

AUSTRALIA'S DYNAMIC MONTHLY

DECEMBER 1971 50c

# electronics TODAY

SPECIAL  
**HI-FI**  
ISSUE

50-DAY  
SOLID  
STATE  
TIMER

HI-FI  
BUYER'S  
GUIDE

ALL  
ABOUT  
ZENES

5/FI  
5/STS

ELRONIC  
PKILLER



# The cassette-corder to top your neighbour's party



## SPECIFICATIONS

Recording system:	2-track monaural recording and playback
Power requirements:	AC 100, 110, 117, 125, 220 or 240V (selectable with a voltage selector), 50/60Hz AC 117V, 60Hz (CSA standard)
Power consumption:	20 watts 30 VA (CSA standard)
Tape:	SONY Compact Cassette C-30, C-60, C-90, C-120 or equivalents
Tape speed:	1½ ips (4.8cm/s)
Power output:	5W by using an external 8-ohm speaker 5W through the built-in speaker
Frequency response:	50 - 12,000 Hz
Bias frequency:	85k Hz
Wow and flutter:	less than 0.2%
Signal-to-noise ratio:	46 dB
Maximum recording time:	120 minutes (with C-120)
Speaker:	4×6" (10×15cm)
Semi-conductors:	10 transistors, 4 diodes
Input jacks:	Microphone jack, 600 ohms, -72dB (0.2mV) Auxiliary input jack, 100k ohms, -22dB (0.06V)
Output jacks:	External speaker, 8-ohms Monitor out, 8-ohm earphone
Dimensions:	12½"(W)×4½"(H)×11½"(D) (328×119×296.5mm)
Weight:	11 lb 1 oz (5.0kg)
Accessories:	Microphone F-25.....1 Connecting cord RK-69.....1 Demonstration tape CD-151.....1 Earphone ME-20.....1 Head cleaning tips.....1 set Dust cover.....1 Plug adaptor PC-1.....2
Optional accessories:	Telephone pick up TP-5S (TP-4S for Canada) Microphone mixer MX-600M Microphone F-25 SONY Compact Cassette C-30, C-60, C-90, C-120

Meet the cassette-corder with man-sized muscle! SONY compact TC-180 has enough full-throated power (5 w) to effectively defend yourself from any neighbourly. That extra power means superior sound reproduction. And you can even use the TC-180 as a public address TC-180 features SONY-O-MATIC automatic (or manual) recording control. Two microphone jacks for mixing sounds at once. Easy loading. Tape and alarm. Fast forward and rewind. Retractable handle. About \$221.00.

# SONY

## JACOBY KEMPTHORNE

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# electronics TODAY

DECEMBER

Vol. 1 No. 9

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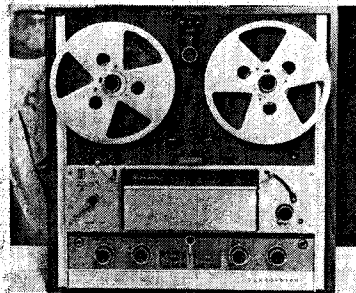
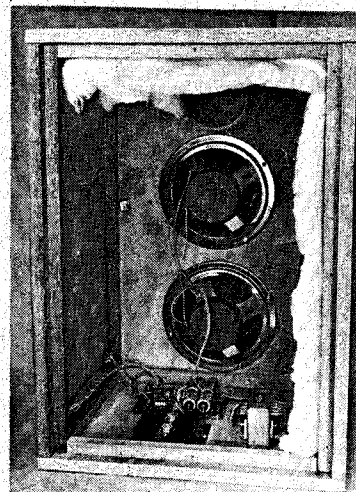
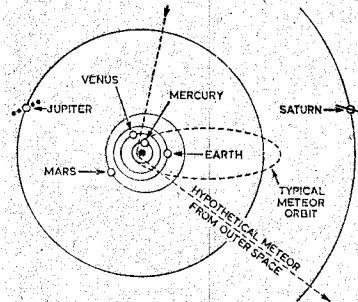
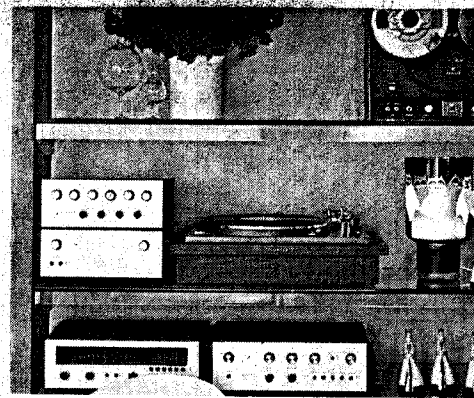
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COVER: Three members of Sydney pop group — King Fox — provide a  
background for Sansui's latest 210A tuner/amplifier. (Full test of the 210A —  
page 28 of this issue).

