levels; microphone or line input, tape bias and Dolby mode switches and a peak level indicator.





## TEAC A-350 DOLBY CASSETTE RECORDER

that this figure varied considerably from tape to tape but rarely exceeded the 0.13% claimed by the manufacturer. These low figures are mainly attributable to the large fly-wheel in the drive mechanism and the use of an outer-rotor type hysteresis-synchronous motor.

During the measurements and the subjective tests it was noted that the left and right channels were slightly different. Further investigation showed that the bias settings for each channel were completely different, as shown below.

### Relative bias settings prior to conducting measurements

Bias switch setting	Right Channel OdB (reference level)	Left channel
Normal	+1dB	+2.6dB
High	+1dB	+4dB

We have not been able positively to establish whether the bias settings were changed subsequent to manufacture. Correctly biased, we obtained good frequency responses, with both standard and chromium dioxide tapes.

The overall performance of the recorder was subjectively tested by playing specially pre-recorded cassettes and by recording excerpts from two records; Warner Brothers — JBL test record, and the CBS Simoň and Garfunkel "Bridge Over Troubled Waters". The tapes were then compared with the record in an A-B type test. When chromium dioxide tapes were used, the difference between the original and the tape was particularly hard to detect, the only discernable loss being at very high frequencies. The loss was more apparent to the ear when conventional cassettes were used, as their frequency response rolls over before 10kHz on this recorder. In many homes, or where background music is required, the difference would not be noticeable.

For these tape comparisons the Dolby system was used and the marked reduction in tape noise provided by the Dolby Noise Reduction System was quite apparent, and certainly a necessary function to be used, if one desires to utilize the maximum frequency performance that chromium dioxide tapes can provide.

The frequency response obtainable from this machine is largely determined by the type of tape being used. Table I shows the extraordinarily wide range obtainable (at -10VU) with Advocate Crolyn and BASF CrO<sub>2</sub> tapes compared with a number of the other top quality tape cassettes.

### Tape

Advocate Crolyn Tape  
 BASF CrO<sub>2</sub>  
 TDK Super Dynamic C60  
 Scotch High Energy Cobalt C60  
 TEAC C60 cassette

### Measured Frequency Response

20Hz to 14kHz ±3dB  
 20Hz to 12kHz ±3dB  
 25Hz to 9kHz ±3dB  
 20Hz to 8kHz ±3dB  
 25Hz to 5kHz ±3dB

The main circuitry is located on three separate printed circuit boards, which are clearly labelled so that each channel and its respective trimmer potentiometers can be identified. All the transistors are silicon and the microphone preamplifier has a frequency response of 20-20kHz +0 -2dB. The drive motor is fitted with a double grooved pulley, which can be inverted to provide the speed change necessary for 60Hz. The mains power fuse, located in the base of the machine, incorporates a multipin plug, which has five positions. These provide voltage settings 240V, 220V, 200V, 117V and 100V.

The high density ferrite heads fitted to the tape recorder carry a lifetime guarantee with respect to wear and performance. The recorder is supplied with a very basic, illustrated, eight page instruction manual complete with circuit diagram. TEAC also supply a quick reference card with operating

instructions on the front and maintenance instructions on the back.

A full set of R.C.A. patching leads, and a cleaning kit consisting of a bottle of cleaning fluid and a packet of cotton swabs are also supplied.

The recorder was a delight to use and certainly should make anyone question the advantages of a conventional reel to reel recorder, with its attendant threading problems and relative inconvenience.

This "Dolbyised" deck helps to place cassette recorders in a new position in the High Fidelity field. They are no longer toys.

The inclusion of the Dolby system within the machine obviates the problems and inconvenience that occur with a separate Dolby unit which we personally dislike from a ergonomic point of view.

With a suggested retail selling price of \$318.00 this unit is good value for money.

### MEASURED PERFORMANCE TEAC A-350 STEREO CASSETTE DECK WITH DOLBY, MODEL A-350 SERIAL NO. 4346

#### Record to Replay Frequency Response

With TEAC C60	0VU	-10VU
25Hz to 4kHz ±3dB		25Hz to 5kHz ±3dB
With Advocate Crolyn CrO <sub>2</sub> C60	0VU	-10VU
20Hz to 8kHz $\pm 2.3$ dB		20Hz to 14kHz ±3dB

#### Wow and Flutter

0.06% RMS

#### Total Harmonic Distortion Re 1kHz Signal

0VU	-10VU
1.4%	0.4%

#### Signal-to-Noise Ratio Unweighted

55dB

#### Cross Talk at 0VU

1kHz	100Hz
41dB	43dB

#### Intermodulation Distortion

With 1kHz and 970Hz Signal @ 0VU

-41dB

#### Line Input Sensitivity for 0VU

= 86mV

#### Microphone Input Sensitivity for 0VU

= 3.6mV

#### Line Output Sensitivity for 0VU Signal Level

and Maximum Gain

= 700mV

Dimensions: 4-3/8" (H) x 16-15/16" (W) x 9-7/8" (D)

Weight: 11-3/4 lbs (5.3kg)

Price: \$318



### 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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8" P.A. speaker and projection flare — \$16.25  
600/15 line transformers — \$3.00  
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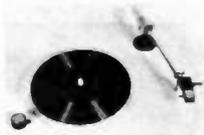


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C116 — C117 — C117A3

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Deluxe model as above with — adjustable counter balance, 2 spindles, calibrated stylus pressure control added ..... \$46.50  
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Model C117 and C117A3 can be supplied with Magnetic Cartridge and Diamond Stylus at \$10.00 extra. Pre-cut Mounting Platforms are available to suit Changers ..... Price \$9.00  
Also Fully Moulded Smoke Tinted Perspec Covers ..... Price \$9.00

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12U50	— 50 Watts R.M.S. —	\$34.50.

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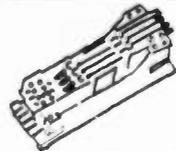
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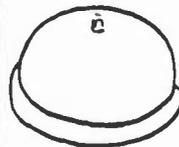
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2,500 MFD	80V	\$2.50	11,000 MFD	19V	\$3.50
3,500 MFD	75V	\$2.50	24,000 MFD	13V	\$3.00
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# CASSETTES ...loaded cartridges

By Martin Dworkin

EVERYONE talking about cassettes — and in the world of the information and entertainment arts-industries this means everyone — agrees that they portend a revolution. But there is little agreement on anything else. As matters stand, there are so many competing concepts and attendant incompatibilities in technology, so many variables affecting development of processes, and so many imponderables beclouding public acceptance, that it is difficult to exercise prudence without actually favouring one system or another. The choice of technology, too, will surely affect and be affected by the nature of the material to be recorded and replayed — raising profoundly serious questions concerning the ways of living that the new machinery may make possible, or, in effect, may actually enforce. The stakes are high enough to evoke the greatest concern, even as huge sums of money are ventured by established giants of the electronics and entertainment industries, and new companies are formed expressly to make the cassette revolution happen.

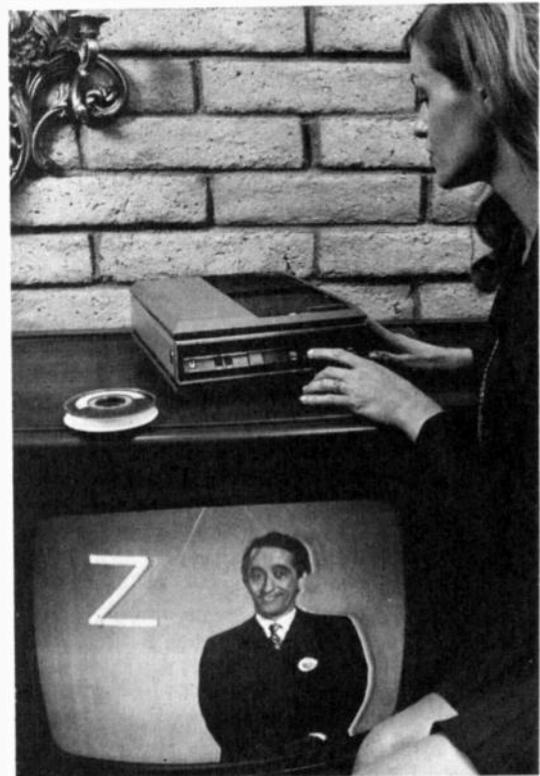
As with revolutions, there are cassettes and cassettes — and some that aren't cassettes at all. The word, as used by the media prophets, is increasingly being understood specifically to mean containers of recorded visual and audio materials for playback via television receivers. Often, it serves as a contraction for "tv-cassettes," or "video-cassettes," distinguishing the new system from the now-familiar (but still not standardized!) magnetic-tape magazines for sound-recording and reproducing machines; or, for that matter, from the various holders, packs, magazines, cartridges, or other devices for loading sheets or rolls of photographic film, that have gone by the name "cassettes" since the days of glass plates.

In fact, film, in what are often deliberately (if not very precisely) differentiated as "cartridges," is the essential element of several systems considered as competing with tape

videocassettes for general acceptance. But even here there are sharp differences in the ways film is used, to begin with according to whether it is optically projected, as with conventional reel-to-reel machines directly on to screens or walls — a leading example being the Technicolor Super-8mm system; or, whether the film is scanned, or "read" electronically, and the sound and images converted for television receivers, in a manner modifying standard professional telecasting techniques — here two leading protagonists, both using 8mm films, are Vidicord and NordMende.

Film in cartridges, this time 8.75mm wide, carrying two picture channels and two audio tracks, also characterizes the EVR (Electronic Video Recording) system developed by CBS laboratories. But the film is produced by a unique process, combining electronic beam recording and optical printing, for replay using an oscillating spot-scanner attached to a standard television set. The EVR system has had more publicity than any other, especially in Britain and the United States — but also more actual demonstration, in a form produced by Motorola for educational and industrial applications. EVR programmes, it is important to note, can be made from conventional motion picture films — in fact, probably the greatest source of material; but the EVR films themselves, whether in cartridges or not, cannot be shown on standard or other projectors, existing or contemplated.

A kind of film, also in cartridges, is used in the SelectaVision holography process announced by RCA. The "film" however, actually is chemically treated transparent stock, significantly inexpensive, on which split laser beams "emboss" patterns of their "interference" with one another, as they are reflected from the material, such as films, photographs, and videotapes, that is being holographed. The resulting holograms in effect are "codes" which must be unscrabbled by another laser device, attached to or



incorporated in a television receiver. RCA is promising that SelectaVision players and cartridges will be available by mid-1972, but only pilot models have been in operation so far, and industry observers are dubious about the projected arrival. However, RCA is already producing related laser-using devices for industry, such as a holographic lock-and-key system for plant security, and much in this technology may help to advance SelectaVision.

These systems all use "film," but they have little in common in concept or practice, and the cassettes or cartridges employed in any one of them will not work in any other. In the case of systems using magnetic tape, the factor of compatibility is somewhat less hopeless, although not by much. All the systems seek to exploit the instant-recording, instant-replay potential of tape — in contrast to the requirement, in using

## CASSETTES ...loaded cartridges

films, including RCA's holographic tapes, of several, usually expensive processing and conversion steps. Here the contender with the lightest, most portable apparatus so far is Instavision, developed by Ampex (the Toshiba trade name will be used in Japan), the company that marketed the first videotape recorder in 1956. Professional-standard equipment is planned for early release, with cheaper versions for amateurs and the home-entertainment trade to follow.

Similarly, the Sony Videocassettes system is being presented first for the enormous industrial and educational markets, with more compact, less expensive models for playback and recording in the home to come a year or so later. On the other hand, the AVCO Corporation's subsidiary, Cartridge Television, Inc., is directing its Cartrivision (or Admiral) colour recorder and player outfit firstly to home buyers, also offering a light black-and-white camera to be available "soon". AVCO-Cartrivision also claims to be producing adapters for converting standard television sets for recording and playback — with the catch, of course, that only its own cassettes will fit the machinery.

Of the tape systems, the one coming closest to establishing a measure of general applicability is the Philips-VCR (for Video Cassette Recorder), for the reason the Philips has been able to convince a number of companies, in Europe and the Americas, to agree to make recorders and players that will accept VCR cassettes. Philips' vast size and power in the electronics industry is undoubtedly a decisive factor, but there also may be some beginnings here of the movement toward rationalizing standards that communications industrialists and professionals argue will have to take hold, for there to be realization of the potentialities of individual recording

and playback systems. Such standards, however, are a long way off, as the several systems — more than a score, by one count — compete for opening advantage in the race for acceptance. And, to make matters worse — or more interesting, as one prefers — there is no telling for sure that it will be some form of cassette or cartridge, using film, holograms, or magnetized tapes, that will win out.

For, already there are systems considered whenever cassette television is discussed that do not rely on such containers of material, but on discs resembling gramophone records: for example, the Teldec Video Disc concept developed in Britain and Germany jointly by Decca and Telefunken. The Video Discs carry signals of both sound and images in grooves considerably finer, up to 150 per millimeter, than those of present "long-playing" records, which usually have from 10 to 13 per millimeter. Playing speed is even more spectacularly faster: from 1500 to 1800 revolutions per minute, as compared with 33-1/3, 45, or the older 78 rpm of sound recordings. There are claims that discs would make the cheapest and most convenient vehicles for playback television, and several companies, most notably M.C.A., the huge entertainment complex, say they are working on disc systems.

Advocates of tape assert, however, that discs, requiring elaborate production processes, however ingenious, effectively rule out home-made television, one of the salient possibilities of cassette or cartridge technology. And such doubts, in turn, point to the questions observers, professionals, and would-be entrepreneurs are asking about playback television, whether employing cassettes or other expedients.

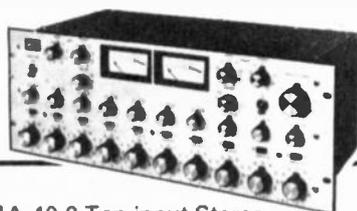
First, and perhaps finally, what will be in the programmes? Will they be so different from available TV that people will want to buy and keep copies? Or, will these be so expensive that most people will have to rent

them? How will creators of programmes, as well as performers and technicians, be paid for their work, by fees or continuing royalties? And how will the ease of making copies with home equipment — or large-scale, commercial pirating of cassettes (already the horror of audio-tape producers) affect original programming?

Dozens of companies, including the leaders in broadcasting, motion pictures, book and periodical publishing, computers, communications, and information technology, are busily accumulating programme materials — especially films — or rights to their production or reproduction, in many cases without having committed themselves to any particular playback process. What will be the effects of cassettes or the like on theatre-going, television-viewing, radio-listening, sports attendance, reading, writing, and the myriad creative, participative, and receptive activities of modern cultural life? Even in the areas where cassette technology already has had considerable application, in education and industry, there is much less than unanimity on questions of potential growth, directions of development, and eventual significance in transforming ways of teaching and learning; gathering, storing, and retrieving information; controlling processes of manufacturing, and doing business in general.

The questions about cassette equipment, or "hardware," and programming, or "software," actually may be incidental to those involving the other decisive development in communications of the past decade or so: cable television, or CATV. Many industry leaders consider cassettes and cable-TV to be integrally related, and that the true consumer market for "software" lies in wiring homes to central communications complexes, incorporating libraries storing every kind of programme material in cassettes, available for instant transmission to individual home receivers. In this concept, relatively few cassettes, carrying specialized or favorite material, would need to be kept in the home, while an infinite variety could be dialed to show on any TV screen, at any hour.

To be sure, that possibility will make knowing what to choose more difficult than ever, with the potentialities for harm, and, hopefully, for benefit, immeasurably magnified. And the ultimate issue may be that of making sure that there are real choices, and not mere multiplication of seductive mindlessness — and, as always, that one's own judgmental "hardware" can make a difference in whatever "software" shows on screen.



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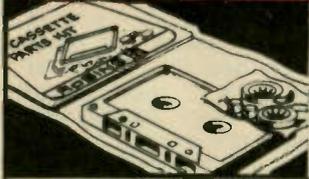
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	5D7M	7"	2400	11.50	5.99
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	1/2 MIL.	7"	2400	12.95	6.50
MYLAR	5D32MS	3"	600	3.15	1.60
	1/3 MIL.	5"	1800	9.25	4.55
	5D7MS	7"	3600	16.50	8.75
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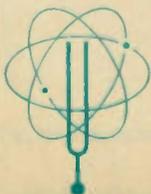
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\*IMPORTANT: Prices quoted in this advertisement are suggested consumer prices only.

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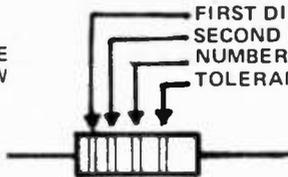
# COMMON COMPONENT CONNECTIONS

The connections shown here are those most commonly used. Occasionally however, components may be found with outlines similar to those above, but with differing pin connections (for example, some FETs have the source and drain connections reversed; SCRs are occasionally sold in matched pairs for back to back operation on a common heat sink, and with the anode and cathode reversed on one unit).

## RESISTORS

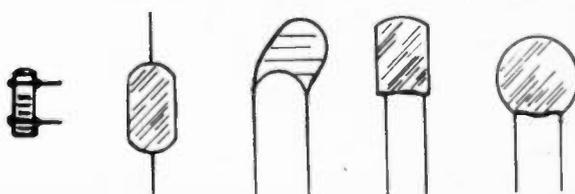


- 0 - BLACK
- 1 - BROWN
- 2 - RED
- 3 - ORANGE
- 4 - YELLOW
- 5 - GREEN
- 6 - BLUE
- 7 - VIOLET
- 8 - GREY
- 9 - WHITE

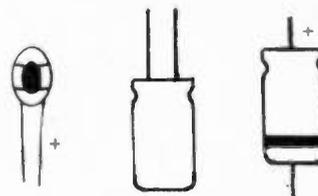
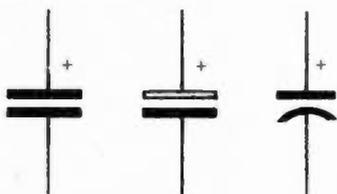


FIRST DIGIT		
SECOND DIGIT		
NUMBER OF ZEROS FOLLOWING		
TOLERANCE -	RED	2%
	GOLD	5%
	SILVER	10%
	NO BAND	20%

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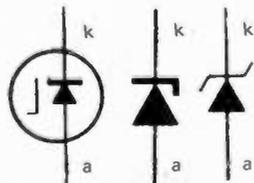
## POLAR CAPACITORS



## DIODES



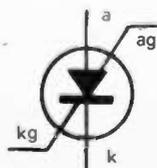
## ZENER DIODES



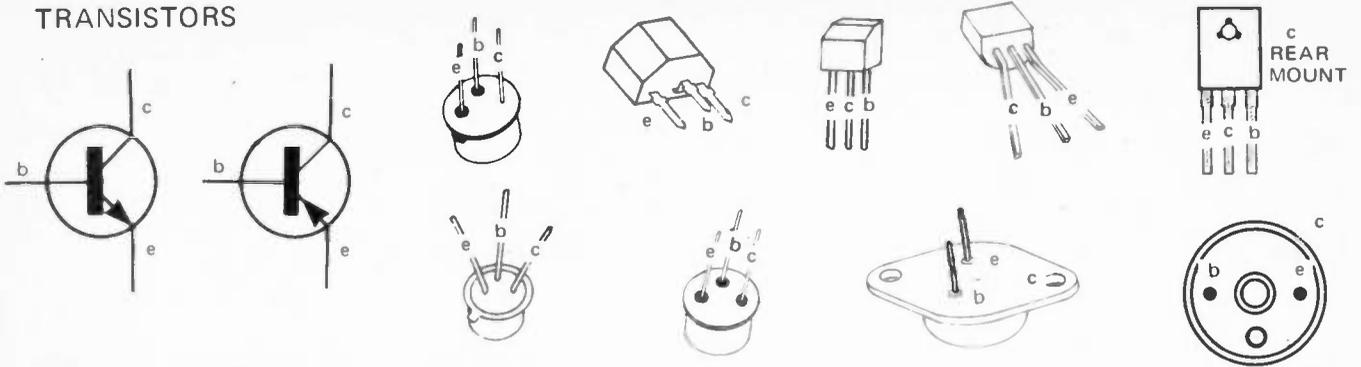
## DIACS (NON-POLAR)



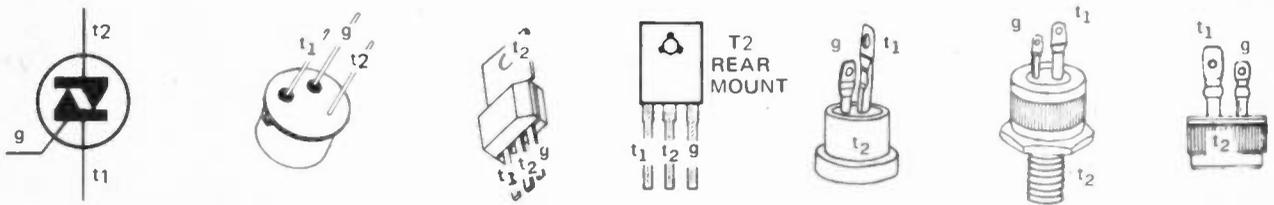
## SILICON CONTROLLED SWITCH



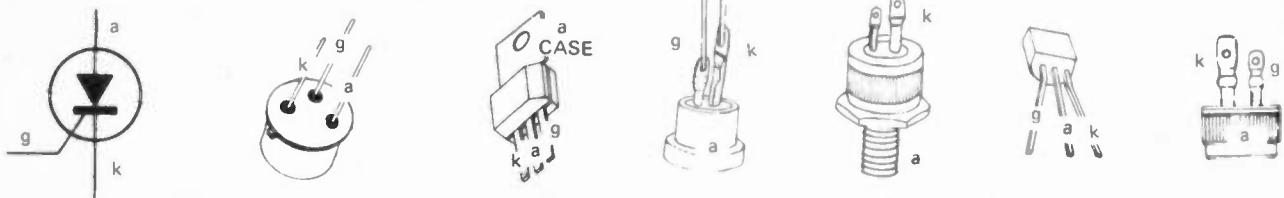
## TRANSISTORS



## TRIACS



## SILICON CONTROLLED RECTIFIERS (SCR)



# SIMPLE BASS-REFLEX CABINET

**W**HERE space is at a premium the only really satisfactory way of producing good high-fidelity sound is to combine a totally enclosed 'infinite baffle' type of speaker with a high powered amplifier.