# GREAT NEW PRODUCTS!

## DYNASONIC DELUXE AUTO ALARM SYSTEM

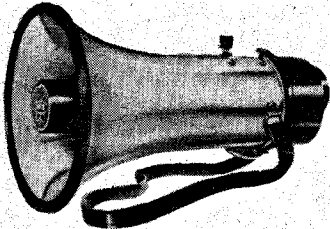


Size 6 1/4" x 4 1/4" x 1 1/2"

Stop thieves! Burglar-proof your car & valuables with the Fedtro Dynasonic. Gives complete protection . . . horn sounds either continuously or intermittently (depending on which way alarm is set) when any of the doors are opened, bonnet or boot is raised. Just turn the pick-proof lock switch to set alarm or silence alarm - can be conveniently mounted on outside of car. Windscreen and rear window stickers are furnished stating your car is protected. Normally \$39.95.

SALE \$29.95

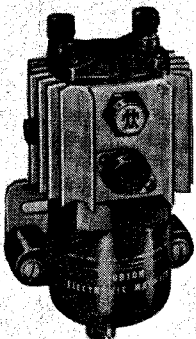
## POWERHOUSE TRANSISTORIZED MEGAPHONE



By Fedtro, the world's leading supplier of transistorized megaphones. OFFICIAL megaphone of the New York World's Fair and the 1968 Olympic Games at Mexico. Waterproof, shockproof, rustproof. Features all aluminium construction, superior clarity and tonal quality, durable carrying strap, instant battery loading, noise-cancelling microphone, fingertip volume control, power packed amplification. Operates on 4 flashlight "D" batteries. 7 1/4" diameter, 12 1/4" length. Weight 2.7 lbs. Power range up to 1,200 feet. Ask for free literature.

## JUDSON ELECTRONIC MAGNETO . . .

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Don't settle for a hit and miss ignition system - feel the snap and surge of real performance that comes from positive ignition! Install a Judson Electronic Magneto. It offers the combined advantages of both the standard transistorized and capacitive discharge systems in one simplified patented circuit. Puts an end to ignition problems - provides positive ignition under any conditions.

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the better the spark. Increases patrol mileage usually from 2-6 miles per gallon. Improves engine performance throughout entire range from starting to top speed. Easy to install - as simple as replacing a coil - no complicated wiring. Made by the Judson Research and Mfg. Co., Conshohocken, Pennsylvania, U.S.A. Over 100,000 users around the world. Literature available.

SALE \$59.50      NORMALLY \$69.50

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# DRAFT STANDARD FOR SOUND SYSTEM EQUIPMENT

## GE QUIT IC MARKET

The USA's General Electric Co. has just announced that it is ceasing manufacture - as from now - of integrated circuits.

Thus GE join the growing ranks of US companies who have written off their microcircuit operations - GTE Sylvania, Philco-Ford and United Aircraft have dropped out of the IC business this year.

General Electric entered the IC market in 1968 believing that it could use its expertise in other manufacturing fields to catch up with its competitors.

The Company put most of its efforts into developing linear integrated circuits probably hoping to avoid the fierce competition in the digital IC market.

But price cutting in the linear IC field has become almost as fierce as in the digital market and accepting a \$50 million loss GE decided to quit.

It is believed that the company attained less than 1% of the possible market - thus their yearly IC sales were under \$5 million.

## DRAFT STANDARD FOR SOUND SYSTEM EQUIPMENT

The Standards Association is seeking comment on a draft Australian Standard for general terms for sound system equipment, issued as Doc. 1835.