There is no way in the world that a bass reflex enclosure can compete because bass reflex enclosures have certain critical dimensions below which they are ineffective.

But not everyone lives in rooms 10ft. square, nor has to fit speaker enclosures in the space normally considered adequate for a pair of china cats.

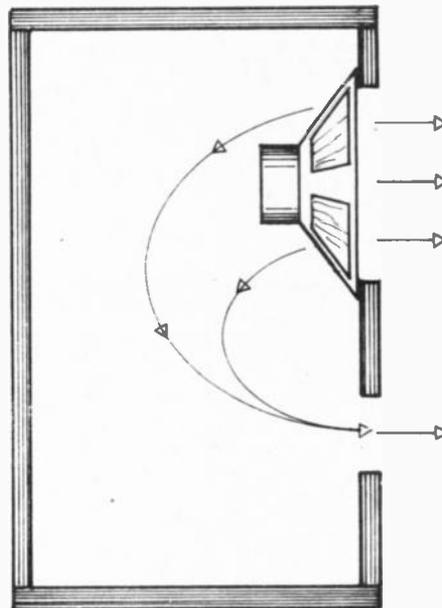
For those whose choice of speakers is not completely dictated by considerations of space, the bass reflex design has still a lot going for it.

This type of enclosure was first used commercially by the USA's Jensen company back in 1936, and was based on research by a number of workers including Voight, Olsen and Thuras, all of whom in turn based their studies on the Helmholtz resonator discovered in the 1800s (Fig. 1).

The basic bass reflex enclosure consists of a box, airtight except for a loudspeaker drive unit mounted on the front panel, and a vent (or tuned port) generally located on the front panel below the speaker.

The actual *location* of the vent is not too critical because the wavelength of the frequencies at which the vent operates is far longer than the overall dimensions of the speaker enclosure.

Loudspeaker enclosure design is normally a very complex procedure. But the simplified approach presented here will provide surprisingly effective results.



The *size* of the vent is important, for it is a combination of this and the physical dimensions of the enclosure, that determines the behaviour of the system and provides the smooth, extended low frequency response for which this type of enclosure is renowned.

The *purpose* of the vent is to allow out-of-phase radiation from the back of the cone to be 'reflexed' so as to bring it in phase with the front radiation at low frequencies.

Simple bass-reflex cabinets may be designed, either by calculating the enclosure dimensions from the speaker diameter — or more satisfactorily — by determining the speaker's free air

resonance and then designing the enclosure and vent to suit.

No matter which design method is used, the method of construction will be the same. Primarily, the aim is to produce a rigid, non-resonant enclosure, airtight except for the loudspeaker cutout and vent.

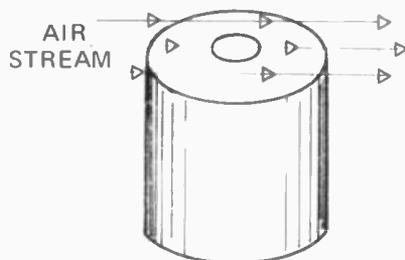
Various materials may be used — from concrete, to plywood or pineboard. The thickness of material will depend upon the size of the enclosure. Generally, 1/2" or 5/8" plywood will suffice for the smaller enclosures, increasing to 1" to 1 1/2" for the largest.

It is literally impossible to make the enclosures *too* rigid; if space allows, use the most massive material that you have available, or can afford.

Unless really heavy material is used, reinforce all diagonals (except the front panel) with 3" by 1 1/2" bracing and use wooden blocks to reinforce all joints and corners. All joints should be securely glued and screwed.

Rubber or cork gaskets should be used to seal any removable panels.

The completed cabinet should then be checked for airtightness and if satisfactory, then lined on at least



**Fig. 1.**  
A Helmholtz resonator consists of a cavity with a single hole open to the outside air. Air blowing across the hole will cause a sound to be generated at a frequency dependent on the volume of the cavity. The bass-reflex enclosure is in reality a Helmholtz resonator in which the acoustical capacitance of the enclosed air resonates with a mass of air enclosed within the confines of the port opening.

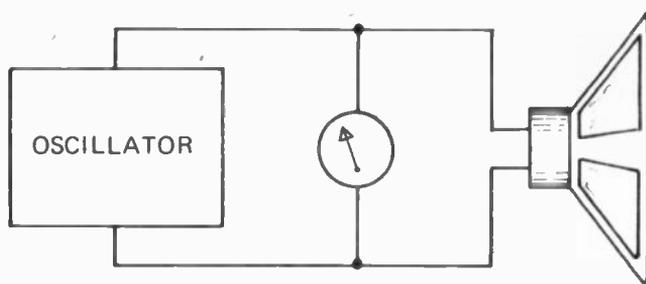


Fig. 2. The free-air resonance of a speaker is determined by measuring the voltage across the speaker's voice coil whilst it is energised over a swept frequency range. The speaker must be suspended away from walls or other reflecting surfaces.



DO YOU THINK YOU COULD GIVE US SOME IDEA OF HOW YOU CAME TO INVENT STEREO.....

three facing surfaces with two-inch thick Fibreglass or Innerbond. The lining material should be glued in place using a contact adhesive.

If mid-range and tweeter drive units are to be incorporated, these should be boxed in with separate airtight enclosures. These secondary enclosures should be as small as possible and their cubic capacity taken into account when calculating the total enclosure volume.

The positioning of the auxiliary drive units is not critical – but keep them at least 3" from other speakers and the walls of the enclosure.

The front panel of the speaker enclosure should be painted matt black and then covered with an open weave grille cloth (this can be obtained from many specialist hi-fi dealers).

As explained above, a bass-reflex cabinet *can* be designed using the speaker diameter as a basis for the enclosure dimensions. The dimensions for a number of enclosures of this type are given in Table 1. These enclosures are based on the nominal speaker diameter – e.g., the diameter that is quoted by the manufacturer. The actual cone diameter will be less than this – probably by an inch or so. The area of the vent is shown in Table 1 and this is calculated from the *actual* measured speaker cone diameter.

The shape of the vent is not important; it may be circular, square or rectangular (as long as the ratio of length to height does not exceed five) or even divided into two or three separate vents whose total area equals that of the single correctly sized vent.

The position of the vent is also relatively unimportant, although it should not be located closer than 2" to the main speaker opening.

Whilst this design approach will result in a speaker enclosure with generally excellent performance – a more elegant approach is that based on the known (or calculated) free air resonance of the speaker.

This figure is generally quoted in the manufacturer's literature. But it is quite easy to determine – if one has (or can borrow) a suitable oscillator and ac voltmeter. All that is necessary is to connect the speaker as shown in Fig. 2 and with the speaker suspended from a cord (and well away from walls or other reflecting surfaces), to sweep the oscillator frequency *very slowly* from 10 Hz to about 150Hz. The

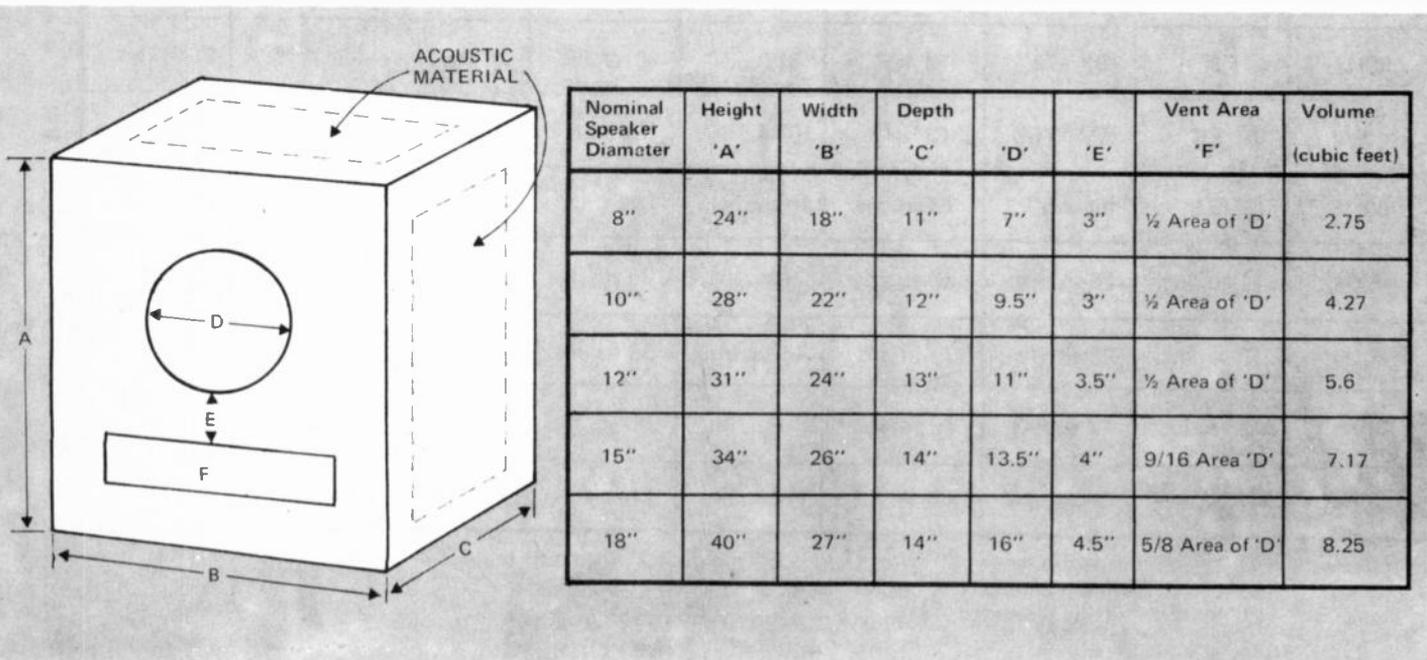


Table 1 – this table and the associated drawing shows how to design a reflex cabinet if no data other than speaker diameter is known.

# SIMPLE BASS-REFLEX CABINET

Nominal diameter of speaker	Frequency
8"	45 - 150 Hz
10"	40 - 100 Hz
12"	30 - 85 Hz
15"	25 - 55 Hz
18"	20 - 40 Hz

Table II - Typical free-air resonances of various size speakers.

voltage indicated by the meter will rise steeply at the free air resonance point. The frequency at which this occurs depends upon the design of the speaker - typical figures for various size speakers are shown in Table II.

(The free air resonance of a speaker changes slightly as the speaker ages - the greatest change takes place within the first few hundred hours - some constructors 'run-in' their speakers in sound proof enclosures before measuring the free air resonance.)

Once the free air resonance has been established, the enclosure dimensions

can be determined from the data shown in Table III.

The important factors are the free air resonance, the internal volume of the enclosure, and the size of the vent. The shape should be vaguely rectangular, but providing the width and height are at least twice the diameter of the speaker, and the depth is at least one third the width, then the enclosure may be shaped to fit on a shelf, against a wall or as required.

The internal dimensions shown are fairly critical, and the necessary allowance must be made for panel thickness, stiffeners, crossover networks, and other internal

enclosures. Do not make any dimensional allowance for the Fibreglass or Innerbond liner.

As Table III indicates, many of the enclosures are fitted with tuned ducts, rather than just plain vents. These ducts can be made from standard cardboard mailing tubes - obtainable from many office supply companies - or may readily be made by winding glue-coated brown paper tightly around a pre-waxed former of the correct diameter. The wall thickness of the duct should be between 1/8" and 1/4". (Note that at the extremes of frequency and volume shown in Table III - no duct or vent is used - the enclosure is, in effect, an infinite baffle).

As with the first design approach described in this article the position of the duct, or vent, is not critical.

That's basically it. There are other, far more complex, ways to design bass reflex enclosures and many of these methods may well result in marginally improved performance - especially if the duct is subsequently tuned to obtain the flattest possible bass response. But the method outlined in this article will provide a basis for producing enclosures with at least the performance of most professional designs. ●

Free-air resonance	Volume in Cubic Feet							
	2.0	2.5	3.0	3.5	4.0	5.0	6.0	8.0
25Hz	(A) 5"	(A) 3.75"	(A) 2.75"	(B) 6"	(B) 5"	(B) 3.25"	(C) 8.75"	(C) 5.5"
30Hz	(A) 3"	(B) 5.75"	(B) 4.5"	(B) 3.5"	(C) 9.25"	(C) 6.5"	(C) 4.75"	11 sq. ins.
40Hz	(B) 3.5"	(C) 7.75"	(C) 5.75"	(C) 4.5"	(C) 3.25"	13 sq. ins.	18 sq. ins.	28 sq. ins.
50Hz	(C) 5.5"	(C) 3.5"	13 sq. ins.	16 sq. ins.	18 sq. ins.	29 sq. ins.	39 sq. ins.	62 sq. ins.
60Hz	11 sq. ins.	16 sq. ins.	20 sq. ins.	29 sq. ins.	35 sq. ins.	50 sq. ins.	75 sq. ins.	Closed
70Hz	18 sq. ins.	26 sq. ins.	35 sq. ins.	46 sq. ins.	58 sq. ins.	90 sq. ins.	Closed	Closed
80Hz	28 sq. ins.	41 sq. ins.	60 sq. ins.	80 sq. ins.	96 sq. ins.	Closed	Closed	Closed
90Hz	42 sq. ins.	64 sq. ins.	89 sq. ins.	117 sq. ins.	Closed	Closed	Closed	Closed

Duct Tubes  
 (A) = 2" inside diameter  
 (B) = 3" inside diameter  
 (C) = 4 3/4" inside diameter

Thus (A) - 2.5" is a duct 2" inside diameter by 2.5" long.

Where a measurement is given in square inches - this implies that a vent is required - not a tuned duct.

Table III - This table provides the design data for a given speaker free-air resonance and various enclosure volumes (in cubic feet)

Toggle, rocker, pushbutton, paddle, lever lock . . . every practical alternative lever action combined with maximum performance, minimum weight and size and available in one, two, three and four pole models.

Subminiature switches manufactured by **C. & K. Components Inc. U.S.A.** are readily available in just about every shape, size and configuration imaginable and they are readily adaptable to a multitude of uses where space is at a premium. All switches feature rugged construction and simple mounting . . . long-term, trouble-free operation is ensured.

Contacts are rated 2 amps @ 240v. AC and 5 amps @ 28v. DC resistive load.

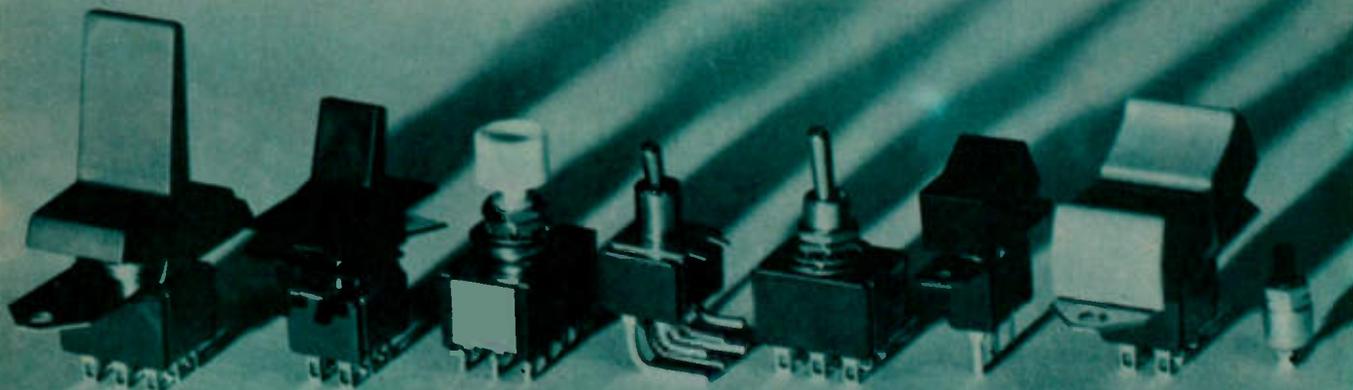
The full **C. & K.** range is now available from the Professional Components Department, Villawood, NSW or Plessey Ducon Interstate offices. Catalogue containing full specifications, options, information on hardware, panel layouts, mounting, etc. is available on request.

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In a unique manner, BASF chromium dioxide cassettes correct certain deficiencies in conventional cassette transport systems.

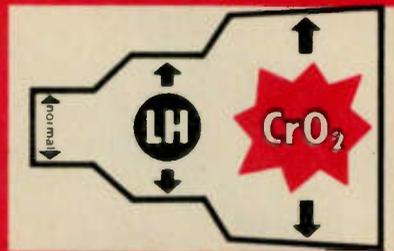
The new S. M. systems prevents the tape from sticking. Preclude wow and flutter. Insures trouble free running, even for extended - play cassettes.



## astonishing new sound

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Top results which show a much increased high frequency response - are best achieved on tape decks with a CrO<sub>2</sub> switch.



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**and LH quality**



BA1695

# SODALITE DARK-TRACE TUBES

by M.J. Taylor, Royal Radar Establishment.

*The cathode ray tube is the basis of many, if not most, present-day display systems and seems likely to remain so for some time to come. The versatility of the device has been greatly extended over the years by the development of special types of tube for different uses and a recent addition is the dark-trace tube with a screen of powdered sodalite. This gives a high brightness display with a built-in variable memory time.*

THE principle of the dark-trace tube is simple. Where the electron beam hits the screen material a darkened area appears, instead of luminescence as with an ordinary phosphor screen. The dark area usually has a colour which is characteristic of the particular screen material so that the display has the appearance of a coloured drawing on white paper, with an overall brightness determined by the level to which the tube face is illuminated externally. It happens that the light which is absorbed in the darkened areas also causes these areas to fade (bleach). The greater the light level the faster the fading.

The concept of the dark-trace tube

was first described in 1940 by A. H. Rosenthal and a device based on his ideas was subsequently developed during the war for military radar displays. Known as the skiatron or scotophor-tube it had a screen of potassium chloride. With an image taking minutes to fade, it was convenient for displaying slowly changing radar patterns. Moreover an image of the tube face could be projected onto a large display area.

Although it satisfied a need in the urgency of war, the skiatron tube has now largely been superseded by more versatile types of display. The greatest drawback of the skiatron tube is that the properties of the screen gradually change with use, so that the dark-trace

becomes progressively more and more difficult to bleach. Eventually the tube has to be removed from its mount and the face heated to about 150°C to clear the screen. Nevertheless the essential simplicity and potentially low cost of dark-trace devices remain an attraction and have been the stimulus for recent research into new screen materials, of which sodalite has turned out to be the most promising so far. Tubes with sodalite screens have a better performance in several respects than tubes with potassium chloride screens: in particular, they have a much faster optical bleaching process.

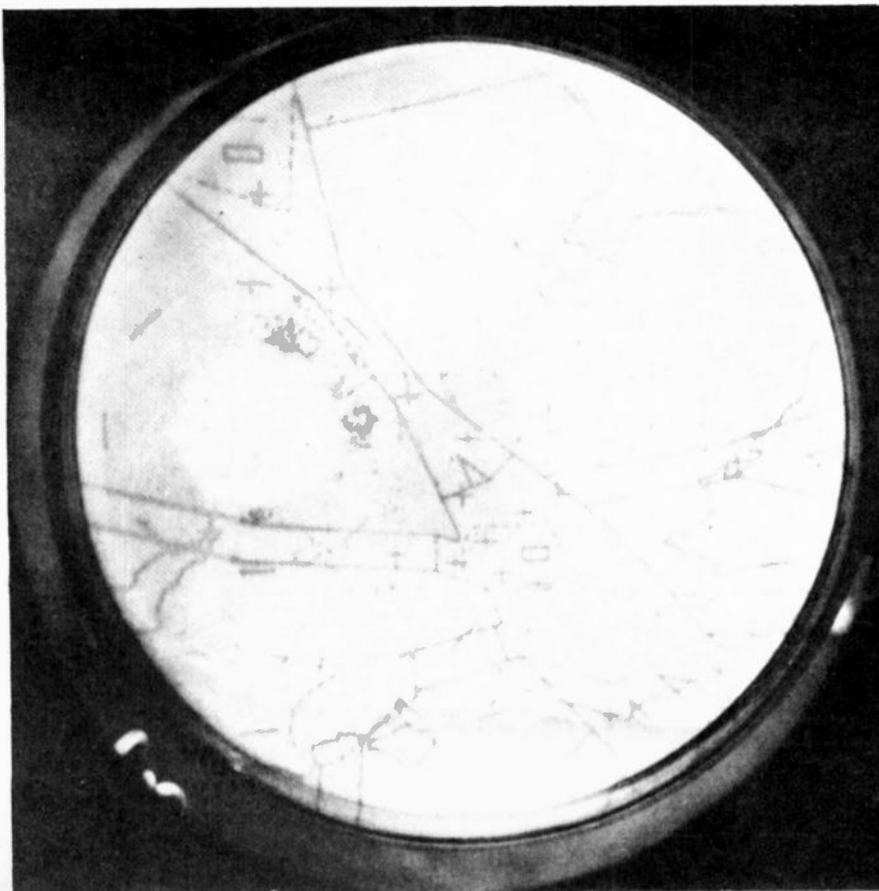
Dark-trace tubes are currently being reconsidered for a number of display applications for which there is an advantage in the built-in memory time, an added bonus being the brightness of the display, which removes the necessity for viewing the displays in a darkened environment. These devices compete directly with the so-called Direct Vision Storage Tube (DVST) in which the memory is achieved by storing a pattern of charge and the screen uses a conventional phosphor. The choice is largely, although not entirely, one of cost; the DVST and associated electronics are complex and expensive in comparison with dark-trace devices. There are, however, other minor differences in performance which may determine the choice for a particular application.

As an example of the use of sodalite tubes in the optical erase form, the illustration shows a display of air-traffic radar data on a sodalite tube, taken at RRE, Malvern with a tube constructed by Ferranti Ltd. Aircraft tracks can be seen superimposed on a map of the coastline of eastern and southern England. The aerial in this case was rotating at about 4 rev/min and the illumination of the tube face was adjusted to give fading "tails" on aircraft echoes, providing vital directional information.

Weather and marine radars are other possible applications for sodalite tubes, involving relatively slow changes in displayed data.

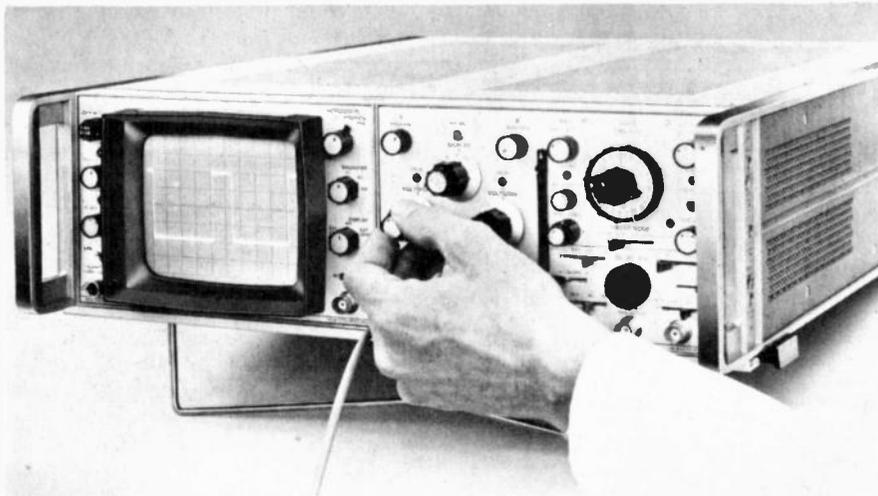
Of the non-radar applications one of the most promising is in remote access data display terminals. A page of print can for example, be scanned electronically and the electrical data transmitted by telephone line to the remote display, where, because of the built-in storage it can be displayed as long as the user requires. This makes economic use of telephone links, and moreover, the data bandwidth requirements can be matched to ordinary lines by suitably low data transmission rates. Sodalite tubes may also find application in displays of computer graphics. ●

*Radar display on a sodalite tube at the Royal Radar Establishment.*



# EQUIPMENT NEWS

## BRIGHT TRACE OSCILLOSCOPE



In the new Model 180C/D version of its 180-series Oscilloscopes, Hewlett-Packard has increased trace brightness by a factor of about five, giving a writing speed of 1500 cm/ $\mu$ s. (Standard P31 phosphor as photographed with 10,000 ASA film, f1.3 lens, 1:0.5 object-to-image ratio without film fogging. Substantial increase in writing rate can be had with P11 phosphor, faster lenses, and use of film fogging techniques.)

This high writing speed, until now available only in much more expensive oscilloscopes, is particularly valuable for engineers working with the design, test, and maintenance of computer peripherals. Low pulse repetition rate makes it well nigh impossible to view the fast pulses in many of these devices on ordinary oscilloscopes.

The new 180C/D Oscilloscopes are an economical solution to this problem.

These new scopes are not limited to computer peripheral testing, however. They can use all existing plug-ins for the 180 series that give real-time frequency response to 100 MHz, and sampling response to 12.4 GHz with a 35 ps Time Domain Reflectometer. They are, according to Hewlett-Packard, truly general-purpose instruments with the performance and versatility needed for electronic laboratory applications, the economy desired for single-purpose production use, and the compactness needed for service applications.

Full details from Hewlett-Packard Pty. Ltd., 22-26 Weir St., Glen Iris, Victoria. 3147.

## STATIC DETECTOR

A new device known as a Statometer, detects static build up in any material, such as plastic, paper, laminates etc. It gives direct and instant readout, indicating strength and polarity of charge on a large, easy-to-read, scale graduated in Volt/centimeters.

The transistorized electronic part of the Statometer is mounted together with a large-size, easily readable indicating instrument in a handy casing at the front of which is a measuring tube. This tube forms a chamber in which air is ionised by alpha rays emitted by a radium source and thus made electrically conductive. The electric field to be measured enters the open front of the ionisation chamber and accelerates the ions thus producing a current which is proportional to the field intensity.

Full details from Peter Shalley Electronics Pty. Ltd., 127 York Street, Sydney, NSW 2000.

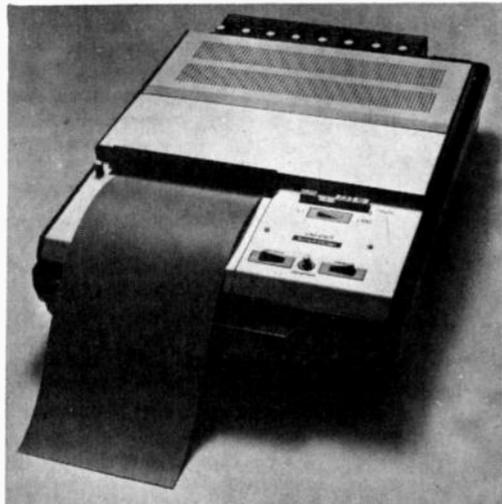
## ROHOE & SCHWARZ

Agreement has been reached for Jacoby Mitchell Limited exclusively to represent Rohde & Schwarz in Australia, effective from 1st January, 1972.

Rohde & Schwarz is one of the pioneers of electronics and, from its base in Munich, Bavaria, now operates world-wide as one of the few manufacturers covering all aspects of the industry, from communications equipment, through sophisticated test instrumentation, to major civil and military capital equipment projects. Jacoby Mitchell Limited will become the Australian Sales and Service Organisation for the whole Rohde & Schwarz programme.

Associated with this expansion, the Jacoby Mitchell Head Office has moved to new premises at 215 North Rocks Road, North Rocks, NSW., 2151 - P.O. Box No. 2009, North Parramatta, 2151 - Telephone 630-7400 - Telex 21123.

## OPTICAL UV RECORDER



The new Schlumberger/SIS optical UV recorder model OM 4501 allows the simultaneous recording from one to eight parameters in cartesian coordinates. The traces are recorded on daylight printing paper, sensitive to ultra-violet rays and are chemically developed following exposure to daylight.

The OM 4501 features voltage driven amplifiers which eliminates the matching problems associated with current driven UV recorders. The plug in amplifiers have variable gain, high input impedance, protection against overload and may be easily calibrated against internal reference supplies.

Recording may be carried out at any of eight speeds from 0.25 mm/s to 1000 mm/s, with remote control facilities. Two sets of



lines, one along the ordinate, every 5 mm and in heavier print every 25 mm, and the other on the abscissor in the form of a coded time base, permit visual definition of the cartesian references, independently of the proper speed. A numbered identification spot discriminator allows each trace to be identified.

The instrument is housed in an anti-shock case and is intended for rugged field application.

Full details from Schlumberger Instrumentation Australia Pty. Ltd., Head Office, 112 High Street South, Kew, Victoria, 3101.

## ELECTRONICALLY CONTROLLED SOLDERING IRON

The electronics industry has discovered in the last five years that the control over the soldering tip temperature is a vital pre-requisite to circuit reliability, since most faults arise at component interconnections. Earlier, temperature control was by electro-mechanical means but, like so many other systems, these have now been surpassed by electronic circuitry.

An all solid state sensing and switching system has been introduced by Adcola Australia, after a long period of development and stringent tests. The manufacturers claim very high accuracy and sensitivity for their unit ( $\pm 10^{\circ}\text{C}$  at all settings up to  $360^{\circ}\text{C}$ ).

Temperature and power availability can be changed at any time by turning a knob, even while the tool is under load, as the soldering iron is moved from one type of circuit to another. According to the manufacturers high quality soldering is assured as excessively high and low temperatures (even during extended soldering sequences) can be avoided.

Since the unit will sense and switch off the temperature at the pre-set level, very high powered heating elements can be used. The controlled temperature tool, suitable for use on all types of printed circuits (and turret lug terminals up to 1/8" diameter), weighs only 4/5ths oz. Heat-up time to working temperature is a mere 40 seconds.

The larger unit (Cat. No. CT8,) while weighing only 2½ ounces, is said to have a work output equal to conventional tools from 15 to 100 watts.

Both of these tools use standard Adcola non-freezing tips, available in many different face profiles. Changeover from one tip to another is fast and simple, merely by sliding in and out of stainless steel collets.

Full details from Adcola Products Pty. Ltd., 22 Firth St., Doncaster, Victoria. 3108.

## PRECISION STEREO MICROSCOPE



An image-splitting module capable of high precision micro-measurements, developed by Vickers Instruments Ltd., was one of only seven foreign winners to receive an Industrial New Product Award for 1971 from the Museum of Science and Industry, Chicago. A panel of leading American scientists and engineers selected the Vickers instrument on the basis of technical importance, uniqueness and usefulness when choosing the 100 most significant new technical products of the year.

The Vickers winning entry is the Model M152520 binocular image shearing module. High precision micro-measurements can now be made with binocular microscopes; before the development, only approximate measurements were possible with binocular vision. The instrument's essential advantage lies in the greatly improved speed and convenience in use which is now possible. This in turn means that more measurements can be made and that precise measurement techniques can be employed in a greater variety of applications.

Full details from Vickers Ltd., Vickers House, Millbank Tower, London, England.

## PATON'S NEW AGENT

Paton Electrical Pty. Ltd. announces the appointment of Northern Instrument Services of 13 Hall Street, Edgeworth, Newcastle, Tel. 58-2449, as its agent for electrical instrument products in the Newcastle and northern areas of N.S.W.

Northern Instrument Services have specialised in the servicing and maintenance of all types of instrumentation and control systems in New Castle, and have detailed knowledge of the Paton instrument range.

Full details from Paton Electrical Pty. Ltd., 90-94 Victoria St., Ashfield, Sydney. N.S.W. 2131.

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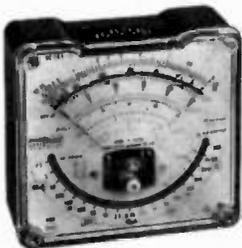
**U-50<sub>Dx</sub> — Quality-wide range VOM**  
 DC Voltage: 0.1V, 0.5V, 5V, 50V, 250V, 1000V.  
 AC Voltage: 2.5V, 10V, 50V, 250V, 1000V  
 DC Current: 50 $\mu$ A, 0.5mA, 5mA, 50mA, 250mA.  
 Resistance: Rx1, Rx10, Rx100, Rx1k  
 dB: -20dB ~ +62dB  
 M $\Omega$ : 1M $\Omega$  ~ 500M $\Omega$  with external power.  
 $\mu$ F: 0.0001 $\mu$ F ~ 0.2 $\mu$ F

**\*\$16.95**

**460-ED — Ultrahigh Sensitivity VOM**  
 DC Voltage: ( $\pm$ ) 0.3V, 3V, 12V, 30V, 120V, 300V.  
 DC Current: ( $\pm$ ) 12 $\mu$ A, 0.3mA, 3mA, 30mA, 300mA, 1.2A, 12A  
 AC Voltage: 3V, 12V, 30V, 120V, 300V, 1.2kV.  
 AC Current: 1.2A, 12A.  
 Resistance: Rx1, Rx10, Rx100, Rx10k (Max 50M $\Omega$ )  
 dB: -20dB ~ +63dB



**\*\$45.00**



**F-80TRd — Unique Taut Band VOM**  
 DC Voltage: 0.25V, 2.5V, 10V, 50V, 250V, 500V, 1000V.  
 AC Voltage: 2.5V, 10V, 50V, 250V, 500V, 1000V.  
 DC Current: 40 $\mu$ A, 0.5mA, 5mA, 50mA, 500mA.  
 Resistance: Rx1, Rx10, Rx100, (Max. 50M $\Omega$ )  
 dB: -10dB ~ +36dB  
 LI: 15mA, 1.5mA, 150 $\mu$ A  
 LV: 1.5V

**\*\$32.25**

**A-303TRd — Medium Size, High Sensitivity VOM**  
 DC Voltage: 0.3V, 1.2V, 3V, 12V, 30V, 120V, 300V, 1200V.  
 AC Voltage: 6V, 30V, 120V, 300V, 1200V  
 DC Current: 60 $\mu$ A, 3mA, 30mA, 300mA, 1.2A, 12A.  
 Resistance: Rx1, Rx100, Rx1k, Rx10k, (Max 50M $\Omega$ )  
 dB: -10dB ~ +63dB  
 LI: 60mA, 600 $\mu$ A, 60 $\mu$ A  
 LV: 1.5V



**\*\$25.50**



**P-2<sub>B</sub> — A versatile pocket multimeter**  
 DC Voltage: 10V, 50V, 250V, 500V, 1000V.  
 AC Voltage: 10V, 50V, 250V, 500V, 1000V.  
 DC Current: 0.5mA, 10mA, 250mA.  
 Resistance: 0 ~ 5k $\Omega$ , 0 ~ 500k $\Omega$   
 Volume Level: -20 ~ +22dB, +20 ~ +36dB  
 Megohm: 0.1 ~ 50M $\Omega$   
 Capacity: 0.0002 ~ 0.3 $\mu$ F & use external power  
 0.01 ~ 0.6 $\mu$ F

**\*\$10.95**

**N-301 — Sensitive VOM with overload circuit breaker**  
 DC Voltage: ( $\pm$ ) 0.25V, 1K, 2.5V, 10V, 50V, 250V, 1000V.  
 DC Current: ( $\pm$ ) 50 $\mu$ A, 1mA, 10mA, 100mA, 1A, 10A.  
 AC Voltage: 2.5V, 10V, 50V, 250V, 1000V  
 Resistance: Rx1, Rx10, Rx100, Rx1k, Rx10k. (Max 20M $\Omega$ )  
 Frequency Response: 50Hz ~ 100kHz for 10V & below.  
 50Hz ~ 20kHz for 50V & 250V.



**\*\$49.95**

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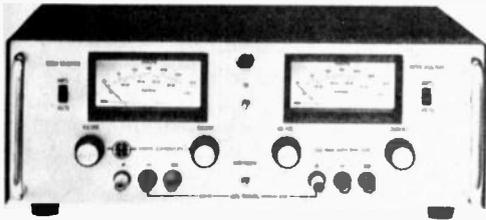
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\* Prices shown are suggested trade prices which may vary slightly from location to location.

# EQUIPMENT NEWS

## DUAL POWER SUPPLIES



A new range of high performance general purpose dual power supplies has been announced by Scientific Electronics Pty. Ltd.

The new units - which are intended for use in laboratories, schools and general educational applications - have both independent and auto-tracking modes.

The two identical supplies are completely independent when in the independent mode.

The auto tracking mode provides master/slave connection, with the slave tracking the master. This mode is ideally suited for semiconductor devices requiring dual supplies.

Constant voltage/current limit or constant voltage/constant current with automatic crossover ensures short circuit proof operation and permits series and parallel connection of two or more supplies when greater voltage or current is desired.

Brief specifications

Load Regulation: Less than 0.01%  
Line Regulation: Less than 0.01%  
Ripple and Noise:

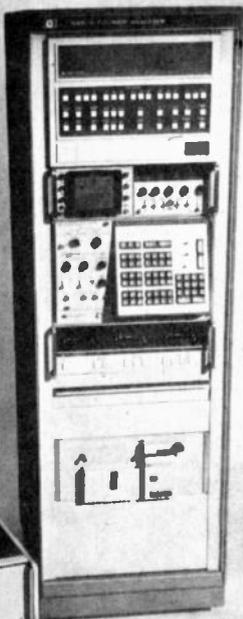
Less than 1mV p-p (dc to 20MHz)

Controls: ten turn controls

Operating Temp. Range: 0°C to 60°C

Full details from Scientific Electronics Pty. Ltd., P.O. Box 61, Blackburn, Victoria. 3130.

## FAST FOURIER-TRANSFORM ANALYZERS



A new Fourier Analyzer, a plug-in Fast Fourier Transform Arithmetic Unit and a high-speed Fast Fourier Processor have been introduced by Hewlett-Packard. Their design is the result of the company's experience over the last several years with Fourier analyzer applications in such diverse fields as:

- automotive test (including trucks, trains, etc.)
- machine design
- aircraft structural test
- automatic control system analysis
- underwater acoustics
- oceanography
- communications systems (telephone and microwave)
- environmental test
- biomedicine (nerve signal and brain wave analysis)
- geophysics and oil exploration
- nuclear reactor design and test
- electrical power system and machinery analysis
- university research
- analytical chemistry (NMR)

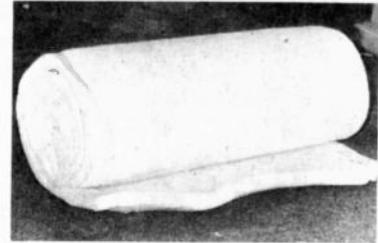
The Model 5451A Fourier Analyzer is much like earlier HP Fourier Analyzers. It's faster though, taking only one second to perform a 1024-point Fourier transform. It also has a greater dynamic range: 80 dB for both linear and power-spectrum measurements. Relocatable software is furnished so the user can easily add his own programmes to extend the capability of the system.

The Model 5451A is a complete, fully calibrated, dc-to-25 kHz signal analysis system. It has two input channels which are sampled simultaneously; according to Hewlett-Packard this is practically essential for accurate comparisons of signals when making such measurements as transfer function, coherence function, or crosscorrelation function. At the flick of a switch, the analyzer becomes a general-purpose digital computer, but no knowledge of computer programming is required to use it as a Fourier Analyzer - it's keyboard controlled.

The other two new Fourier analysis products are peripheral processors for computers or Fourier Analyzers, mainly HP. One or the other would be used, but not both at the same time.

If one second transforms aren't fast enough, the new Model 5471A Fast Fourier Transform Arithmetic Unit can be added to any HP Fourier Analyzer, new or old. It consists of four printed-circuit cards which plug into any HP computer in four contiguous I/O slots. When integrated with the 5451A Fourier Analyzer, Model 5471A does 1024-point transforms in only 160 milliseconds. This makes possible real-time power-spectrum analysis to frequencies beyond 2 kHz. Analyzer operation is unchanged; the same keyboard controls everything, but processing speeds are increased over six times. The new FFT Arithmetic Unit can also be used simply as an additional arithmetic unit in any HP computer to perform fast Fourier transforms of up to 2048 points, to do complex and complex-conjugate multiplication, and to perform Hanning operations. A software driver is supplied. Model 5471A should be very useful to

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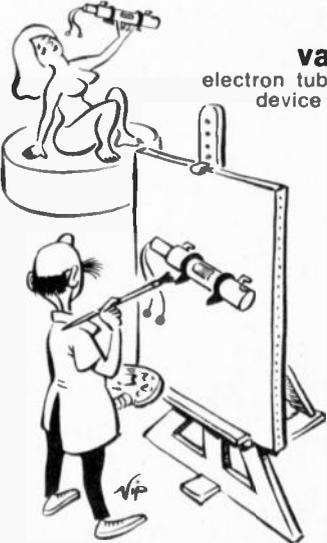
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### BASIC LAMP DIMMER KIT

Consists of 6 amp. triac, diac, switch pot., ferrite rod inductor, 4 resistors, 2 capacitors & circuit. \$5.95; Including postage.

### SIX AMP. TRIAC & DIAC

As in above kit, \$2.75 pair, including postage.

### BASIC POWER SUPPLY KITS

Consist of Multi-tapped transformer, bridge rectifier, filter capacitor & circuit. Will supply any DC voltage from 6 to 12. Can replace batteries in all types of transistor equipment. Also as car battery trickle charger. 600 ma. size, \$5.25; 1 amp. size, \$5.95; 2 amp. size, \$6.95. Plus pack & post. Vic. 0.40c Other. 0.70c.