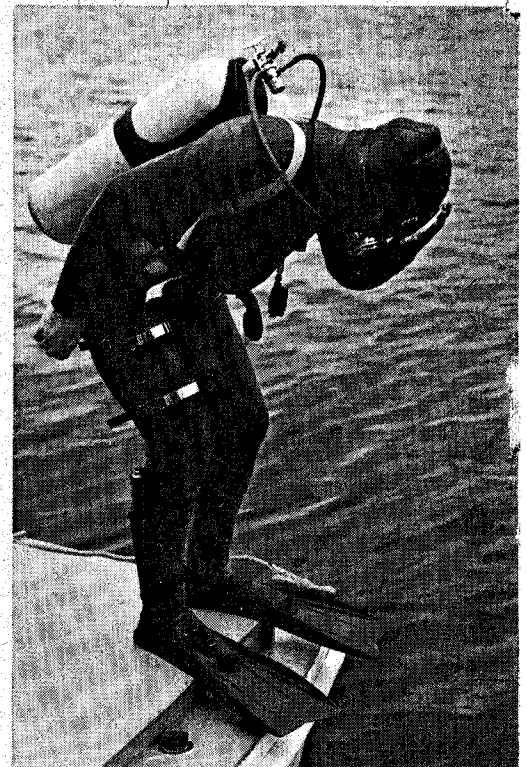
Forming one part of a comprehensive standard, this draft defines the characteristics of the audio-equipment covered by further parts of the Standard. By defining the characteristics in this way, it is intended to facilitate the determination of the quality of audio-equipment, the comparison of the various types and the determination of their practical application.

The draft closely follows the international (IEC) recommendation.

Copies of Doc. 1835 may be obtained without charge, from the various offices of the Standards Association of Australia in all capital cities and Newcastle.

Comment on the provisions of the draft is invited from persons or organizations experienced in the manufacturing, use and testing of sound system equipment, and should reach head office of the Association, 80 Arthur Street, North Sydney, NSW, 2060, or any branch office, not later than 31 January 1972.

## TALKING UNDER WATER



A British electronics company has produced a submersible communications equipment intended for diver-to-diver and diver-to-ship operation.

The equipment has a range of 540 metres and a maximum operating depth of 90 metres.

The system uses ultrasonics as the transmission media, and the receiver - normally strapped to the diver's thigh - uses bone conduction for transmission of the received signal to the normal sensory mechanism of the brain.

# looks good...sounds better... new Plessey C80X

Here's an outstanding new wide-range high performance loud-speaker you can't afford to miss. It has superb good looks and sounds even better. In the recommended enclosure you'll have exceptional response

54 Hz to 20 kHz  $\pm$  6 dB and remarkable 20 watts RMS power handling. This is a truly exciting yet economical hi-fi speaker... be sure to see it and hear it. Available at Plessey Rola distributors and leading hi-fi centres.

## Features

Large 'O' magnet gives 20 watts RMS power handling in recommended enclosures and lower 'Q' for cleaner bass. Long throw voice coil allows extreme excursions with minimum distortion. Infinite baffle response is 35 Hz to 20 kHz.

In the recommended 1.8 cu. ft. enclosure it is 54 Hz to 20 kHz  $\pm$  6 dB and 41 Hz to 20 kHz at  $\pm$  10 dB. The high frequency response is a particularly outstanding feature in such a rugged speaker capable of 20 watts RMS power handling.

## Specifications

Power handling capacity	20 watts RMS in recommended enclosure
Fundamental resonance	45 Hz nominal
Voice coil diameter	1"
Voice coil impedance	8 or 15 ohms
Frequency response	35 Hz to 20 kHz $\pm$ 6 dB
Air gap flux density	1.15 tesla
Total gap flux	455 $\mu$ weber

\* A woofer version, C80, is also available. Frequency response is 35 Hz to 8 kHz  $\pm$  6 dB.



**PLESSEY**  
**Rola**



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S.A.: General Accessories, Gerard & Goodman Pty. Ltd. W.A.: Atkins Carlyle Ltd., General Accessories. Tas.: W. & G. Genders Pty. Ltd., Homecrafts Tasmania

# Already discerning enthusiasts have set two recently released And it's not

Both Sansui products . . . the Model 210A stereo tuner/amplifier and the Model AU-101 stereo control amplifier . . . offer extraordinary value for money. In terms of sheer performance no other similarly priced amplifier available in Australia today can match or surpass the 210A or the AU-101, including some products twice the Sansui price.

#### SANSUI MODEL AU-101 STEREO AMPLIFIER

Two leading Australian electronics magazines have reviewed the all low-noise silicon transistor Sansui Model AU-101. *"Electronics Australia"* (August, 1971) says . . . *"the best comment we can make about the AU-101 is that few amplifiers, regardless of price, give an overall test result as good as this. This makes it a real bargain at the very reasonable price of \$138"*. *"Electronics Today"* (May, 1971) says . . . *"Surprise Packet" . . . "Performance of the Sansui AU-101 belies its low price" . . . "The hum and noise performance are both very good and better than most other amplifiers at twice the price" . . . "The Sansui AU-101 is a very good buy, particularly at the price"*.