### SPEED CONTROLLER

For electric hand tools. Controls speed from full to stop without loss of torque. Suitable only for ac/dc or brush type motors. Complete with flex. & plug. 500 watt (2 amp.) size, \$11.50; 2500 watt (10 amp.) size, \$19.50; Plus pack & post. Vic., 0.40c Other, 0.70c.

### AMPLIFIER MODULE KIT

Consists of PC. board 3 1/4" X 2 1/2", 4 Fairchild transistors, 5 capacitors, 6 resistors, circuit & wiring diagram. Output 3.5 watts RMS with 20 volt supply, \$6.50, including postage.

### SILICON DIODES

Stud mount type for automotive or battery charger use. Rated at 25 amps., 50 p.v., \$1.15; Rated at 25 amps., 100 p.v., \$1.30; Heat sink adaptors, 0.35c Prices include postage.

### ELECTROLYTIC CAPACITOR BARGAIN

Pack of 48 contains 12 each-4.7mfd.25v., 10mfd.10v., 50mfd.10v., & 100mfd.10v., \$5.50 including postage.

## PIONEER

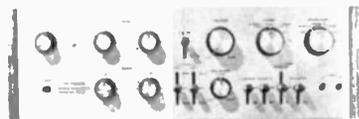
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#### SA 600

20W RMS/CH  
0.5% Distortion  
10Hz - 50 kHz  
± 1dB  
100dB S/W

#### SA 800

34W RMS/CH  
0.5% Distortion  
5Hz - 80kHz  
± dB  
100db S/W

#### SA 1000

82W RMS/CH  
0.3% Distortion  
5 - 80kHz  
± dB  
100dB S/W

#### QA 800

4 Channel Amp  
25W RMS/CH  
Complete W/  
Synthesizer  
100dB S/W

## EQUIPMENT NEWS

university researchers and others with limited funds.

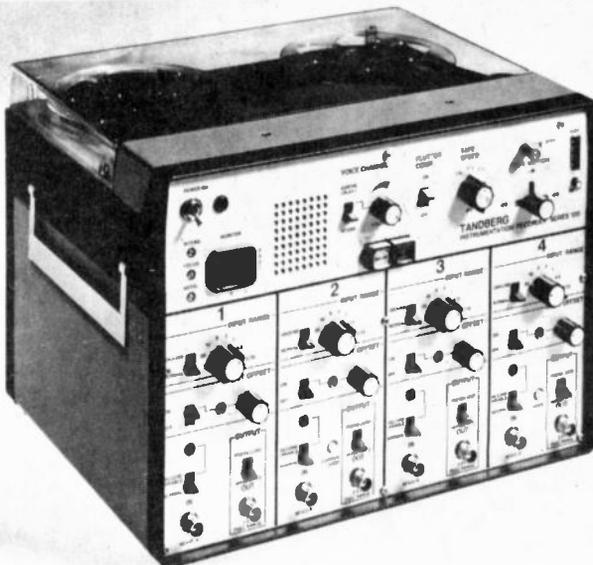
Even faster transforms — an order of magnitude faster — are possible with the new Model 5470A Fast Fourier Processor. This processor can be used as a peripheral for many manufacturers' computers. However, it's supplied with an interface and software driver for HP computers only. Integrated with any HP Fourier Analyzer or computer, Model 5470A reduces the time required for a 1024-point transform to 15 milliseconds. This makes possible real-time power-spectrum analysis to over 20 kHz. Multiple 5470s can be used for greater increases in speed: two processors will nearly double processing speeds. The processor has its own 4096-word core memory and can perform transforms of up to 2048 points. Larger memories and larger transform sizes are optional. The processor's self-contained memory allows parallel processing in the computer and the processor for faster throughput speeds.

Full details from Hewlett-Packard Aust. Pty. Ltd., 22-26 Weir Street, Glen Iris, Victoria. 3147.

### ABOUT FOURIER ANALYZERS

Fourier analyzers perform powerful analyses of signals from dc to beyond the audio frequency range. They are operated by key strokes on a simple calculator-type keyboard. One of these instruments can be used as a transfer function or mechanical impedance analyzer, a correlator, a spectrum analyzer, a harmonic analyzer and many other instruments. Answers are automatically displayed on a 'scope in the time domain or the frequency domain, in rectangular or polar coordinates, in linear or log dimensions, or in Nyquist or Bode plots. Users report that it's two to 100 times faster to set up and perform experiments using these on-line analyzers instead of recording data for future analysis at a central computer.

### NEW INSTRUMENTATION RECORDER



A completely new Tandberg instrumentation recorder, the "Series 100", has just been released in Australia by the Australian Distributors, Simon Gray Pty. Ltd.

Performance equals the most advanced instrumentation recorders available for stationary use; however, the portable Tandberg "Series 100" is much lower in price. As the Tandberg model weighs only 25 lbs. it is completely portable and requires only standard power supply.

It features 4 tracks of IRIG Standard FM recording on 1/4" tape at the speeds of 7 1/2, 3 3/4 and 1-7/8 ips. Signal-to-noise ratio at 7 1/2 ips is claimed to be better than 47 dB. Figures for flutter are extremely low and can be improved still further by use of electronic flutter compensation.

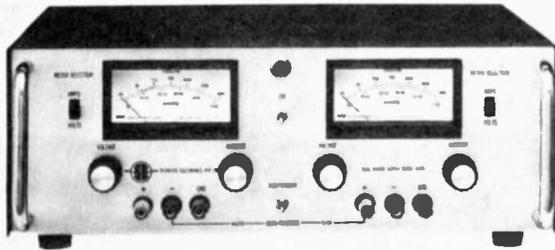
A CRT monitor displays the deviation of

all four channels simultaneously, to facilitate the selection of the appropriate input range. A dc motor permits use of the recorder on all line frequencies between 48 and 1000 Hz.

A spokesman for the Australian distributors, Mr. W. K. Dougall, stated that sales in Australia are expected to follow the trend overseas, particularly on the Continent and in the United States. In both of these international markets keen interest has been displayed; the interest shown reflects modern requirements for high quality instrumentation equipment in the fields of engineering and research. At the same time the lower initial cost of the Tandberg "Series 100" has proved an attractive sales incentive.

Full details from Simon Gray Pty. Ltd., 28 Elizabeth St., Melbourne, Vic.

## VARIABLE POWER SUPPLIES



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### SCIENTIFIC ELECTRONICS PTY. LIMITED

42 Barry Street, Bayswater,  
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Melbourne 729-3170; Brisbane 47-4311;  
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**COMPUTER RACKS** — 28½" x 28½" x 71". Square Tube 1¼" Cad. Steel. All members are bolted together and can be made to various size racks. Double B/Bearing slide rails. Price \$30 ea. Racks are dis-assembled for transport. Freight Forward.

**POWER TRANSFORMERS** — BRAND NEW, Primary 230 Volt AC-Sec. 26-0-26 volts 280 ma-Sec No.2 90 volts. Size 2¼" x 2" x 7/8". Only 1-50 ea. P/P 50 cents.

**SPECIAL** — CURLY CORDS, 25 cents ea. P/P 15 cents.

### MULTIMETERS —

	Sensitivity DC	Sensitivity AC	PRICE
C-1000	1,000 o/v	1,000 o/v	\$6.75
CT500/P	20,000 o/v	10,000 o/v	\$17.75
AS 100D/P	100,000 o/v	10,000 o/v	\$34.50

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 7½" x 7½". Weight approx. 25 lbs. Price \$35.00. Freight forward.

**POWER SUPPLIES**, 12 volt, 5 amp, same specifications as 35 volt model. Weight approx. 18 lbs. Price \$25.00. Freight forward.

**SPECIAL: ERIE** 1 watt 5% High Stab. Resistors and 2 watt 1% and 2% Mixed 1 and 2 watt, \$1.50 per 100. P/P 40 cents.

**3,000 TYPE RELAYS**. No specific coil resistance supplied. 50 cents ea. P/P 30 cents.

**PIANO KEY SWITCHES**. 6 keys, 4 sections with 6 changeovers. \$1.00 ea. P/P 40 cents.

**SILICON DIODES**. 100 P.I.V.-145 amps. \$4.50 ea. P/P 40 cents.

**CAPACITORS**. Mixed values Mica and Ceramic. Poly bags, \$2 per 100 P/P 30 cents.

**SPECIAL. HIGH IMPEDANCE HEADPHONES**, 2600 ohms. Hurry, limited number only at this price, just \$2.50. P/P 50 cents.

**VALVES** — 6J6, 30 cents ea. ATS 25-807, 50 cents ea. 6J7, 60 cents ea. 6SL7GT, 60 cents ea.

**SPECIAL ELECTROLYTICS**. 75 uF 10 volt working, upright printed circuit type. 10 cents ea. P/P 6 cents.

**CAPACITORS**. 33 uF 400 volt DC working, printed circuit type. 10 cents each. P/P 6 cents.

**VHF Converters**, Aircraft Band 108 Mhz-136 Mhz. Just place alongside your Broadcast Radio and set dial in a clear spot between 600 Khz and 1000 Khz, then do tuning on converter dial. No connecting wires are needed. Converter operates from 9 volt transistor battery. Price \$14.65. P/P 45 cents.

**RELAYS** — 6 volt miniature 280.ohm coil \$1.20. P/P 25 cents.

**COMPUTER MODULES**. Contain 2.12AU7 and 1% Resistors. 40 cents ea. P/P 20 cents.

**DENSHI CONSTRUCTION KITS**, no soldering required. There are 16 Projects, including Transistor Radio, Morse Code Oscillator, Continuity Tester, Signal Injector, Transistor Wireless Microphone, Transistor Reflex Radio and numerous others. These kits are priced at only \$11.50. P/P 80 cents.

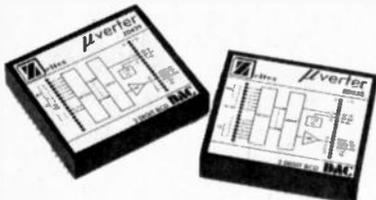
**ELECO ELECTRONIC KIT No. 9**. 20 Projects, no soldering or tools required. This kit includes a Solar Cell. Projects include Transistor Radio, Transformer coupled with 2 Transistor Radio, Shortwave Radio, 2 Transistor Intercom, 2 Transistor Audio AMP, Signal Tracer, Wireless Microphone, Audio Oscillator, Microphone, included in kit. **SPECIAL PRICE** only \$16.50. P/P \$1.00.

ALL PRICES SUBJECT TO ALTERATION WITHOUT NOTICE

**Wanted to buy — Test Equipment  
Transmitters, Receivers, etc.**

# COMPONENT NEWS

## DIGITAL-TO-ANALOGUE CONVERTER



The new Zeltex ZD429 and ZD433 Digital-to-Analogue Converters accept two and three digit BCD (8,4,2,1) inputs with corresponding outputs of 0 to +0.9V and 0 to +9.99V.

These completely self-contained D/A Converters have a settling time of 20  $\mu$ /seconds and  $\pm 1/2$  LSB linearity temperature co-efficient is  $\pm 20$  ppm/ $^{\circ}$ C.

Additional features including pin-for-pin compatibility between models, adjustable full scale and zero offset, dip socket compatibility and a 16 hour burn-in @ 85 $^{\circ}$ C to reduce early mortality.

Full details from Racal Electronics Pty. Ltd., 47 Talavera Road, North Ryde, NSW 2113.

## NEW DIGITAL READOUTS



To fill the price gap between low-cost NIXIES and the more expensive LED displays, Sperry Information Displays Division have released its SP-730 series – a seven-segment display available in two-digit and three-digit packages.

By a patented process, Sperry converts the glass front-plate into the unit's anode. Character height is 0.33 in., and, with a red filter in front of it, the display resembles an LED readout.

Like other gas-discharge types, the Sperry display requires a high voltage – 170 Volt. Current for the figure "8" is 1.4 mA. Decoder/drivers and a 16 Digit multiplex board can be supplied.

Full details from NIC Instrument Company, 7 Sydney St., Marrickville, N.S.W.

## PRESSURE SWITCH

A sub-miniature adjustable electrical pressure switch has been designed specifically to provide electrical outputs from pneumatic inputs, and can be used to initiate electrical functions such as motors, lights, and timers, and in fluidic,

instrumentation, and power pneumatic applications.

The switch, manufactured in the U.K. by Pneumaid Ltd., is supplied in three pressure ranges 1 1/2 - 10 psi, 3-30 psi, and 10-100 psi, the switch is sub-base mounted and electrical connections are made with one-piece push-in cable socket, enabling it to be detached quickly for servicing or replacement.

Switch dimensions are 1.25 in. by 1 in. by 1.57 in., and, according to the manufacturers, life expectancy is 25 million operations at 100 milli-volts.

Full details from Fluid Power Company Pty. Ltd., 4 Palmer Court, Mt. Waverley, Vic. 3149.

## MONOLITHIC CAPACITOR ARRAYS



Employing "Ceram" multi-layer chip capacitors, 14-pin and 16-pin DIP packages are now offered by AUX. Low-cost prototype quantities for evaluation are supplied with standard chip capacitors mounted in pre-formed packages. For production quantities, the entire capacitor array can be fabricated as a single monolithic structure with multiple connections attached to the lead frame, providing higher component density, lower cost and greater reliability. The complete structure is co-molded and cross-overs and interconnects can be combined with the capacitor array as required.

Chip capacitors are provided in voltage ratings of 25, 50 and 100 Vdc and in capacitance ratings from 1 pF through 1 mF. Temperature characteristics available as standard are NPO, X7R and Z5U.

Full details from Auriema (Australasia) Pty. Ltd., 549 Pittwater Road, Brookvale, NSW. 2100.

## HIGH STABILITY PRESSURE TRANSDUCERS

Vibration or temperature changes will not affect the accuracy of a new range of high-stability pressure transducers, the British manufacturers – Transducers (CEL) Ltd – claims.

This is due to the advanced techniques used in the manufacture of the transducers, which are also said to respond well to step inputs.

The six models cover the range of 0 to 15,000 psi, although specials up to 50,000 psi can be supplied. All models measure less

than four inches long by one inch in diameter. They have a repeatability of 0.1%, a non-linearity of  $\pm 0.25\%$  and a nominal rated output of 1.1 mV per V.

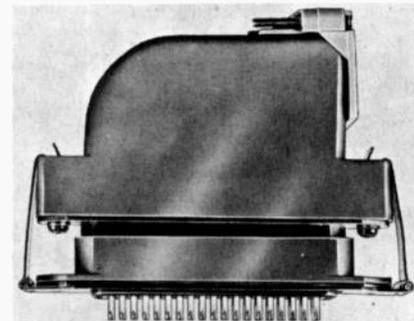
Each transducer embodies a cylindrical sensing member of beryllium copper or stainless steel, on to which is bonded a strain gauge which forms the four arms of a Wheatstone bridge.

With an applied voltage up to 16V ac or dc, the pressure on this member puts the bridge out of balance, resulting in an electrical analogue output signal of the pressure being generated; this can then be used for display or control purpose.

Special models are available for operation in extreme environmental conditions, or with customer-specified characteristics, and a complete system-design service is offered by the company.

Full details from Transducers (CEL) Ltd., Trafford Road, Reading, Berkshire, England.

## MINIATURE RED RANGE CONNECTORS



A new, miniature range of connectors is announced by McMurdo Pty Ltd. All original design advantages of the Red Range are embodied in only a quarter of the size; thus offering enhanced use of existing panel space.

The Redette Range consists of connectors of 16, 26, 38 and 52 ways. Fixing dimensions common to other connectors have been chosen but the contact density is such that two more connections are available than on comparable types.

Sockets are fitted with floating bushes to assist alignment on back-rack applications. Plastic covers with cable entries and clamps for top and side entry are provided together with positive latches and plug protective shrouds.

Mouldings are in D.A.P., Contacts are hard gold plated. Current rating is 3 Amps per contact. Minimum proof voltage is 1700 volts peak and contact resistance less than 10 milli-ohms.

Engagement and disengagement forces are not more than 8 oz. per contact.

Full details from McMurdo (Australia) Pty. Ltd., 17-21 Carinish Rd., Clayton, Vic. 3168.

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AU110

# AUDIO NEWS

## MALLORY DURATAPE CASSETTES



The announcement of Mallory Duratape blank cassettes, a new product of Mallory Batteries (Australasia) Pty. Ltd., was made recently by Mr. J. David Ehlers, Managing Director of the Company. The new range of Mallory Duratape medium priced cassettes are available in the popular C-30 (to run 30 minutes recording time), C-60 and C-90 recording lengths. Mallory also introduces at this time a cassette size magnetic head cleaner, C.H.C. These Mallory Duratape products are introduced in a form of packaging designed primarily for mass merchandising and impulse sales.

Mallory Duratape, introduced approx. nine months ago, has met with world wide acceptance in Canada and most of Europe as well as the U.S.A. Mr. Ehlers said that Mallory Duratape is one of a number of consumer-oriented products scheduled for introduction in Australia by Mallory Batteries (Australasia) Pty. Ltd. Mallory Batteries (Australasia) Pty. Ltd. is a wholly-owned subsidiary of P. R. Mallory & Co. Inc., located in Indianapolis, Indiana, U.S.A. with affiliates in thirteen nations, and sales and distribution programmes throughout many countries.

## A NEW FEATHERLIGHT HEADSET



A major advance in micro-miniature headsets is announced by Amplivox Communications Ltd. of Wembley, England.

Amplivox Communications have produced a fully adjustable earphone housing, enabling the user to receive incoming signals without discomfort and irritation of earplug type designs. Fully adjustable in all directions for correct location and optimum performance, with 180° rotation to enable use on the right or left hand side of the head, the earphone's soft ear-piece has minimum contact with the bowl of the ear. When desired the earphone can be slightly moved away from the ear to avoid physical contact altogether and act as a miniature speaker in "free-field".

The microphone utilizes a specially designed acoustic tube to

convey sound to the tropicalized microphone element, providing excellent speech intelligibility and improved overall stability. Telescopic adjustment and rotation of the acoustic tube allow for correct positioning near the mouth, or for parking on any size of head.

Both earphone and microphone transducers are well-proven Amplivox products of military type design providing for rugged and reliable performance. The whole assembly without cable, but complete with a new type of integral sliding headband, weighs less than 2 ounces, or without headband, for fitting on spectacle frames, less than 1 ounce. Each "Minilite" headset is supplied with a slim carrying pouch for personal use and safe storage.

Further Details may be obtained from: - RACAL ELECTRONICS PTY. LTD., 74 Talavera Road, North Ryde, N.S.W. 2113

## THREE-HOUR CASSETTES

We understand from a reliable source that the Japanese TDK company may soon be releasing a C-180 cassette. It is believed that TDK are taking advantage of their experience gained in producing their new C-120 cassettes which have excellent anti-jamming characteristics.

## VIDEO DISCS IN COLOUR

The TELDEC disc (a video equivalent of the long playing record) described in our April issue, has now been produced as a full colour reproducing system.

The new system, recently shown in Berlin, has undergone several other changes since our previous report. The disc size is now 8 1/4" in diameter and this provides five minutes playing time. The machine now features an automatic record changer. This extracts the records from their sleeves, plays them in the required sequence, and then reacks them. The disc-changing time is claimed by the makers to be less than half a second.

As with practically every other home video system, both delivery dates and prices are vague. Originally scheduled for late '72, deliveries are now stated to commence in mid '73 and prices are now quoted at nearly double the original estimates of \$120 (single play, black and white machine).

## RECTILINEAR LOUDSPEAKERS

Leroya Industries announce their appointment as Australian distributors for Rectilinear loudspeakers.

These speakers have a five year parts and labour warranty.

Six models are available, ranging in price from \$150 to \$545.

## DOLBY LABORATORIES ANNOUNCES NEW LICENSEES

Two more major audio manufacturers in Japan have concluded licensing arrangements for use of the Dolby System, according to Robert Berkovitz, Head of Advertising and Information for Dolby Laboratories. Berkovitz made the announcement on Thursday, October 28, when he gave a lecture/demonstration on the Dolby System, entitled "Music and Silence" during the International Audio Festival and Fair in London.

The newly signed licensees, PIONEER ELECTRONIC CORPORATION and TOKYO SHIBAURA ELECTRIC COMPANY (TOSHIBA), bring to nearly 40 the number of hardware manufacturers now marketing or planning to introduce Dolby B-System products. Among pre-recorded cassette manufacturers, NIPPON COLUMBIA (Japan) and RCA (U.K.)

# JOIN THE TAPE REVOLUTION 'TDK-SD\*' IS HERE!

(\*SUPER DYNAMIC)

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.

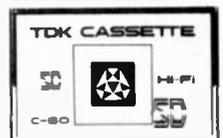
The surface of SD tapes is almost mirror smooth, which combined with special binders and lubricants has all but eliminated head wear. The tape offers the following features:

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,  
C180.

## OTHER TDK TAPES AVAILABLE

DIGI-Pack Computer Cassettes • Endless tape cassettes (3 mins, 6 mins, 30 sec. and 90 sec.) • Video and Computer tapes • Bulk packs. All tapes are Polyester based.

SOLE AUSTRALIAN AGENTS

CONVOY IMPORTS, 1 Maclean St., Woolloomooloo, Sydney, 2011. Phone 357-2444.

have been the latest to decide that their cassette releases will be in the Dolby B format. Other major companies who now issue all their cassettes encoded with the Dolby B characteristic include AMPEX STEREO TAPES (U.S.A.) CBS/COLUMBIA RECORDS (U.S.A.), and DECCA/LONDON (U.K.). Soon, Mr. Berkovitz stated, two more major recording companies in the U.S. will join the others so that almost 90% of the new cassette output in America will be Dolby encoded.

At the London Audio Fair a number of new Dolby products were on show, including cassette recorders from Sansui, open-reel tape decks from Ferrograph and Revox, and noise reduction units by Highgate Acoustics and Kellar. Cassette decks introduced at last year's fair by Bell & Howell, Harman-Kardon, and Rank-Wharfedale were also demonstrated. The Decca Record Company and Precision Tapes gave visitors to their stands the opportunity to hear some of the wide range of Dolby cassettes now available on the British market.

The following companies now have available or will soon introduce Dolby System products for consumers:

Advent	U.S.A.
AGS	Canada
Allied Radio Shack	U.S.A.
Allison Audio	U.S.A.
Ampex	U.S.A.
Ampex Stereo Tapes	U.S.A./Canada/Belgium
Bell & Howell	U.K.
Benjamin	U.S.A.
Bigston	Japan
Cinema Tape Productions	U.S.A.
Columbia Records	U.S.A.
Concord	U.S.A.
Crown Radio	Japan
Decca	U.K.
Decca Musicassettes	U.K.
Dubbings Electronics	U.S.A.
Europa Film	Sweden
Ferrograph	U.K.
Fisher	U.S.A.
Harman-Kardon	U.S.A.
Highgate (Alpha)	U.S.A.
His Master's Voice	U.K.
Hispavox	N.Z.
Hitachi	Spain
Iberofon	Japan
Janszen	Spain
Kenwood/Trio	U.S.A.
Key	Japan
King Records	U.K.
Lafayette	U.S.A.
Lenco	Switzerland
London Records	U.S.A./Canada
Mitsubishi	Japan
Mood Music	France
Musical Heritage Society	U.S.A.
Music Carriers	N.Z.
Nakamichi Research	Japan
Nippon Columbia	Japan
Phonodisc	U.K.
Planet Research	Japan
Plastic Products	U.S.A.
Preferred Sounds	U.S.A.
Pye Records/Precision Tapes	U.K.
RCA Ltd.	U.K.
RCA Italiana	Italy
Rank Wharfedale	U.K.
Revox	Switzerland
Roger Arnhoff Lydstudio	Norway
Sansui	Japan
Silver	Japan
Singer/KLH	U.S.A.
Sonab	Sweden
Sono-Press (Eurodisc)	Germany
Standard Radio	Japan
Tape Duplicating Metrosound	U.K.
Teac	Japan
Teleton	Germany
Telex	U.S.A.
Trident Tape Services	U.K.
Ulvex	Sweden
Vox Cassettes	U.S.A.
Wollensak/3M	U.S.A.
Columbia Records	Canada
MCA	U.S.A./Canada
Pioneer	Japan
Sanyo	Japan
Tokyo Shibaura (Toshiba)	Japan

Please send me further information on "TDK-SD" Super Dynamic tape.

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Occupation .....

Address .....

Postcode .....

# When all you want is soft romantic music



that's all you get with **BASF LH-hifi recording tape**—*nothing else.*

The fact that tape "Hiss" is anything but seductive is one of the reasons why we have virtually eliminated it from BASF LH-hifi recording tape. The gradual narrowing of track widths and lowering of tape speed on domestic tape recorders, places, above all, great demands on tape to head contact and magnetic uniformity.

A natural consequence of this development appeared to be background noise which became more audible during sound reproduction. To counter this, BASF engineers have introduced low noise equalisations and eliminated the background noise, increased sensitivity and achieved dramatic improvement in signal-to-noise ratio of as much as 8dB over other quality tapes.

Whatever music you decide is most persuasive, BASF LH-hifi will give it greater clarity, more realism and less distortion. The rest is up to you.

BASF Compact Cassettes are available in the following playing times:

C30	= 2 x 15 minutes	= 30 minutes.
C60	= 2 x 30 minutes	= 60 minutes.
C90	= 2 x 45 minutes	= 90 minutes.
C120	= 2 x 60 minutes	= 120 minutes.

BASF Compact Cassettes available everywhere in your choice of either "Trans," "Snap" or "Plastic Pack."

**BASF HAS THE QUALITY—YOU MAKE THE MUSIC—BASF FOR ENDLESS PLEASURE**

**BASF**

Australian Distributors:  
**Maurice Chapman & Company Pty. Ltd.,**  
276 Castlereagh St., Sydney. Phone: 61 9881.  
146 Burwood Rd., Hawthorn, Vic.  
Phone: 81 0574.



BA1371A

# RECORDINGS... CLASSICAL

REVIEWERS: John Clare,  
Christopher Wagstaff

**DELIUS — SEA DRIFT — HASSAN**  
Bruce Boyce, Leslie Fry (baritones)  
Royal Philharmonic Orch. & BBC  
Chorus, Beecham (cond.) CBS 61224  
(mono).

**DELIUS — A MASS OF LIFE** Soloists,  
London Philharmonic Choir, Royal  
Phil. Orch. Sir Thomas Beecham  
(cond.) CBS 2BR 220303 (mono).

The notion that Delius was essentially a miniaturist is quite justified, most of his extended works having unrelieved stretches or else one seems to be hearing a string of miniatures. But Delius successfully captured an almost epic utterance in Paris (1899-1900), Sea Drift (1903), and A Mass of Life (1904-05). None of these works is familiarly known to present day listeners, performances being few, and it is an even more shocking state of affairs when none of these works is currently available in up-to-date recordings. The ordinary listener has had to wait for these reissues to get to know A Mass of Life and Sea Drift, while no currently available recording exists of Paris.

Sea Drift is Delius' masterpiece and almost certainly among the most eloquent settings in the literature. Taking one of Whitman's most successful poems, Delius is uncannily responsive to all its nuances — the various levels of reminiscence, the juxtapositions of childhood and maturer experiences, of the natural and human. And how well Delius understands the Whitmanesque ambiguity of point of view (lover, brother, friend, what does it matter) and his musical portrayal of loss is rightly both personal and of greater significance. With this piece Delius remains the most successful composer to set Whitman, not an easy task as anyone who has tried his hand at it can testify. But it is especially in the evocation of the sea that makes this setting so memorable. In using this poem, Delius chose to omit Whitman's opening and closing sections (not the strongest portions of the poem, one must admit) preferring to suggest the "cradle endlessly rocking" with a swaying motion that establishes Whitman's intended atmosphere naturally and without direct statement, a device of course, easier to use in music than in words. This swaying motion pervades the entire setting, and is not only appropriate to the pattern of recall, but also calls to mind those other musical narratives of loss — Tristan, Pelleas with their evocation of the sea as a primordial and desolate presence. So accurate in fact is Delius' observation of this common emotional experience of the sea that one cannot help but note how rightly the swaying ceases at "O rising stars!", resuming shortly after and climaxing at "O darkness! O in vain!", then silence and the baritone's "I am very sick and sorrowful". One almost does not notice the rocking

resume and fade gradually as the setting ends in a complex of emotion.

Beecham here gave one of his greatest performances and it would be hard to better this in a newer recording. His baritone soloist Bruce Boyce and the choir directed by Leslie Woodgate were also very much caught up in the spirit of the work. CBS is therefore to be congratulated for giving us back this performance and it is a pity that it did not see fit to release this record in Australia. But no doubt certain shops will be keeping import copies in stock. The recording is remarkably good although I am told by some that certain copies reveal a very slight wow. On the reverse of this disc is Delius' very pleasant incidental music to Hassan in a good enough performance. Most of the numbers on this side are also otherwise unavailable.

Less successful than Sea Drift and perhaps showing dated spots is Delius' setting of selections from Nietzsche's Zarathustra, A Mass of Life. At the risk of seeming ungrateful and especially since CBS has taken the trouble to release these records locally I must state that the recording on these discs were never good to begin with and the refurbishing improves things very little indeed. Sound is constricted and the wealth of orchestral detail in this score is not very much apparent. Nor I regret to say, is Beecham's performance one of his best. The opening is not rousing enough and the "Grosser Mittag" section seems rather sluggish. Elsewhere things go well enough but all is definitely not the best. Inasmuch as HMV has announced a new recording under Charles Groves it would perhaps be well to wait a bit although in all fairness to CBS I am almost tempted to think this new release should have happened a long time ago. — J.A.A.

**RAVEL — Fanfare from L'Eventail de Jeanne** FRANCK — Symphony in D minor. Stokowski, Hilversum Radio Philharmonic Orchestra DECCA Phase Four PFS-4218.

This record opens with a brilliant fanfare written by Ravel for a composite ballet *L'Eventail de Jeanne*. A tiny masterpiece of orchestration this fanfare certainly is, and Stokowski is very much in his element here. I am not in a position to say whether Stokowski has added or retouched anything but his performance here is all too brief. If the rest of the ballet is anything like this, perhaps a complete recording should have been made. The cover notes list the rest of the numbers, each composed by some contemporary of Ravel's: Poulenc, Auric, Milhaud, Ferroud, Delannoy, Schmitt and Roussel.

In the past year or so, at least three new recordings of the Franck Symphony have been released, which seems a bit strange,

considering that Franck's music is hardly the most popular fare these days. There are a dozen or so other recordings currently listed in the Schwann and Gramophone catalogues, and since I can hardly think of one version which is anything less than good, this new effort seems to reflect the usual absurd marketing practices most recording companies have today. Be that as it may Stokowski is at least never uninteresting and when he conducts something from the basic repertoire the results are usually at least stimulating. Give Stokowski an old war-horse and one is bound to learn a thing or two about the work. Well, yes, this performance is in fact interesting. Certainly there are very few conductors today who pay as much attention to detail and inner voices. Having been a turn of the century organist Stokowski would rather naturally bring out the "romantic organ" aspects of this score. Phrasing is rather fine if at times a trifle exaggerated (not always inappropriate in this work). There are undoubtedly some very fine moments, especially those flute/oboe trills at 485-90. Nevertheless I find it very hard to say why I cannot enjoy this performance as much as the recent Karajan (HMV) or the Martinon (ERATO). There almost seems to be a lack of conviction to this performance which belies Stokowski's admiring notes on the record jacket. Certainly this is a less fiery performance than Karajan's. Also, the Hilversum Radio may well be one of Holland's best but it is no Concertgebouw. The all-important English horn has, for instance, a rather wooden quality to it and is often just accurate. And why must Stokowski insist at times on a very *vibrato* string ensemble?

Recording and surfaces on this record are superb. — J.A.A.

**SIBELIUS — Kullervo Symphony, Op. 7. Kuolema — Scene with Cranes, Op. 44. Swanwhite, Op. 54 — Incidental Music: nos. 2-4, 6. Soloists, Helsinki University Male Voice Choir, E. Pohjola (dir.) Bournemouth Symphony Orchestra, Paavo Berglund (conductor). HMV SLS-807 (2 records).**

At the premiere of his Eighth Symphony, Mahler is said to have told Sibelius, "A symphony must be like the world, it must embrace everything." Sibelius in 1910 already possessed very different ideas as to what a symphony should be. The Third Symphony (1907) was already behind him and he was working on his Fourth, to be his finest achievement and certainly very different from Mahler's Eighth.

Admiration for Sibelius' symphonic achievement and the uniqueness of his "sound" as compared to most

# CLASSICAL

post-Wagnerian writing has tended to neglect altogether any discussion of influences on his work. While an almost grudging concession to the presence of Tchaikovskian elements is made with regard to the First Symphony, any talk about Wagnerian sounds in say, the Fourth Symphony has generally been avoided.

This recording does set things in their right perspective. Begun during his student days in Vienna, the Kullervo Symphony enables us to hear the various lines along which the composer might have developed. One, for instance, recognizes Bruckner in the length of themes and pedal basses, the writing for horns in the second movement, and the transitions in especially the first movement. More obviously, the form of the symphony (five movements, choral sections) links this work to late German romantic writing, although it must be remembered that Kullervo does precede Mahler's Resurrection, so that whatever its relationship to the German stream, the form of this work must still have been something of a novelty to most audiences of the time. But while some aspects of this symphony seems to set Sibelius as starting off from late German romanticism, it must be admitted that already very little in this work sounds German, and that is in great part due to a greater influence on Sibelius than anything in the Wagnerian vein, that of Tchaikovsky. By virtue of hindsight we realize that it was Tchaikovsky who veered Sibelius away from the post-romantic German elements. It was Tchaikovsky which impressed Sibelius with the fact that symphonies could, in fact, be written without Wagnerian chromaticism and in more classical lines. The First Symphony is final proof of this. But once again it is only too easy to emphasize the antecedents in this work. There is very little here that is as personal as Tchaikovsky. Nor is this work a "world" or else it is the confined world of the Kalevala. One has to admit that much of the writing here already reflects Sibelius' own voice, for instance, the illusion of movement not so much by means of counterpoint as by alternating dynamics and speed (Harold Truscott). Whatever moments of poor quality this work has, it is

nevertheless rather remarkable and avid Sibelians will definitely want a copy of this work. Performances from all concerned are always on a high level, recording is excellent, and surfaces on my copy are good.

The Kullervo is, however, not the only cause for joy in this album. We are also given the only recordings of the Scene with Cranes from Kuolema and four excerpts from Swanwhite. No cause for complaint here except that too little of Swanwhite is included. While none of these pieces is top level Sibelius, there are very lovely moments and the writing for two clarinets in the Scene with Cranes is very haunting indeed. And now will HMV or anybody give us a complete recording of the Tempest music? — J.A.A.

**PANUFNIK — Universal Prayer. Soloists, Louis Halsey Singers, Nicholas Kynaston (organ) Leopold Stokowski (conductor). Unicorn RHS—305.**

Panufnik's Universal Prayer is most certainly not "one of the most original musical creations of the middle Twentieth Century" nor is it "an entirely new development of music" whatever Stokowski may say on the cover of this record.

For someone responsible for numerous premieres of truly original works (Ives, Symphonic No. 4, Varese Arcana, for example) Stokowski can be strangely and irritatingly naive at times when he does talk about some of the music he conducts. Nor are Panufnik's own notes and graph of the geometrical symmetry of his work more inviting. If these are not naive, one is strongly tempted to think them pretentious. Ultimately of course it is the music that must stand up to the test and whatever Panufnik's ruminations as to the work's being neither twelve-tone nor aleatory but based strictly upon one triad only, everything sounds very much old hat to me. Certainly this work is carefully organised, or one is tempted to say too rigidly perhaps, without any musical compensations. Panufnik's earlier symphonies, the Rustica and Sacra may have been conventional but one felt at least the man was trying to write music not mathematics, and I have nothing against very mathematical composers like

Boulez or Xenakis who can also be musical.

For those who do not agree with me, here is a very good performance indeed from a conductor who seems to believe in this work. Recordings is very good, except for some distortion towards the end of each side. — J.A.A.

**"O SACRUM CONVIVIUM" — Modern French Church Music. Jean Langlais — "Messe Solennelle"; Maurice Durufle — Quatre Motets; Gabriel Faure — "Messe Basse"; Francis Poulenc — "Litanies a la Vierge Noire" — Choir of St. John's College, Cambridge; Stephen Cleobury, organ; Andrew Brunt, solo treble; George Guest, director. Argo ZRG—662.**

The diversity of style in modern French church music becomes vividly apparent with this new release. All the works have their own individuality and are fascinatingly dissimilar — the lyrical approach to the words of the mass by Faure; the modal tonalities and contrapuntal texture of four motets by Durufle; the frequent mood changes in Poulenc's "Litanies"; the mystic colouring of the Messiaen, and the intense dissonances amidst contrapuntal textures of the Langlais Mass. It might be argued that the Faure Mass is out of place on a recording devoted to Modern French music but this is really immaterial.

The work which stands apart in originality is the "Messe Solennelle" by Jean Langlais — a remarkable piece of writing; intense, exciting and forceful. It deserves the marvellous rendering given to it here. From the opening suspense-laden organ dissonances to the crowning glory of the 'trompette reals' peeling above the choir one just becomes immersed in the work. Mention should be made here of the organist, Stephen Cleobury. His understanding of the work and the application of a fine technique together with control of suitable registration schemes give the work a strong individuality.

The quality of singing is just as fine. Entries are firm and balance of voices (including the alto line!) is clear. One can almost feel the tension in their voices as they convey this general feeling of intensity. Certainly their voices do not blend as well as their neighbours at King's, but they are probably not meant to. In any case the contrapuntal lines are transparently clear and there is a sense of freshness and gentle radiance in their voices.

Faure's "Messe Basse" contains a few anticipations of his "Requiem" and is set for treble voices. A charming rendering, especially from treble soloist Andrew Brunt who sings confidently and with a delicate lilt. Incidentally the organ accompaniments here are simply gorgeous.

The other works are given equally fine renditions. I single out the Langlais as it is the most striking and leaves a more lasting impression.

Sound is particularly clear and there is a commendable balance between organ and choir (full organ as used in the Langlais never drowns the choir). Some slight background noise (passing cars, I think) in the Durufle. The disc comes complete with texts (and translations) and an excellent sleeve note by Philip Radcliffe.

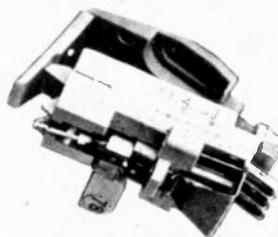
Possibly the finest recording the choir has made. — C.M.W.

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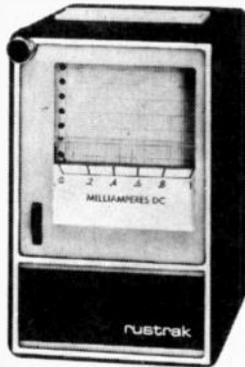
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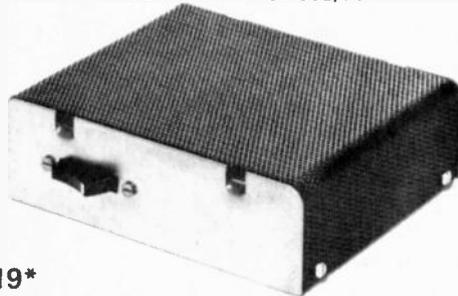


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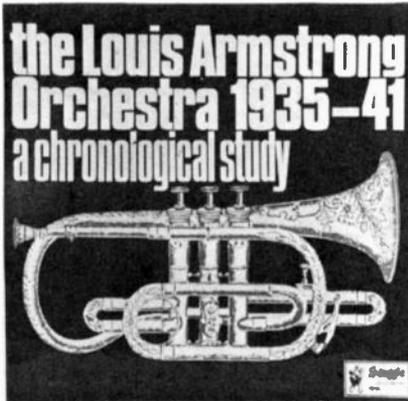
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This volume in Swagie's chronological study of Louis Armstrong's swing years seems to me to be superior to Volume One, which we've already reviewed, from the point of view of Louis' playing and sometimes of the orchestral support.

Some of the tunes have long been forgotten, and I wonder if — and how — they could ever have been very popular. Yet in his improvisations on even the very worst tunes, Armstrong comes up each time with at least one brilliant idea which is appropriate to the particular opus, and not just to the chords. Sometimes it's hard to know how he could have been bothered, yet the results are always worthwhile.

Louis used three slightly different sounds and approaches at different stages of his career, each one immediately recognizable as his own. His last sound, just before his playing fell right off in old age, was the most raw and emotional, his early cornet style the most inventive and technically florid, and the style recorded here was his most contained and perhaps most subtle approach. You really need this recording if you are to have the complete Armstrong picture.

In the coda to I Come From A Musical Family he lets some perfectly rounded low notes slide out like pistons leaving a cylinder. These notes seem to define the interior space of the instrument. There follows an uncannily plaintive hooting note which does not quite fill the instrument out. He has fractionally depressed one of the valves I should say, which sounds for all the world as though he has sung through the tubing.

The most inventive solo is on Somebody

Stole My Riff. He just rolls low notes over each other, almost offhandedly, foreshadowing Lester Young, as though for a moment he has contemplated dropping right out of the tune into another key. Then he cracks out over the top of the band just when you think they are about to leave him behind.

On Dippermouth he proves to be just as effective with the powerhouse orchestrated Dixieland of the Jimmy Dorsey Orchestra. In fact, that is his best accompaniment on the recording. Dorsey backs him again on an embarrassing thing called Hurdy Gurdy Man and on the second version of Swing That Music. This rattles along in a marvellously old fashioned Down On The Levee sort of way, but Louis' trumpet is again timeless.

Mostly terrible tunes; great Armstrong. Recorded sound is excellent except for a couple of tracks on the first side on which there is a bit of gurgling distortion. Very pronounced pre-echo. — J.C.

**BENNIE MOTEN** Bennie Moten's Kansas City Orchestra 1923-5 Swagie S1278 Mono. Elephant's Wobble, Crawdad Blues, South, Vine Street Blues, Tulsa Blues, Goofy Dust, Baby Dear, She's Sweeter Than Sugar, South Street Blues, Sister Honky Tonk, As I Like It, Things Seem So Blue To Me, 18th Street Strut, Kater Street Rag.

This is one of the best examples I have heard of the beginnings of organised and arranged Negro jazz. In its day this band would be regarded as a dance band and one can see these virile young Negroes changing from their loose working clothes into awkward starched collars and shirts and donning black dinner suits which always look too small because of their bulging muscles. It is also more than likely that they would never leave the stage in between dances except when it was time for the supper, which they would inevitably eat in the kitchen. It would never enter their heads that they were making history or doing anything important other than going out to do a gig the same as any other dance band.