There you are . . . unbiased comments from two leading publications. What precisely does the Sansui AU-101 offer? Look at these specifications!

**AU-101 Specifications:**— ● Music power: 50 watts at 4 ohms, 44 watts at 8 ohms. ● R.M.S. power: 36 watts at 4 ohms, 30 watts at 8 ohms. ● Total harmonic distortion: Less than 0.8% at rated output. ● Frequency response: 20-60,000 Hz.  $\pm 2$  dB. ● Channel separation: Better than 45 dB. ● Input sensitivity: 3 mV. (Magnetic cartridge), 4 mV. (Microphone), 200 mV. (Auxiliary and Tape Recorder). ● Dimensions: 16" x 11" x 4 1/2". ● Price: \$138\* (Suggested list price inc. sales tax).

#### SANSUI MODEL 210A STEREO TUNER/AMPLIFIER

The recommended list price of the Model 210A stereo tuner/amplifier is only \$185\*. Power output is 34 watts music power into 4 ohm speaker systems or 22 watts R.M.S. Frequency response is 25-30,000 Hz.  $\pm 2$  dB. and extends well beyond this figure. Sensitivity of the power amplifier suits magnetic cartridges at 3 mV. and 180 mV. sensitivity caters for auxiliary inputs and tape recorders.

An easily read panoramic tuning dial simplifies selection of radio stations on AM/MW or AM/SW bands; a signal strength meter operates on the AM band. Selectivity is an almost unbelievable 40 dB. making the 210A the *most selective receiver Sansui has ever made*. This radically improved selectivity is directly attributable to Sansui's use of two ceramic filters each with two filter elements in the 210A's I.F. amplifier section. A whistle filter eliminates unpleasant interference and noise on weak AM stations. Every desirable control is provided in the Sansui 210A . . . a DIN socket for tape recorders, headphone jack, flexible bass and treble controls, a direct tape monitor switch, loudness control and clearly marked selector switch.

When you call at your franchised Simon Gray dealer to hear the Sansui 210A, *listen critically*. You'll be agreeably surprised with the audible difference Sansui quality makes. Only Sansui — Japan's leading audio only manufacturer — could design and manufacture an outstanding stereo tuner/amplifier expressly for Australian conditions and keep the price down to only \$185\*! Call and see your Simon Gray dealer!

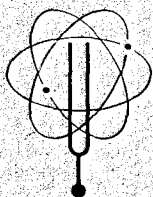
**\*IMPORTANT:** Prices quoted in this advertisement are suggested consumer prices only.



Sansui

*Simon Gray Pty. Ltd.*

**Sansui Distributors:** Australia, excluding W.A.: Simon Gray Pty. Ltd. Head Office: 28 Elizabeth Street, Melbourne. 3000. Tel. 63 8101\*. Telex: 31904. Sydney Office: 53 Victoria Avenue, Chatswood. N.S.W. 2067. Tel. 40 4522\*. Canberra Office: 25 Molonglo Mail, Fyshwick, A.C.T. 2609. Tel. 95 6526. Adelaide Office: 301 South Terrace, Adelaide, S.A. 5000. Tel. 23 6219. N.T.: Pfitzner's Music House, Smith Street, Darwin. 5790. Tel. 3801. Qld.: Sydney G. Hughes, 154-158 Arthur Street, New Farm, Brisbane. 4005. Tel. 58 1422. Tas.: K. W. McCulloch Pty. Ltd., 57 George Street, Launceston. 7250. Tel. 2 5322. W.A. Distributors: Carlyle & Co. Pty. Ltd., 1-9 Milligan Street, Perth. 6000. Tel. 22 0191. Sansui equipment is manufactured by: Sansui Electric Co. Ltd., 14-1, 2-chome, Izumi, Suginami-ku, Tokyo, Japan.



# Australian stereo new sales records for **SANSUI AMPLIFIERS.** surprising.



**Ask for full details.  
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the facts!**

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## SCOPE SOLDERING IRONS

Buy a SCOPE and join the club of satisfied USERS—you need not keep it a secret, others don't. That's why SCOPE IS KNOWN AT ALL THE BEST PLACES—in the tool kit, on the bench, in the boot, on the kitchen table, in the garage, on the service truck, in the engine room, even on the roof. . . . Wherever SCOPE goes it gives you the best service—and a host of satisfied users will agree it is the QUICKEST, the EASIEST, the SAFEST . . . THE BEST OF ALL SOLDERING IRONS.