This album is assembled from old pre-electric 78s and once you get used to the archaic sound you realise what great beauty there is in this pure classic jazz.

Most of the tunes are based on one or another of the 12 bar themes which have become traditional. This is interesting because it was this band which gave birth to the Count Basie Orchestra — a band which has always been noted for playing the 12 bar blues whether slow or jumping. In his cover notes, English collector Brian Rust, likens one of these 12 bar tracks to Muskrat Ramble which makes one wonder what these enthusiasts get out of jazz if they haven't got an ear!

Lamar Wright is on cornet; Thamon Hayes, trombone; Herman Walder, clarinet and tenor; Bennie Moten, piano and leader; Sam Tall, Banjo; and Willie Hall, drums. This is the personnel on the 1923 recordings and they are joined by Henry Cooper, cornet; Harlan Leonard, clarinet and alto for the 1924 session and for the 1925 tracks Vernon Page is added on tuba and LaForest Dent replaces Sam Tall on banjo.

The two cornet style reminds one of the Oliver band and the occasional comedy effects from the reeds brings Jelly Roll to mind. Probably the best solo comes from Moten himself with one of the finest examples of ragtime piano on Kater Street Rag.

Moten finally gave up the piano chair to the young William "Count" Basie and when Moten died, Basie took over the band which has been recording and touring ever since.

This album includes the entire published output of one of the most interesting bands in the history of jazz and it is most satisfying to be able to go back almost half a century to what was the beginning of the Basie band.

But this is not really music to be talked about, it is music to listen to. Surface noise and distortion is inevitable because of the rarity of the original records from which this album was taken. Some of them were far from perfect copies. — G.B.

**ARMAND HUG** — 'Armand Hug Piano Solos' Swagie, Stereo S1281.

Some day, some nut is going to issue an album called Armand Plays Armand. Or maybe Armand Digs Armand or Armand Meets Armand. Or, bottom of the barrel, Armands: Ain't They Sweet?

This fatuity is prompted by the issue on Swagie of a set of piano solos Armand Hug recorded in the New Orleans History of Jazz Museum on January 10, 1971.

Historic site, historic record. This is the first time an Australian company (and Swagie is based in Melbourne, as you doubtless know) has recorded an American jazz artist in America. (I add "in America" in case some smartie refers to the records made here by Max Kaminsky, Rex Stewart and Eddie Shu).

Armand Hug is, I assume, the greatest solo jazz pianist living in New Orleans. Because he knew what it would mean to miss New Orleans, he has never left the Crescent City. Mr. Ray Marginson, the Vice-Principal of Melbourne University, met Mr. Hug recently on some quasi-academic tour which took him to the land of dreams. He reported the encounter to Dick Hughes, a former president of Melbourne University Rhythm Club, at French's Tavern, Darlinghurst, Sydney, where Hughes plays solo piano and leads a trio.

According to Hughes, Hug assured Marginson he had been given first offer of

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# JAZZ

the piano chair in Bob Crosby's band in the mid-thirties. Eddie Miller, Ray Bauduc and Nappy Lamare - New Orleans lads - did their best to persuade Hug to come north to join what became one of the very best white big bands. But Hug sat tight and the piano chair went in turn to Gil Bowers, Bob Zurke, Joe Sullivan and Jess Stacy.

When you're listening to this record, you may think of Stacy occasionally, especially on Hug's own composition, You Cooked Your Goose With Me, with that run of notes in the break of the second chorus. In the chorus, you may even hear echoes of Frol Garner. And for a couple of seconds, at the very beginning you may think you're listening to Squeeze Me.

Why?, and If You Knew How I Love You are Jelly Roll Morton tunes I've never heard before and which I'm prepared to bet a trifling fortune Morton never recorded. He composed them shortly before he died. This record contains another Morton tune, Sweet Substitute, that Jelly recorded for the General label in 1940 on his last visit to a recording studio. Except for the odd frill and grace note here and there, you won't hear much in them to remind you of Jelly, but you may hear touches of Fats Waller in the first chorus of If You Knew How I Love You.

I hope I'm not giving you the impression that Hug is just a derivative pianist. He is, rather, an eclectic, with a distinctive style of his own.

Armand meets Armand (to get us back to where we came in) on Sweet Purple Rose of Cairo, I Can Beat What You're Doin' to Me, Mama's Gone Goodbye and Come Back to Me Mandy. These are all compositions of Armand Piron, one of the early band leaders of New Orleans. Delightful tunes, all of them, but I guess Mama's Gone Goodbye is the only one we've all heard.

Piron composed a host of great tunes and his Red Man Blues was one of the most exciting numbers in the repertoire of the Geoff Bull Olympia Band.

The label also attributes to Piron, I Wish I Could Shimmy Like My Sister Kate. So do all labels, but the tune was actually composed by Louis Armstrong, who sold the copyright to Piron in the early days. (Why did Louis never record it? Wouldn't his vocal on it have been something?)

This is a charming record, but it has one fault. All the tunes are played at practically the same tempo. The only suggestion of speed is in the last chorus of I Can Beat What You're Doing to Me. If a few other tracks had been taken at this or at an even faster tempo, we would have had a much more interesting record. Even so, we owe a debt of thanks to Swaggie for getting down so much Hug.

But what a pity Swaggie didn't get Joe Sullivan to do a solo album before he died in October!

And why doesn't Swaggie get Jess Stacy to do a solo album? Time's running out, friends. - B.W.

## THE REUNION JAZZ BAND - 'Reunion Jazz No. 3. W & G Stereo, 255 5414.

The Reunion Jazz Band is so called because it is a reunion of some of the original members of the Dutch Swing College Band. W & G have released Volume 3 of the Reunion Jazz Band and if Volumes 1 and 2 are as good - or even only nearly as good - then I wish they would hurry up and release them too. They may have released, but not to my knowledge. But then I don't know very much and, if I may quote Vincent and Youmans, I know that you know.

This band must be one of the best revivalist jazz bands in the world. It reminds me a lot of the Graeme Bell band of the mid and late 40s at its very best. Incidentally, I think it was the trombonist of the Dutch Swing College band who got quite perturbed when Roger Bell (Graeme's brother, y'know) suggested he should take more solos. "Honore Dutrey didn't play trombone solos in King Oliver's Creole Jazz Band," he said. "Why should I?"

The Dutch Swing College Band soon got the purist iron out of its system and I feel pretty sure Louis Armstrong meant it when he said: "These are the boys I like to jam with."

Coincidentally, there are two numbers from the Oliver Creole Jazz Band on this record, Working Man Blues and Mabel's Dream, and coincidentally, both have an Australian sound. I guess the Australian sound is pure coincidence although I wouldn't be surprised if it were a lingering indirect result of Bell's first European tours of 1947-48. Dim Kisher on clarinet sounds quite antipodean. New Holland or Old Australia?

This review is not meant to be an essay in jingoism, I assure you, but I must mention the occasional resemblance of Eddie Hamm's tuba playing to that of Bob Wright in the old Southern Jazz Group from Adelaide. It's excellent tuba, anyway, and on Willie the Weeper, behind Pim Hogervorst's glancing, dancing banjo, it bounces along like Bill Bedford's on the 1928 Jelly Roll Morton Red Hot Pepper session.

This record has a most interesting selection of tunes, one of which, Lil Armstrong's Everything's Wrong, Aint' Nothing' Right. I

had never even heard of before. The opening soloist on this is Joop Schrier, who plays a very bluesy back-to-the-roots piano. In the sleeve notes he describes it as "a rare blues melody based on a 16-bar pattern." The other soloists are Dim Kesber and Jan Morks on clarinet, Wim Kolstee on trombone and Wybe Buma on trumpet.

Hoagy Carmichael's beautiful tune, New Orleans, is largely a feature for Buma's trumpet and very lyrical trumpet it is. Notice the whole tone phrase Hogervorst uses at the end of his half-chorus guitar solo.

Jan Morks, who has a short clarinet solo on New Orleans, takes a tenor sax chorus on Sunday and sounds very much like Eddie Miller.

A very versatile band this, with Kisher playing soprano and clarinet, Hogervorst guitar and banjo, Hamm bass and tuba, Morks clarinet, tenor and drums, and Martin Bennen, drums and trumpet. When Bennen joins Buma to play a two-trumpet lead, Morks conveniently deputises for him on drums. All they need is Ade Monsbrough on violin.

I think it was Schrier who played a magnificent piano solo of Saint Louis Blues on one of the Dutch Swing College albums from the early fifties. He leads the Reunion Jazz Band but takes solos only on Sunday, Everything's Wrong and La Chartreuse. Chartreuse opens in Jimmy Yancey style and has a most interesting ending.

I hate to harp on this Australian jazz, but the diligent student is well aware that Ade Monsbrough and Kelly Smith pioneered the use of two clarinets in Melbourne back in the mid forties. The result was one of the distinctive Australian jazz sounds of the golden days of the revival.

Kesber and Morks strut their two clarinet stuff on Louisiana, that delightful tune which got equally definitive interpretations by Bix Beiderbeck and Count Basie. First chorus they play in unison. They chase each other in low register throughout the second chorus. They go back in unison for the third chorus, taking alternate breaks after every two bars. A key change and an abrupt ending make it all add up to a delightful and stimulating track.

On the whole, this is a delightful and stimulating record. If Volumes 1 and 2 of the Reunion Jazz Band are available, just toss them my way would you. W & G? And if they aren't pray remedy the situation post haste. - B.W.

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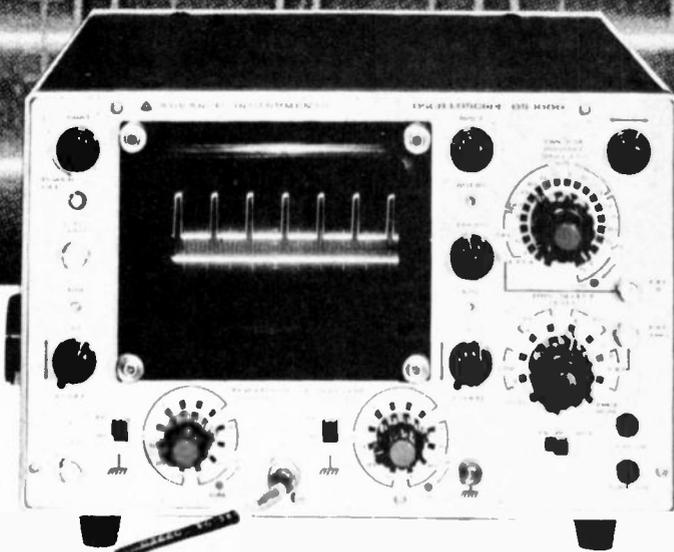
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# RECORDINGS... POP TRENDS

REVIEWER  
John Clare,



**RAY CHARLES — Volcanic Action Of My Soul.** EMI Stereo SPBA 3021. See You Then, What Am I Living For? The Long and Winding Road, The Three Bells, Witchita Lineman, Something, I May Be Wrong, Down In The Valley etc.

Ray, Oh Ray, how silently you lie. Would that there were some volcanic action of your soul!

I don't know what it is. Ray Charles has lost nothing technically, but there is little of the old excitement on his recent recordings — though I believe he is still a knockout in person.

The arrangements are pretty terrible, but then so they often were on 'The Genius Of Ray Charles' and he overcame it all there. Maybe Ray should get back to the blues.

There are a couple of soaring moments on Something and The Long And Winding Road, but generally it's just OK. That's not enough from Ray.

Production and sound quality is very 'commercial'. And that's it, really. — J.C.

**BLOOD SWEAT AND TEARS**  
BS&T 4, Stereo. Go Down Gamblin', Cowboys and Indians, John The Baptist, Redemption, Lisa, High on a Mountain, Valentine's Day, Take Me In Your Arms, For My Lady, Mama Gets High, A Look To My Heart.

One of the things I immediately liked about Blood Sweat and Tears was that although they used resonance and stereo and distancing gimmicks on their recordings, they seemed to know that brass, if bright and immediate, could be a very exciting focal point rather than just a background punctuation. I liked the sound of two trumpets, at times sharp and delicate, reminding me a bit of Andy Kirk. I liked the

way they would establish a cathedral-quiet with the organ and then have the brass crash through, shattering glass.

Obviously they could not go on doing things in exactly the same way, and on this recording they've gone for a much fuller, enveloping sound, not only in the arrangements, but in the way the recording has been produced. This is fine on "Go Down Gamblin'" and "Redemption" which rock quite furiously (Gamblin' has David Clayton Thomas' first guitar solo on record: good feeling; not over-flowing with ideas) but on a couple of the more leisurely things, like the rather trite "Cowboys And Indians", it veers dangerously near that huge, bland and remotely billowing sound you get on the sound track of Western Movies as the waggons roll over the prairies, swept by the shadows of monumental sailing cumulo nimbus, and watched no doubt by Indians. So it's deliberate on 'Cowboys' but it occurs elsewhere too.

It's not all like that, but overall I think the sound is less distinctive than it used to be, despite, or perhaps because of the fact that there are more nice, less obvious, musical things happening: in the instrumental passage before the last vocal chorus of Gamblin', a plunger-muted trumpet plays a slightly more ornamented version of what the rest of the brass are doing. Listen for it, it's a nice effect, and it shows they've heard Clark Terry once or twice. That sound somewhere between an Oriental gong and a train hooting through a tunnel at the end of Cowboys and Indians is actually Dave Bargeron playing one note on the Tuba while singing another note in his throat. It's hard enough to do this in unison to what you are doing, let alone in the weird harmony Bargeron has got here. Don't let anybody tell you that these guys are not first rate musicians. Listen to the trombone skittering around in trumpet register on Redemption.

Most of the songs are originals, but I don't think that any of them are particularly memorable, as some of their early songs were. They are mostly very pleasant however, and worth hearing repeatedly if only for the arrangement. "Mama Gets High" is a gas. It's a tongue in the cheek pseudo-blues with a long improvised dixie-land tag.

All in all, a beautifully played and well-recorded album, but I must confess to liking the previous one better. The Australian pressing compares quite well with the American. A slight airiness, lack of substance in the voice shows that something has been lost. However something has also been gained; namely surface noise. If it were not for this, CBS would be just about my favourite company: most of their recordings are surfacey to begin with, and they take on a lot more surface within a few months. — J.C.



**LEAF HOUND — 'Leaf Hound'** Telefunken, Stereo SLE 14604 —P. Drowned My Life In Fear, Stray, Stagnant Pool, Sad Road To The Sea, Work My Body, Sawdust Caesar, A Minute To Go.

I must confess that I had never heard of Leaf Hound. There is no information on the record sleeve, but they have a heavy American sound, though the singing suggests that they could be English. I imagine that this is their first recording.

Leaf Hound is an archetypal heavy rock band, something like Grand Funk, but not as good. As each tune employs repeating riffs, and usually the same chords, it sounds a bit samey, but the heaviness, simplicity and energy of it all make this a great party record. Sound is very sharp. — J.C.

**CURTIS KNIGHT — Give You Plenty Lovin'** RCA Stereo SL-101955. No Point Of View, Help Me If You Can, Give You Plenty Lovin' Goodbye Cruel World, Lena, Why Are We Here On Earth, Hi Low, Down In The Village etc.

Curtis Knight was at one time in a band with his close friend Jimi Hendrix, and it is said that his ideas as well as Hendrix's helped form what came to be known as psychedelic rock.

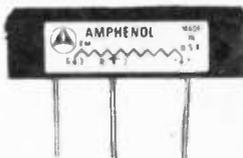
This recording shows off many Hendrix-like ideas, and it is a pity that the sound is often muffled for there is some very good stuff here. On No Point Of View, Knight plays a very hard, swinging chorus on guitar. His sound is sharp and clean, and fairly leaps out of the speakers, in contrast to the slight muddiness of the rest of the band. Elsewhere his guitar is not recorded so well, but he gets off some very fine stuff. On Give You Plenty Lovin' he uses feedback, fuzz, and very occasionally the wa wa pedal to produce some extremely satisfying sounds and ideas. So well does he control distortion and duration of notes that he often seems to be playing a wind



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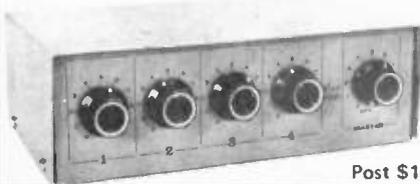


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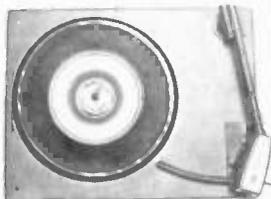


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instrument — in fact he creates a similar effect to Archie Shepp here and there.

The drumming on this track is very busy and very sharp, the organ produces a fierce squawling sound. It is not only very exciting, but texturally it is deeply satisfying. The only weak element to my ears is the bass, which is too orthodox in the context.

Not all the tracks are up to the standard of *Plenty Lovin'*. The duller tracks are doubly so as a result of poor recording quality. Knight's singing is good enough generally, sometimes rather unexciting. He has some of Hendrix's arrogant and satirical approach, but it doesn't quite come off as being so hardbitten as Hendrix.

Three or four tracks on this record are as good as anything I've heard in rock music for some little while but it must be said that the poor recording quality comes near to spoiling the album. — J.C.



**VINCE HILL — *The Singer and The Songs*.** EMI Stereo OCSD 7678. *Daydream, The Green Field, Out Of The Darkness Into The Light, Home To Your Loving Arms, Waterloo Sunset, Danny Boy, All My Love's Laughter, Spinning Wheel* etc.

If your tastes tend towards the middle of the road, I would like to be able to recommend this album by Englishman Vince Hill, because he is really a very good singer. However, I can't really work up much enthusiasm; Vince hardly does himself credit here.

The songs are generally pretty lame and Vince sounds as though he is really trying to sing in as commercial a manner as possible.

I am afraid I am always put off by the feeling that a record has been produced with the sole aim of making a bit of money. Every record is made in the hope of making some money, but when that motive pushes out all joy in the music for its own sake, you are left with a pretty soulless piece of merchandise.

One of the worst tracks is *Spinning Wheel*, but only because I had expected Mr. Hill to do it quite well. Somebody has made a very basic mistake in deciding to do the song over an even, straight ahead four to the bar jazz feeling. The song just does not work without a heavily accented rock beat... *'Spinning Wheel (sock!) Got To Go Round'*... that drum sock is part of the song. The arrangement here, as on all the faster tunes, is brash studio jazz. The

romantic arrangements are workmanlike and eminently forgettable.

Sound has a hard, shallow feeling, and Hill's voice quality seems to have been changed for the worse. I don't like this at all, but then I do not like Engelbert Humperdinck either, so if that's your cup of char you won't want to take my word for it. — J.C.

**THE MOODY BLUES 'Every Good Boy Deserves Favour' Threshold, Stereo THS 5 Procession, The Story In Your Eyes, Our Guessing Game, Emily's Song, After You Came, One More Time To Live, Nice To Be Here, You Can Never Go Home, My Song.**

I once visited a friend who was playing a Procul Harum record, and I remarked that it seemed to be pretty pretentious stuff. He replied, "I suppose I would find it pretentious if I took it seriously. I just like the sound they make."

This is the way to approach the Moody Blues. Apart from their electric guitars, a piano, organ and flute, the Moodies make use of a Mellotron, which is a kind of cousin to the Moog Synthesizer. It certainly makes some pretty sounds. Sometimes it does sound like a full orchestra, but the slight lack in definition and attack lends it a more ethereal effect. Sometimes it's all a little suffocating like a stage version of heaven with cotton wool clouds, tinted mists and lots of talcum powder.

It's a soothing world the Moodies have created, and portentous lyrics dealing with 'Creation! Destruction! Desolation!' emerge in the context like idle surrealist diversions. Nothing is real.

Some of the songs here are very derivative of the Beatles. The others are very, very ordinary. The sound is the same as it always has been, but in terms of material this is not a good Moody Blues album.

In terms of reproduction, the recording is superb by local pressing standards. There are some sound effects at the beginning which would be ideal to show off your equipment: thunder and landslides, and then rain, right there in your living room, very real sounding rain. Better cover the furniture before you play this one. — J.C.

**NIRVANA — *Local Anaesthetic*.** Vertigo, Stereo 6360031. *Modus Operandi, Home.*

There is one thing about groups on the Vertigo label: they are all trying to do something distinctive. Effort, and perhaps a certain amount of pretention, has gone into everything from the cover on in. On the outside of this folding sleeve is a photo of a large room devoid of furniture and painted a silvery white. By the glass doors a young woman sits in a rocking chair while a little girl plays with her hair. They too are painted white. Through the door — like a coloured inset — a lovely fragment of rural English winter: leafless trees, brilliant grass, a blue door. Outside the far window stands a man in black with his back to us. Inside the fold, the same room minus its occupants. The man now looks in.

I rather like the cover, and I rather like the music. Though there are only two titles, each side has several songs. On side one they segue into each other; on side two they are separated into tracks. On side one they employ a formula of one rocking track

followed by a slow exotic one. I must confess that unless I can hear them clearly without straining, I don't pay much attention to underground type lyrics. A stream of images and wise thoughts goes by, soon forgotten. So with Nirvana. Nor are the tunes very good. What I really like are the instrumental interludes.