### ECONOMY

Consumes current only whilst in use. Scope performs all the functions of other irons from 40 to 150 Watts. MINISCOPE—Up to 75 Watts.

### LABOUR SAVING

Fast warm-up—always ready, cuts wiping, retinning and filing of tips to a MINIMUM.

### VERSATILITY

Copes with all soldering jobs—from miniature components to large solder lugs. Can even be operated from a 6 volt car battery.

### CONTROL

Temperature control at your finger tips. Heat only when, where and as much as needed.

### CONVENIENCE

Ideal for those almost inaccessible spots. No burning of adjacent insulation.

### SAFETY

Low voltage operation.

### LESS MAINTENANCE

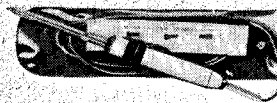
Longer tip life. NO expensive heating elements to replace. Maintenance without special tools. Spare tips and elements readily available from your Scope Distributor.

### SPEED

ONLY 5 to 6 seconds' initial heating up time from cold, then practically instantaneous.

### MINI WEIGHT

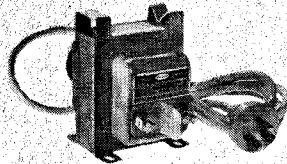
Scope De Luxe weighs only 3½ ozs. complete. Miniscope 1¾.



All irons are supplied complete with a spare tip and two elements and suitably packed for presentation as a gift.

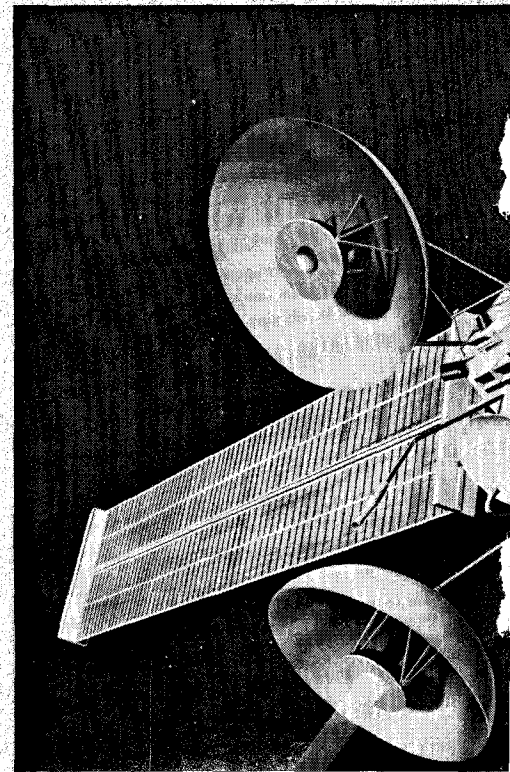
### POWER SOURCE

Scope Irons will operate from 2.5V to 6V. For convenience, Safety and complete satisfaction use only the \*Approved Scope Transformer—look for the name Scope.



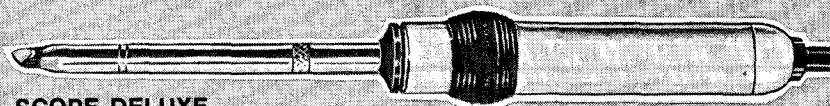
\*Approved by electricity authorities APP. No. N/360/6894—5

Fully guaranteed when used with the approved "Scope" Transformer—Scope Products are available from all major Electrical Wholesalers and Hardware Stores.

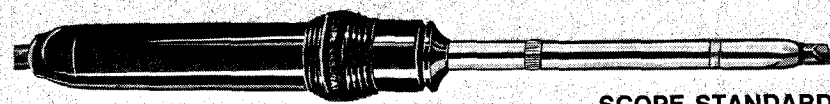


## SPACE LASER

How a satellite in space could communicate by laser with other orbiting satellites is illustrated in this concept by Lockheed Missiles & Space Co., Sunnyvale, Calif. Laser beams are directed from the dish-like arrays. The other dish arrays are for various modes of communication, including microwave radio. Lasers can handle



SCOPE DELUXE



SCOPE STANDARD



MINISCOPE

## SCOPE

## MEANS A CHRISTMAS GIFT

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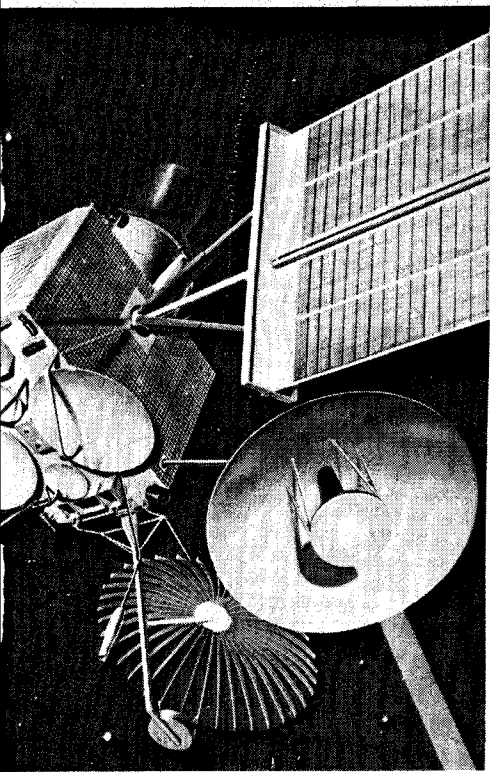
## LASER TESTS POLLUTION

Taking advantage of the fact that polluting materials in the air absorb laser energy, it is now possible to measure pollution as small as 10 parts per 1,000m.

The method gives an immediate reading of the amount of all the common pollutants except sulphur dioxide. It is equally effective on carbon monoxide and hydrocarbons from petrol engines, and the nitric oxides and dioxides from industrial chimneys.

The laser, in the method developed by the Bell Laboratories, Holmdel, NJ, U.S., is tuned to a specific frequency by changing the magnetic field in which it works. Its beam is led through an opto-acoustic absorption





tremendous amounts of information over a single beam. A laser system developed by Lockheed can transmit 70 television channels at once. Or it can transmit digital data at 1 billion bit bits (1 gigabit) per second. When fully developed for space use, the Lockheed system should be able to meet the vastly increased communications needs for the next few years.

cell containing the air sample. The beam is tuned to the specific frequency of the pollutant for which the test is being made.

Any of this pollutant in the sample absorbs energy from the beam. This absorbed energy results in an increase in temperature and pressure in the absorption cell, and the increase is read by a transducer in the cell which generates an electrical signal. The increase and thus the strength of the signal are directly proportional to the amount of polluting material present.

A typical absorption frequency is that for nitric oxide, which takes in energy if the laser is radiating waves of five to six microns length. No other pollutant will absorb energy of this frequency.

# Sydneys' LEADING HI-FI Specialist Centre presents

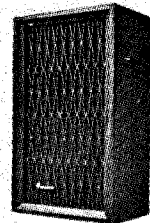
**\*SPECIAL SYSTEM\***  
at a Very Special Price

Treat yourself to a demonstration from the specialist staff.  
Open all day Saturday.



## KENWOOD – THE SOUND APPROACH TO QUALITY

\*KA 4002, 95 watt, complete with all facilities to match any system.



A & R (Japan)  
3 way speaker system  
giving unbelievable results  
out of compact enclosures.

Kenwood  
2002 Amp  
complete. Giving  
56 watts of power.

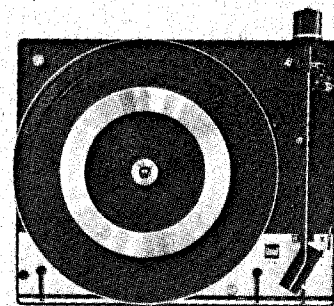


## Want a Stereo?

Then look at this unbelievable system. Better still, come in and listen to this unbelievable system from only

**\$299<sup>00</sup>**  
incl. tax.

System includes the latest Dual 1214 turntable, a perfect blend between manual single player and automatic. Turntable fitted with Shure M55E cartridge.



## AUTEL SYSTEMS Pty. Ltd.

20 Pittwater Rd., Gladesville, N.S.W. , 2111  
Telephone 89 0663

Treat yourself to a demonstration from the specialist staff. Open all day Saturday.

# EXPANSION IN '72

## BRISBANE AGENT.

Now established at 67 Sandgate Rd., ALBION, Brisbane, Qld. 4010  
**\* OPENING 17th JANUARY \***  
 The range of exclusive Pre-Pak products and specials will be available in this large walk — around warehouse. Mail orders welcomed. Our policy throughout Australia is: "We will undersell any other distributor on quality electronic components and equipment."