They get a fine surging rock going with a piano rattling away eight to the bar at the same time and one of two guitars flying along at leisurely speed over the top. What's so different about that? Nothing, nothing at all, except that they do it with lyricism and feeling. I first listened to this record through earphones after having spent two days body surfing in almost the best seas of my experience. I was full of sweet fatigue and the music filled my head with images of rolling waves, the solo guitar like spray flying off into the wind. And the feeling of the voluptuous abrasive slide down the wave face came back into my body. Towards the end of side one the music, now led by a saxophone, increased in intensity and the waves began to chase each other in a great circle.

Forget the songs — it's terribly hard to write a good song — the instrumental parts are full of beautiful motion. Sound is good. — J.C.

**TONY WILLIAMS — 'Ego' Polydor, Stereo 2425 070.** *Clap City, There Comes A Time, Piskow's Filigree, Circa 45, Two Worlds, Some Hip Drum Shit, Lonesome Wells, Mom and Dad, the Urchins of Shermese. Ron Carter, bass and cello; Khalid Yasin, organ; Ted Dunbar, guitar; Don Alias, percussion; Warren Smith, percussion.*

Unfortunately it seems that the further away in time from Miles Davis that Tony Williams gets, the less potent does his music become.

I've liked his other records for their sheer violent force, though I'd found the music a trifle too organised, too rigid almost, in comparison to the music he had been playing with Miles. Talk of incontinence, incidentally, in relation to this music is quite absurd, and indicates a very lazy ear. Harmonically the music has been a little strange, and the sound is very heavy, but in form it was never very complicated or very free.

On this recording Williams is showing signs of not knowing what to do. He may be a leader. I don't know, but he is not a leader in the sense that Miles is a leader able not only to get men together and make them play well, but to lead them through new concepts.

Here we find the sound lighter and yet more conventionally psychedelic. There is more improvisation, more, but not much, collective freedom on this recording, but the results are such that the careless listener will probably conclude that there is less. Some of the guitar solos by Dunbar are in quite a conventional modern jazz mould, and they are very enjoyable. Enjoyable too is Young's atmospheric sound, but he doesn't get enough going for my taste. Williams' songs are not up to much.

Generally, the recording is best played as an intermittently intriguing, almost always pleasant and rhythmic background. Production and recorded sound is ideal for the music. — J.C.

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# RADIO ASTRONOMY

(Continued from page 46)

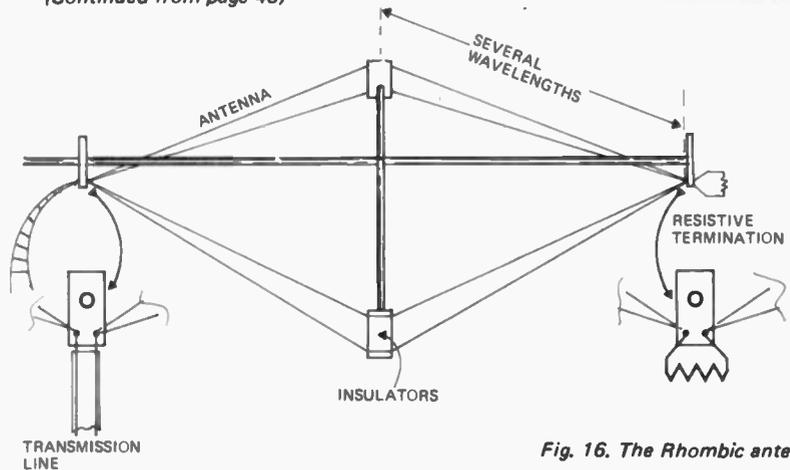


Fig. 16. The Rhombic antenna.

## SPECIAL ANTENNAE

Professional observatories use a number of antennae and techniques which are of interest.

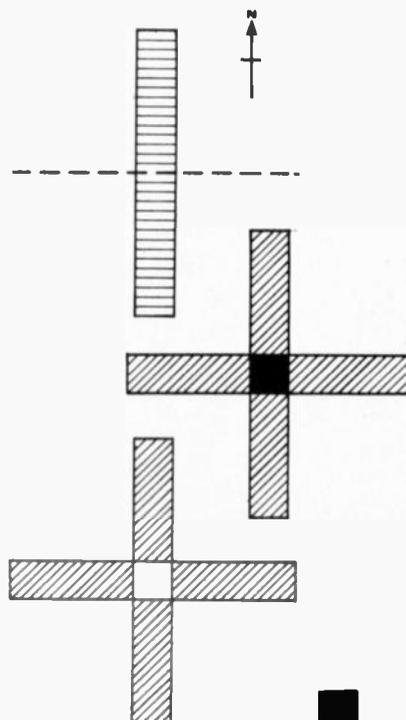
One of the most famous installations in Australia is the *Mills Cross*, located at Molonglo, Canberra. This consists of a series of antennae arranged in a line, one mile long, both lines forming a cross, oriented North-South and East-West. Designed by Professor B. Y.

Fig. 17a. Plan view of antennae in Mills Cross array.

Fig. 17b. In-phase antenna pattern. Black area indicates great enhancement of gain.

Fig. 17c. Out-of-phase antenna pattern. White area indicates large null in pattern.

Fig. 17d. Resultant 'pencil beam' pattern of Mills Cross array.



Mills of Sydney University this antenna provides a very narrow pencil beam and can resolve very fine details of any noise source being studied. A combination of techniques is used to enable the beam to be aimed almost anywhere in the sky. The East-West arm is fully steerable in altitude while the North-South arm uses a lobe phase-switching technique.

The radiation pattern of all the antennae in each line is combined to produce the desired effect.

Another method of increasing resolving power of an antenna is *aperture synthesis*. There are a number of methods of doing this, one being to use a long line of fixed antennae and a moveable line of antennae that moves parallel to the fixed line so that it can

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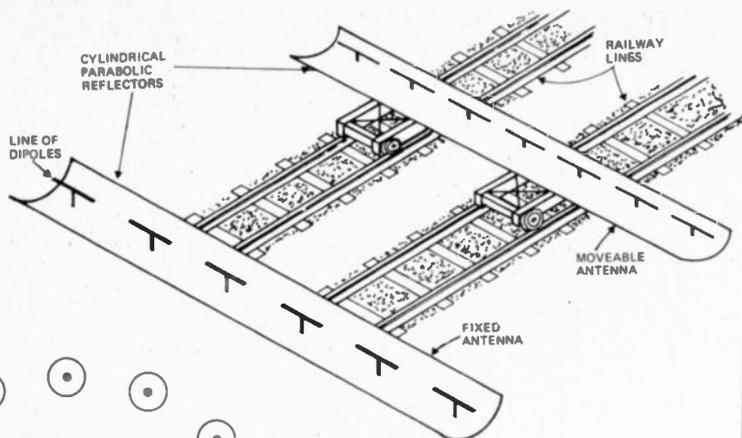


Fig. 18. Aperture synthesis antenna used at Cambridge (UK).

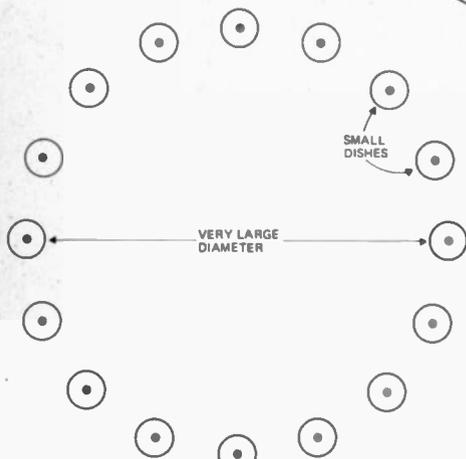


Fig. 19. In this array a circle of small dishes is arranged around the circumference of a very large circle. An ellipse may also be used. A radioheliograph using this principle is currently being constructed in Australia.

take up any position in a rectangle (see Fig. 18).

The resulting antenna pattern is derived using a computer. The receiver output is processed in a similar manner.

Another method is to use a large number of parabolic dishes, arranged in a large circle, and their outputs fed to a special unit that adds the signals from each antenna in such a way that it appears as if the signal were received by one large dish having the diameter of the circle. The radiation pattern of a parabolic dish having a diameter of several miles can be synthesised in this fashion. An illustration is given in Fig. 19. An antenna (or antennae) of this type is currently being constructed in Australia.

An arrangement of antennae can be used to provide greater resolution than one of the antennae alone. This technique is known as *Interferometry*. The output of the antennae is combined so that a number of *peaks* and *nulls* appear in the antenna radiation patterns.

There are a number of techniques used to produce "interference fringes", as they are called, most being named after similar techniques used in optical astronomy.

The third article in this continuing series will be published in Electronics Today next month.

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# BOOK REVIEWS

REVIEWERS: Brian Chapman  
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"ABCs of Integrated Circuits" by Rufus P. Turner, Ph.D. Published by Foulsham-Sams Technical Books, England 1971. 96 pages 8 1/4" x 5 1/2", hard covers. Australian price \$4.25, available from Modern Books & Plans and all leading bookshops.

Few people can now be unaware of the impact on modern living that the development of solid state devices such as the transistor has made. Without the transistor our computer, space age would not be possible.

Less well-known, is the impact of integrated circuits. These devices combine in one 14 or 16 pin case, measuring approximately one inch long by three-eighths of an inch wide, up to several hundred transistors and their associated resistors and capacitors (all in solid state form). ICs, as they are commonly known, are increasing in complexity every day and it is possible to buy such things as dual differential amplifier, 4096 bit random access memories, phased locked loop and complete TV detector, audio output stages, all complete in the one chip and only requiring a few extra components and power supplies to perform the desired function.

An example of the cost reduction effectiveness of these devices is that of the latest generation of small computers. These machines costing approx. \$30,000 occupy about 9 inches in height of a standard 19" rack and have the same capabilities as discrete component machines of 10 years ago which were housed in approximately three full 6' high 19" racks and which bore price tags of \$200,000 or more.

Yet another example of the impact of ICs is in the space industry. The accuracy and precision required for the Apollo moon landings can only be obtained by enormous electronic complexity. Several computers are required for the various functions of launch guidance, space navigation, spacecraft housekeeping and lunar landing control, etc. With discrete components the equipment weight would be prohibitive. Here the extra functional packaging density is of utmost importance.

So much for the areas of science and computation, but additionally, ICs are now invading the domestic scene and there unobtrusively finding their way into the most seemingly unlikely applications such as washing machine control. As unit prices continue to come down and chip complexity increases we can expect to see ICs take over more and more applications which have been traditionally mechanical.

As well as offering increased reliability the new solid state controls will offer increased versatility and by their unified black box construction, dramatically reduce prices of the equipment to which they are applied.

All technicians should note, therefore, that it is imperative to gain a good working knowledge of the operation and application of these devices as the revolution will be in many ways more far reaching than that engendered by the change over from valves to transistors.

At every technological change some people inevitably find themselves, if not redundant, relegated to a lower income bracket. Remember radio mechanics were 30 years ago highly paid and eagerly sought after people. Now it is just another not-too-well paid trade. So be warned - keep moving with times or you will be left behind.

This book offers a simple introduction to the integrated circuits of one of the two main families of devices. These families are:-

1. Linear: Where the output of the circuit is proportional to the input and usually varies linearly with the input.
2. Digital: Where the output has only two stable states dependant on the input level and the built-in logic function.

Although digital ICs are described briefly, the main accent of the book is on the linear devices which are finding increasing application as operational amplifiers, IF amplifiers, modulators, video amplifier, voltage comparator and voltage regulator, to mention just a few.

The text is well written in simple unmathematical terms and is

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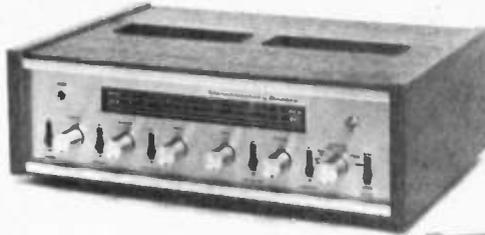
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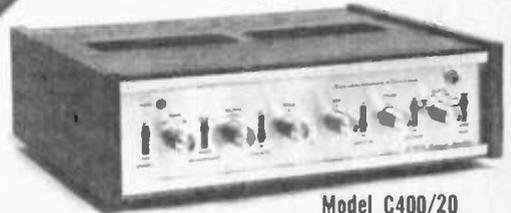
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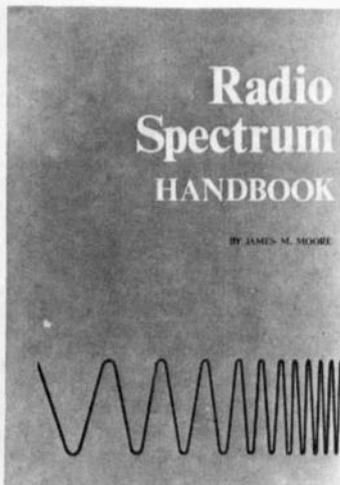
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# REVIEWS

Ideally suited to the needs of technicians who wish to improve their scope or to the electronic hobbyist who wants to use these devices in his projects. Many typical applications are provided under the general headings of Amplifier, Oscillators, Controls, Communications, Test Instrument and Supplementary Applications. Well worth the modest outlay. — B.C.



**Radio Spectrum Handbook** by James M. Moore, Foulsham & Co. Ltd., Slough, UK. Hardback, 192 pages \$10.20. Available from Modern Books & Plans and other booksellers.

This book should prove a useful reference work for those who either use or intend to use some portion of the radio spectrum.

Written for those who have little or no knowledge of radio communications, radar, radio astronomy or allied fields, this book provides a wealth of information for the technician, engineer or scientist, etc.

The topics covered are: Allocation, the Nature of Radio Waves, Receiving Equipment, Very Low Frequencies, Medium Frequencies, High Frequencies, Very High Frequencies and Frequencies above VHF.

The book was written primarily for Americans and thus some of the contents will not apply to Australian or New Zealand conditions, especially as regards frequency allocations. Nevertheless, much of the material is applicable throughout the world and information on local differences can be obtained from the appropriate licensing authority. (In Australia — the P.M.G.).

A preface has been written by W. Oliver (G3XT), for the guidance of English readers, pointing out the differences that apply to conditions in Britain as against America. This is of little value to Australian readers and even for the British reader the preface is inadequate and gives little information of use.

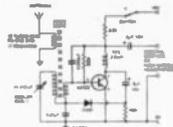
The first chapter gives a very good introduction with a short history and a definition of the radio spectrum. This is followed by explanations of reasons for allocations, regulatory agencies, international call sign prefix allocations, station operating agencies and types of stations. This chapter includes some very good, and necessary definitions (and also some material which is applicable only in the United States).

The second chapter gives a very basic introduction into the nature of radio waves explaining the terminology used, various characteristics, propagation, the ionosphere, noise and interference and types of modulation (AM, FM, SSB and Pulse). This chapter is necessary if readers, unacquainted with radio communications or propagation, are to understand the rest of the book. It is, of necessity, simple and would not stand rigorous technical examination but should be adequate and certainly not misleading to the uninitiated or non-technical reader.

Chapter three explains receiving equipment in a simple straight-forward manner and includes block diagrams and photographs of actual equipment.

Whilst one would assume that this chapter would logically be followed by one on transmitters; this is not the case, in fact, transmitters are described in a section in each of the following

## ONE TRANSISTOR RADIO



As described on page 60. E.T. Dec, 71. An excellent receiver, ideal for the experimenter. Complete kit of parts: **\$6.90 Post 50c.**

## TURNTABLE SPECIAL



Automatic or manual operation: Latest modern style square section brushed aluminium tone arm — fully counter-balanced with calibrated stylus pressure control — anti-skate bias compensator — silicone damped cueing device — light-weight head shell takes any type magnetic cartridge. 11" diecast turntable — dynamically balanced 4 pole motor fitted with click & noise suppressor. Finish — Satin black with brushed aluminium trim. Available with ceramic cartridge and diamond stylus **\$53.75.** Or Magnetic cartridge and diamond stylus **\$61.50. Pack and Post \$1.50.**

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As described in June E.T. Ideal for serviceman/hobbyist. Complete kit including case. **\$27.95 — Post 50c.**

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Supplies 3W RMS into 8 ohm load using crystal or ceramic cartridge. P.C. board size: 2½ x 4½ Full instructions supplied. Post 50c on all

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## BASS BOOSTER

This unit described in December E.T. Full-kit, excluding speakers and cabinet. **\$36.50. Post 80c.**

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# REVIEWS

chapters, presumably because different techniques and consequently, different equipments are employed for different portions of the spectrum. But a short, general chapter on transmitters would have been a great help.

Chapters four, five, six, seven and eight explain the different uses, allocations and equipment used for the VLF, MF, HF, VHF and above VHF portions of the spectrum. These chapters are copiously illustrated with clear and informative tables, diagrams and photographs.

All in all, this is a very informative book for the hobbyist, technician, professional engineer, scientist or anyone who uses or intends to use some portion of the radio spectrum. — R.H.

**"Novel Experiments with Electricity",** by John Potter Shields. Published by W. Foulsham & Co. Ltd., England, 1971. 96 pages 8 3/4" x 5 1/2", hard covers. Australian price \$4.25 available from Modern Books & Plans and other leading booksellers.

Here is a book for all you dads who have young sons and need an excuse to fiddle in the garage. An ideal book for the above purpose, it progresses from basic theory through a range of experiments designed to introduce a lad to the wonders of the world of electricity in a most fascinating manner.

The experiments are designed specifically for home construction at a minimum of cost. In many cases the projects can be assembled from junk box parts.

The parts which have to be bought have been carefully selected so that they can be readily obtained from any local electronics distributor.

Apart from the many classical experiments in electrostatics and magnetics, there are many novel experiments such as home construction of electromagnetics and solenoids, a ground path telephone, magnetic metal finder, simple synchronous motor, simple relay and a host of others.

Keep an eye on junior, however, Dad, some of the experiments show connections direct to mains which is reasonably safe on the U.S. 110 Volt system but could be lethal on our 240 Volts.

The book is well written and illustrated and must be considered to achieve its aim exceedingly well. — B.C.

**"ABCs of Infra Red"** by Burton Bernard. Published by W. Foulsham & Co. Ltd., England, 1971. 144 pages 8 3/4" x 5 1/2", hard covers. Australian price \$4.75, available from Modern Books & Plans and other leading booksellers.

"The infrared spectrum was discovered 170 years ago but very little technical progress took place in the field for the first 130 years".

"The Second World War renewed interest in the infrared spectrum, and rapid advances in the state of the art have taken place". "Today, infrared techniques are commonplace in domestic, industrial, military, medical, and space applications".

This introduction to the book is given by the author in the preface, and exemplifies how many discoveries, made decades, and in some cases, centuries ago, have only recently found useful application. The reason for this is that it is one thing to know what needs to be done, but quite another to develop the tools and technology to do it.

The first four chapters of the book deal with the history of infrared, the laws and principles of electromagnetic radiation, infrared sources and infrared detectors.

Chapters 5 and 6 deal with practical instrumentation and systems based on the previously developed theory. Data is included on such topics as infrared thermometers, spectrometers, communications, temperature measurement and control, gas analysers, etc.

Chapter 7 provides a further treatment of infrared applications in astronomy, space technology, ecology, fishing, air pollution, criminology and the study of oil paintings — a fascinating and varied cross-section.

Each chapter is followed by a series of questions designed to consolidate the reader's understanding of the subject matter. Answers to questions are provided in an appendix, and an index provides quick access to the appropriate text.

Mathematical equations are provided wherever necessary, but the text is not obscured by mathematics and can, therefore, still be understood even if the sums are passed over.

The text is well written and adequately illustrated and the book provides a well rounded coverage of the topic for those who are interested in the field. — B.C.

# HAM

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2 1/4" 8/ohm Voice Coil, \$1.50; 2 1/2" 8/ohm V.C., \$1.75; 2 3/4" 8/ohm V.C., \$1.90; 3" 8/ohm V.C., \$2.00; 4" 8/ohm V.C., \$2.75; 7x5 8/ohm V.C., \$4.75; 6x9 8/ohm V.C., \$5.75.

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**MODEL 200H MULTIMETER**, 20,000 opv. DC Volts: 0-5/25/50/250/500/2500V (20,000 opv) AC Volts: 0-15/50/100/500/1000V (10,000 opv) DC/Amps: 50uA/2.5mA/250mA. Resistance: 0-60K/6M ohm (scale centre 300 ohm — 30K ohm. Capacitance: 10uuf to .001uF — .1uF, D3 scale 20 db to plus 22 db. Size 4 1/2 x 3 3/4 x 1 1/8. — \$11.75, P.P. 40.

**MODEL CT330 MULTIMETER**, 20,000/OPV. DC Volts: 0-6/6/30/120/600/1.2K/3K/6K Volts. AC Volts: 0/6/30/120/600/1.2K Volts (10K/OPV). DC/Amps: (0.06 mA / 6.0 mA / 600 mA). RESISTANCE: 0-6K/600K/6M/60M/600 Megohm. (30/3K/30K/300K ohms) centre scale. Capacitance: 50 uf to .01 uf .001 to 0.2 uf. Decibels: —20 to plus 63 db size approx. 5 1/2 x 3 5/8 x 1 1/4. — \$18.75, P.P. 40.