## SEASONS GREETINGS.

We extend to all our customers our very best wishes for Christmas and the New Year. We hope you will have many fun-filled hours of enjoyment during the coming holidays building your latest project. However, if you have forgotten that vital part, don't worry! We are open for normal trading hours excluding Public Holidays.

## NEW CATALOGUE

Available after 1st January only. This magnificently presented 1972 catalogue will be available for just \$1.00 which is refunded with your first order for \$10.00 or more. Containing more information and revised price lists, our latest catalogue will be your complete shopping guide to Electronics. Featuring special sections on Hi-Fi & disposals, there is something of interest everyone. Send for your copy NOW!

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 2 2N2646 UJT .. \$2.50  
 2 2N3054 Transistors \$3.00  
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 Complete kit with instructions and carrying case. Battery not included. Easy to assemble, attractive case. \$7.95

**PRE-FAB HIFI SPEAKER ENCLOSURES.** All timber pre-cut to exacting specifications, featuring a special "iron-on" veneer. Sarlon grille Innerbond included. See August issue Electronics Today for details. Special offer -  
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# PRE-PAK

electronics



## NAVIGATIONAL AID

A new radio direction finder that rolls its eyes instead of turning its head has been introduced by Raytheon Company.

The new navigation aid for pleasure boats and small commercial craft electronically seeks out the strongest signal on any frequency, locks on it, and then continuously points out the direction of the distant radio beacon, commercial radio broadcasting station or the transmitter aboard another vessel.

The new automatic radio direction-finder, called the "Navimatic", uses phase shifting techniques to point out the bearing of the distant signal. Ordinary radio direction finders must rotate their antennas in order to find the bearing on which the distant radio station lies. The new "Navimatic" ADF uses two 13-inch loops that remain fixed.

Three bands are covered by the automatic direction finder: the 190 to 420 kilohertz beacon band including marine and aviation beacons and consolan signals; the 500 to 1400 kilohertz broadcasting stations; and ship-to-ship and ship-to-shore channels found between 1400 and 3500 kilohertz.

In operation, the boatman tunes to the frequency of the stations selected and the switches on the automatic feature. A bearing arrow on a dummy compass continuously points out the relative bearing of the signal. For even quicker operation, five crystal-tuned channels can be used to automatically tune-in stations frequently homed on or used for navigation.

## WITHOUT COMMENT!

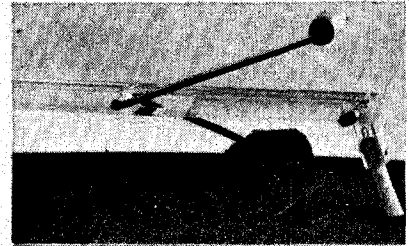
The USA's Radiotrician Confederation have asked the FCC to consider the creation of two new classes of licencing for amateur radio operators.

One would be a 'novices' licence requiring no formal examination.

The second class of licence would require a knowledge of Morse code (to twenty words a minute), a knowledge of the rules governing amateur radio operation, and a demonstrated ability to operate commercially-built radio equipment.

# WATTS to give for Xmas?

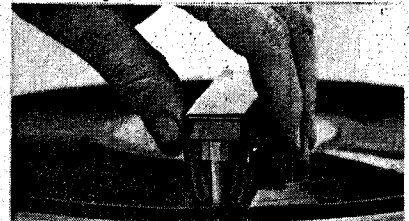
What do you give the hi-fi enthusiast for Xmas? This is always a problem . . . but, at last, a highly satisfactory solution has been found. *Watts record cleaning equipment.* Now you can give a present that offers immediate and lasting pleasure without involving excessive outlay!



The most popular Watts record cleaner is the remarkable "Dust-Bug" which automatically cleans the record as it plays. Static charges are removed simultaneously . . . the "Dust-Bug" costs only \$5.60.\*



New records are kept like new with the Watts "Disc Preener". All dust is collected from the record surface simply by holding the Preener as the record revolves. This effective unit costs only \$2.10.\*



Keeping new records as-new and restoring fidelity to older discs is a job for the Watts "Manual Parastat Mk. IIA". Where pick-up pressure is less than 1½ grams the "Manual Parastat" is essential, for even the most minute particle of dust or dirt will adversely affect performance. Price of the Watts "Manual Parastat" is \$13.80.\*

Watts record maintenance products are available at all franchised Simon Gray dealers.

\*Prices quoted are suggested consumer prices only.