**MODEL OL-64D MULTIMETER**, 20,000/OPV. DC Volts: 0-0.25/1/10/50/250/500/1000V at 20K/OPV, 5000 volts at 10K/OPV, AC Volts: 0-10/50/250/1000V at 8K/OPV. DC/A: 50uA/1mA/50mA/500mA/10 amps. RESISTANCE: 0-4K/400K/4M/40 Megohm. DB Scale: —20 to plus 36 db; Capacitance: 250pF to .02uF. induct. 0-5000H, size 5 3/4 x 4 1/8 x 1 1/4 in. — \$19.75, P.P. 40.

**NEW MODEL US-100**. Overload protection. Shockproof Movement, polarity switch. DC Volts: 0.25/1/25/10/50/250/1000V (20K/OPV), AC Volts: 0-2.5, 10/50/250/1000V (5K/OPV). DC/Amps: 1mA/25mA/500mA and 10A. AC/Amps 10A. RESISTANCE: 0-50M/ohms (centre scale 50) R X 1/10/100/1K/10K, db scale —20 to plus 10 plus 22/plus 35/plus 50 db. — \$29.90, P.P. 40.

US-106 As above but 50,000/OPV. — \$34.00, P.P. 40.

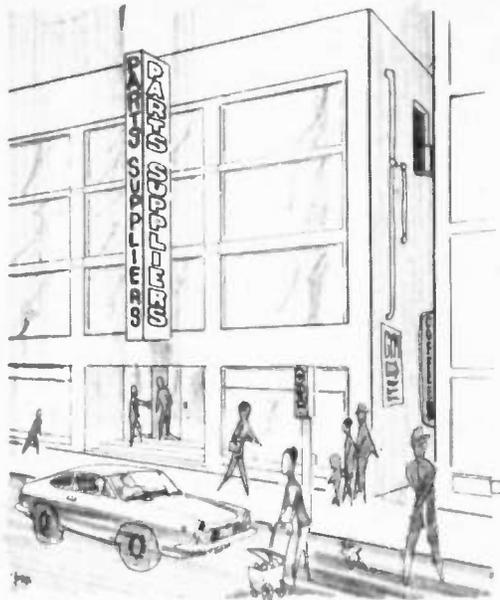
**MODEL AS100/DP HIGH SENSITIVITY**, 100,000/ohms/volt DC. Mirror Scale. PROTECTED MOVEMENT. SPECIFICATIONS: 6/20/120/300/600/1200 Volts A.C. (10K/OPV) Volts D.C.: 3/12/60/120/300/600/1200 (100K/OPV). D.C. Amps: 12uA/6mA/60mA/300mA/12 Amps. RESISTANCE: 2K/200K/20Mg/200Meg. Decibels: —20 to plus 63 db. AUDIO OUTPUT: 6 Volts/30/120/300/600/1200V A.C. Size: 7 1/2 in x 5 1/2 in x 2 1/4 in. — \$34.50, P.P. 40.



**1 WATT TRANSCEIVER, 13 TRANSISTOR, 3 CHANNEL** and Call System. Specifications: Circuit: 13 Transistors, 1 Diode, 1 Thermistor. Range: Up to 10 miles (depending on terrain, etc.). Frequency: 27.240 MHz (PMG approved) Freq. Stability: Plus or minus 0.005%. Transmitter: Crystal controlled, 1 watt. Receiver: Superhetrodyne, Crystal controlled. Antenna: 13 Section Telescopic. Power Source: 8 UM3 1.5 volt pen batts. Size 8 1/4 in. x 3 1/4 in. x 1 1/4 in. Weight: 25 ozs. Other features: Leather carrying case, battery level meter, squelch control, earphone jack, A.C. adaptor jack, etc. Price — Single units \$37.50. Be early!

# electronics TODAY

## APPROVED KIT AND PARTS SUPPLIERS



THE COMPANIES LISTED ON THIS PAGE STOCK KITS AND/OR PARTS FOR "ELECTRONICS TODAY" PROJECTS. THEY DO THEIR BEST TO HAVE ALL PARTS AVAILABLE AS SOON AS POSSIBLE AFTER PUBLICATION.

HOWEVER IT MUST BE APPRECIATED THAT DUE TO THE VAGARIES IN SUPPLY AND DEMAND THERE MAY BE OCCASIONS WHEN A PARTICULAR PART OR KIT CANNOT BE SUPPLIED DIRECTLY FROM STOCK.

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**EDGE ELECTRIX:** 25a Burwood Road, Burwood, 2134. Telephone 747-2931.

**INSTROL:** 91a York Street, Sydney 2000. Telephone 29-4285.

**KITSETS AUSTRALIA:** Suite 2, 21 Oaks Avenue, Dee Why, 2099. Telephone 982-5571.

**NATIONAL RADIO SUPPLIES:** 332 Parramatta Road, Stanmore, 2048. Telephone 56-7398.

**PRE-PAK ELECTRONICS:** 718 Parramatta Road, Croydon, 2132. Telephone 797-6144.

**RADIO DESPATCH SERVICE:** 869 George Street, Sydney, 2000. Telephone 211-0191.

### VICTORIA

**E.D. & E:** 232 Flinders Lane, Melbourne, 3000. Telephone 63-3596.

**J.H. MAGRATH & CO:** 208 Little Lonsdale Street, Melbourne, 3000. Telephone 663-3731.

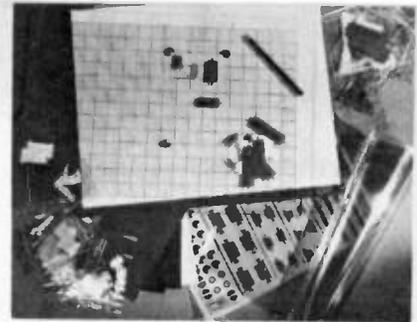
**S.T.A. ELECTRONICS:** 392 Centre Road, Bentleigh, 3204. Telephone 97-4832.

### QUEENSLAND

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### SOUTH AUSTRALIA

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## New Printed Circuit Layout Method

**A** NEW method of preparing printed circuit board layouts is being introduced into Australia. Called the DRL Masterplan, it is claimed to simplify the initial design stages of printed circuit board production very considerably.

The new system involves the selection of a number of cut-out silhouette shapes of the discrete components specified on the theoretical diagram and arranging them into position to form a convenient layout on one side of a transparent acrylic sheet. This sheet is accurately printed with a grid matrix on both sides and represents the circuit board itself to a scale of two to one. The sils cling firmly to the sheet merely by finger pressure but can be removed and repositioned at will. By turning the sheet over, the component side is visible through the sheet, reversed left to right, and the circuit side can be sketched with a wax pencil — an operation requiring little or no precision.

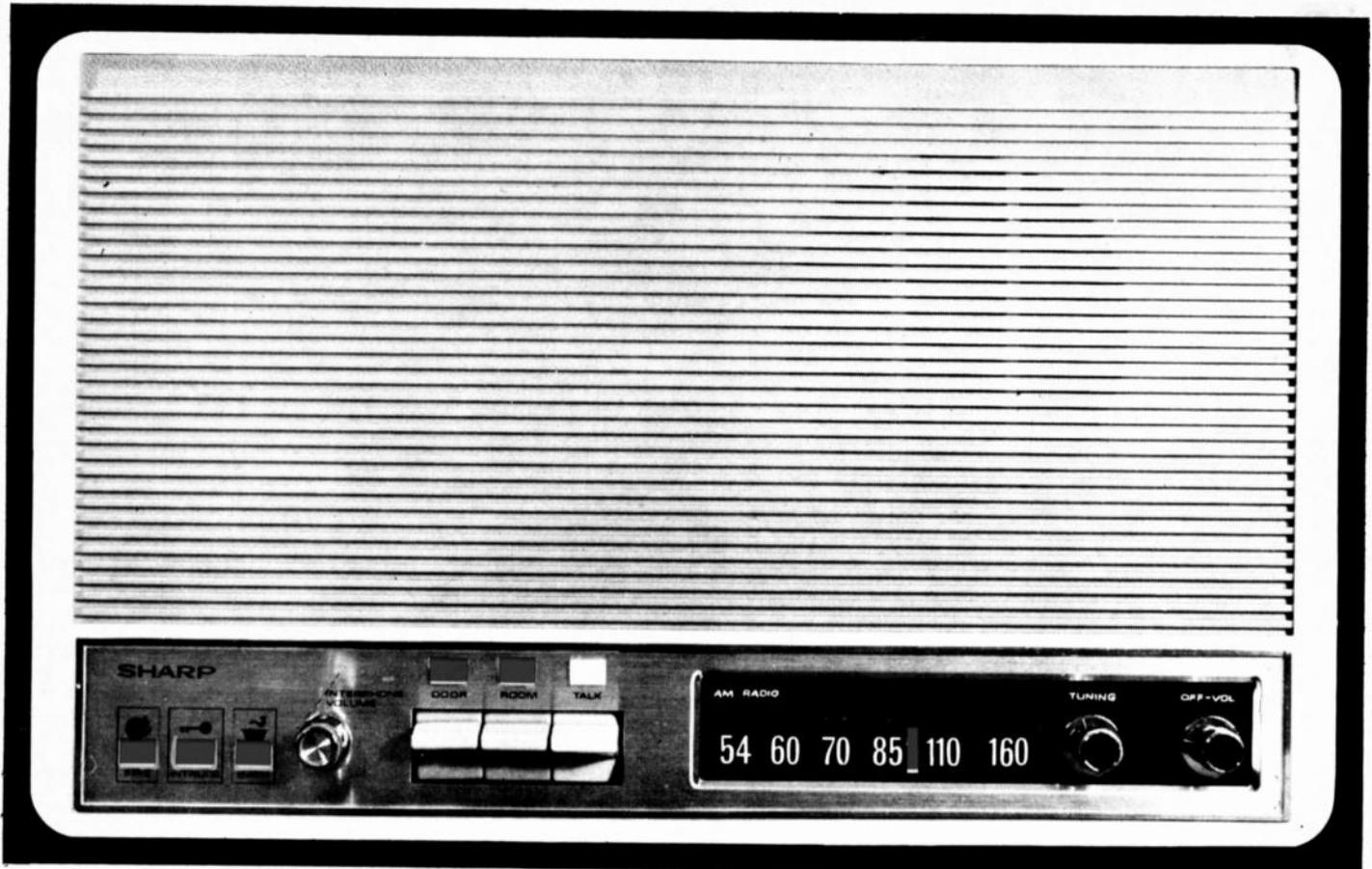
Alterations to both sides will be necessary before the design is finalized but these alterations can be made easily and quickly. A sheet of dimensionally stable film is now taped to the circuit side and, following the wax pencil sketching underneath, the circuit is prepared in its final form with orthodox crepe tape and self-adhesive patches.

These simple concepts result in an accurate master, twice full size and ready for the camera. A special dry-transfer sheet provides connection patterns for integrated circuit packs. Masters for screen printing components references, double sided boards and masks for auto-mated soldering techniques can be produced with equal facility.

The DRL Masterplan system is manufactured under licence in Australia by Standard Industries Pty. Limited, 28 Ridge Street, North Sydney, who have appointed Messrs Warburton Franki Industries their agents.

# SHARP

# HOMEKEEPER



**FIRE ALARM**  
FK-100J



**BURGLAR ALARM**  
1K-100J



**POOL ALARM**  
BK-100J



**DOOR PHONE**  
FPM-101R



**INTERCOM**  
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BURGLAR - FIRE - POOL - BATH  
ALARMS**

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AVAILABLE AS A KIT HKK-107R**



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Is it permissible to manufacture for public sale any items that you print as projects in ELECTRONICS TODAY? Would I be contravening any copyright or patent laws?

R.J.S. Kensington Pk., S.A.

- Everything printed in ELECTRONICS TODAY is, of course, subject to copyright and permission must be obtained from the Editor before reproduction.

Such permission is normally granted provided ELECTRONICS TODAY is credited in the reproduced article. Much the same applies to constructional projects, except that whilst we generally do not take out patent rights on any of our projects we cannot guarantee that none has been taken out elsewhere.

Any company wishing to manufacture equipment based on ELECTRONICS TODAY projects should first discuss the matter with our Engineering Manager — and then with a patent attorney.

## CONGRATULATIONS

I would like to congratulate you and your staff on the excellent article 'Hi-Fi — a Buyer's guide' published in your previous issue. There was more common sense advice and useful technical information packed into the article's six pages than I have found in most full length books.

T.S. Adelaide, S.A.

- Thank you, but see below!

## ANGRY DEALER

I protest most strongly about the obvious prejudice and sheer misinformation contained in your so-called 'Hi-Fi — buyer's guide', in your last issue.

You have quite obviously not researched your subject — your statement that it is impossible to buy acceptable hi-fi for less than \$150 is untrue — you know perfectly well that my company sells an excellent stereo system for under \$100. Nobody in their right mind would pay over \$250

for a complete hi-fi system. Articles like yours are stupid and damage the industry. Of course you won't print this letter.

F.S. Sydney, NSW.

- Who won't? Our correspondent has generated more indignation than he can contain. He has failed even to read the article. We did not state that 'it is impossible to buy acceptable hi-fi for less than \$150', anywhere in the article. Maybe we should have done — because you can't — our correspondent's equipment notwithstanding.

What our correspondent means by 'prejudice', 'sheer misinformation' and 'lack of research' is that we did not call and see him when preparing the article. We did not do so because the product referred to is a cheap imported record player with not the slightest justification to the claim of 'hi-fi' performance.

We leave the claim that our article has 'damaged the industry' for the industry and our readers to decide.

## EIGENTONES

I have heard that for good sound reproduction the dimensions of a listening room are quite critical — and that furthermore the length of a room will determine the lowest frequency that can be reproduced.

G.L. Durban  
South Africa

- This is right. It is necessary to avoid rooms whose dimensions are equal, or simple multiples of each other, or have a common denominator. In such cases, so-called eigentones superimpose upon one another and leave gaps in parts of the frequency range.

The lowest frequency that can be reproduced in a room is a function of the longest dimension of that room. The proof requires detailed mathematical analysis. In simplified form the formula becomes

$$f_{\min} = \frac{340}{a}$$

where  $f_{\min}$  is the lowest reproducible frequency, and  $a$  is the longest room dimension in ft.

## CLEANING TAPE

I would like to comment on I.C.L.'s letter (ELECTRONICS TODAY — December 1971) concerning his suggestion that tape cassette manufacturers use cleaning tape as a leader.

There are a few problems in this. The most important of these is that many cassette players continue to run when the end of the cassette tape is reached. The capstan then continues to turn and can wear through the leader unless this has some special properties that cleaning tapes does not have

Other disadvantages relate to tape lay-up, available space (cleaning tape is quite thick), and also strength.

R. D. Beecroft, NSW.

## TIME SHARING?

I refer to your advt. on page 7 of the December issue. As a service to your readers you might consider storing data on such young ladies in a computer and then charge fees to those making enquiry of it. In return for this brilliant idea would you let me have the name, 'phone number, interests, vital statistics, etc., of the lady in question.

M.R.G., Toorak, Vic.

- What can M.R.G. mean by 'etc' — ?

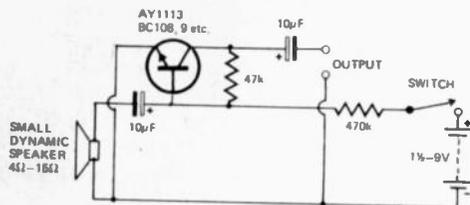
## READERS' LETTERS

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.

# TECH-TIPS

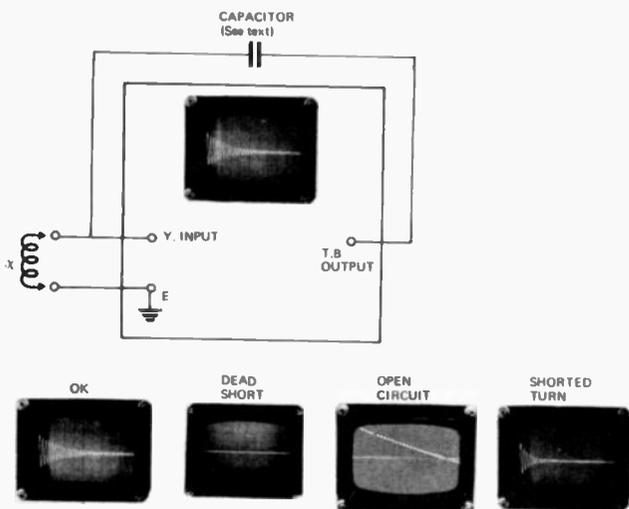
## A LOUDSPEAKER MICROPHONE



A small loudspeaker may be used as a very effective microphone for intercom's, if it is coupled to an amplifier via the circuit shown here.

Output is sufficient to drive practically any transistor (or valve) audio amplifier.

## TRANSFORMER-INDUCTOR TESTER



Transformers and inductors can be checked for open circuits, short circuits, shorted turns, etc., by this very simple method.

The inductance to be checked is connected across the Y-input terminals of a CRO and the time-base output coupled to the Y-input via a small capacitor. The retrace edge of the timebase ramp will set the inductance ringing, and a decaying oscillation will result.

Various conditions are shown in the accompanying illustrations — these have been photographed directly from an oscilloscope. From left to right, the photographs show — no fault — a dead short — an open circuit — a shorted turn.

The capacitor should be between 100pF and 1000pF for inductances down to 2 mH. It should be decreased for inductances lower than 2 mH. Meaningful results can be obtained for inductances as low as 50 µH. Timebase speed should be increased as inductance is decreased.

# CAREER OPPORTUNITIES

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## RADIO ENGINEER

A vacancy exists for a fully licenced engineer capable of operating a well equipped IFR workshop. Must be experienced in installation and bench work on Communication and Navigational equipment. Commencing salary \$5720. Particulars of experience and licences to:

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P.O. BOX 36, ARCHERFIELD, QLD.

## COMPUTER OPERATOR

APPLICATIONS ARE INVITED FROM EXPERIENCED Computer Operators to fill a vacancy with an International Company whose base is located in the city.

Applicants should have had practical experience in the operation of N.C.R. 315 or IBM 360/30.

The successful applicants should be prepared to do shift work if necessary.

Good working conditions with superannuation benefits are available and the salary will be commensurate with ability. For interview please Phone:

Personnel Manager,  
UNILEVER AUSTRALIA PTY. LTD.,  
20-551 ext. 246.

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An interesting position is available with W. H. Paling Pty. Ltd. to service electronic organs. Basic practical experience in electronics, radio or similar sphere essential, knowledge of electronic organs an advantage.

Own vehicle necessary. This is an excellent opportunity for the right man in a fast developing field.

Write or phone for appointment to:

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W. H. PALING PTY. LTD.,  
338 George Street, SYDNEY.  
Ph. 25-2331.

For more information on the Careers Opportunity Columns of Electronics Today (Advertising rate 76c per line) contact:—Sydney, Howard Jenkins or Terry Marsden, 26 2296; Melbourne, Clarrie Levy, 51 9776.

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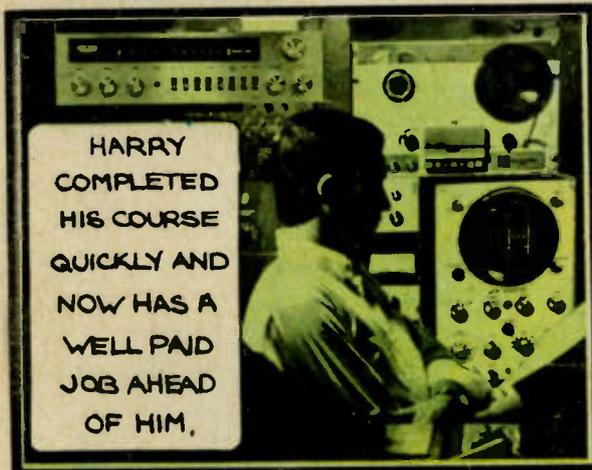
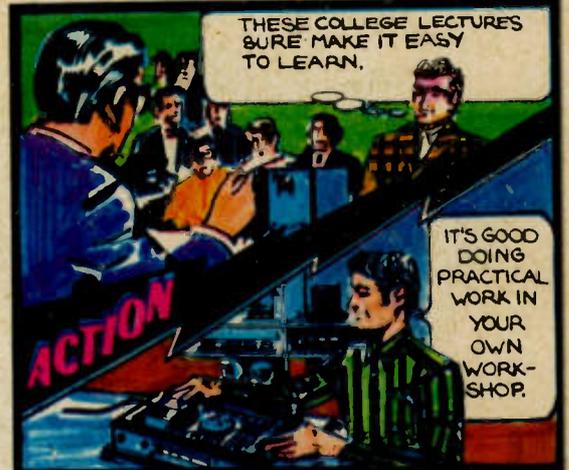
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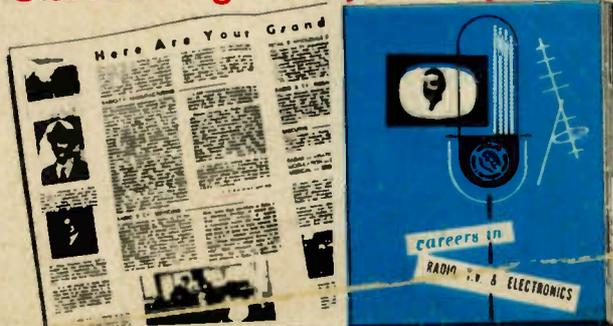
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