56.WX3

## FOR THE VHF'er

Mobile whips complete ¼ wave \$7.50. 5/8 w. base loaded \$19.50. Roof bases \$3.50. Everest Deluxe whip only \$16.00. Suit ¼", 5/16" and 3/8" brass thread bases.

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Inoue Icom IC20 2m F.M. 12 channel 10W solid state Transceivers \$325.00.

Inoue Icom IC71 6m F.M. xtl and V.F.O. 10W Solid state Transceivers \$315.00.

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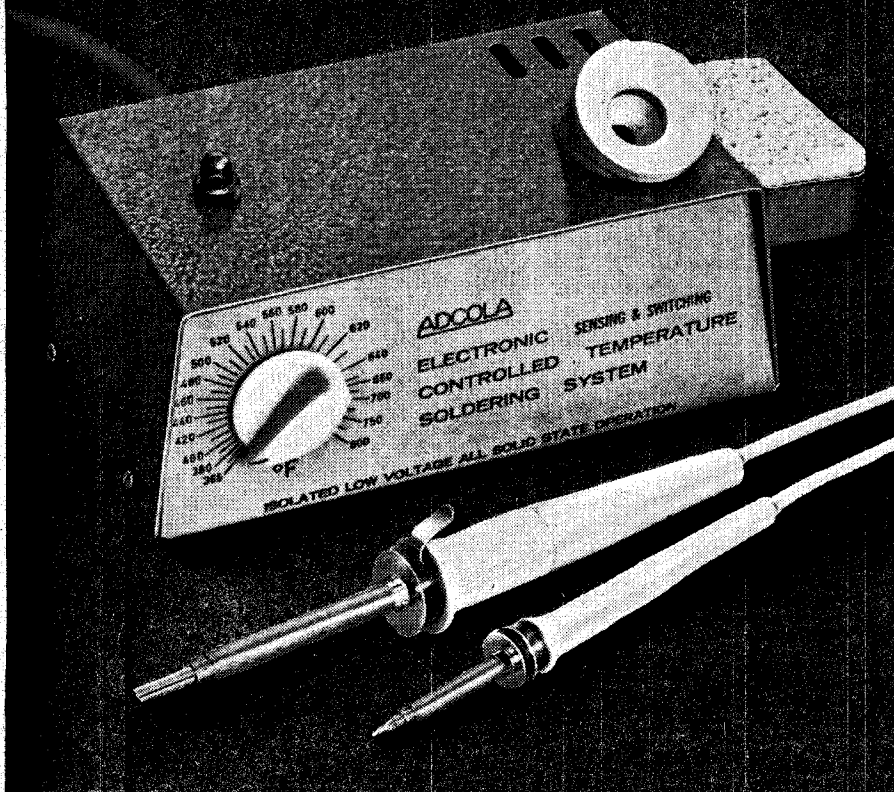
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TC3, weighing 1/3ths oz., has three times the power of equivalent size 12 watt M20.

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RAB

## news digest

### SATELLITE HOTLINE

The United States and the Soviet Union have agreed to establish a new satellite hotline to prevent nuclear accidents resulting in war.

The USA will use the Intelsat satellite for the hotline and Russia will use its Molnya II.

A satellite circuit will be established for each nation as well as multiple terminals to increase reliability of the link.

### THE PHILIPS GA 202 TURNTABLE

In our product test of this unit — published last month — the description of the drive mechanism was rather ambiguous.

The system uses an ac tachogenerator, driven directly from the commutator motor spindle to provide a direct indication of motor speed. This signal is compared against an electrical reference voltage (that is adjustable to allow for speed changes) and the resultant difference signal is used to correct any errors in speed.

Our measurements showed that an ac component existed across the motor hence our comments concerning high frequency vibration.

Philips have queried our figure of 0.5% wow and flutter. We understand that whilst our measurement was quoted as a peak-to-peak figure, the Philips specification refers to a peak reading only. This ambiguity highlights the urgent need for internationally recognised standards of measurement — for there are no less than three different ways of expressing this particular measurement. (Peak-to-peak, peak, rms).

The corrected figures are:—  
 Philips specification — 0.18% (peak)  
 Our measured results — 0.25% (peak)

Our measured results of 0.25% (peak) wow and flutter exceeds the Philips specification by 38%, nevertheless a figure of 0.25% is not excessive, and wow and flutter of this magnitude would be unnoticeable by the average user.

Our overall impressions of the turntable remain as stated in our review.

# who needs 40 watts r.m.s.?

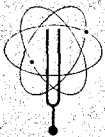
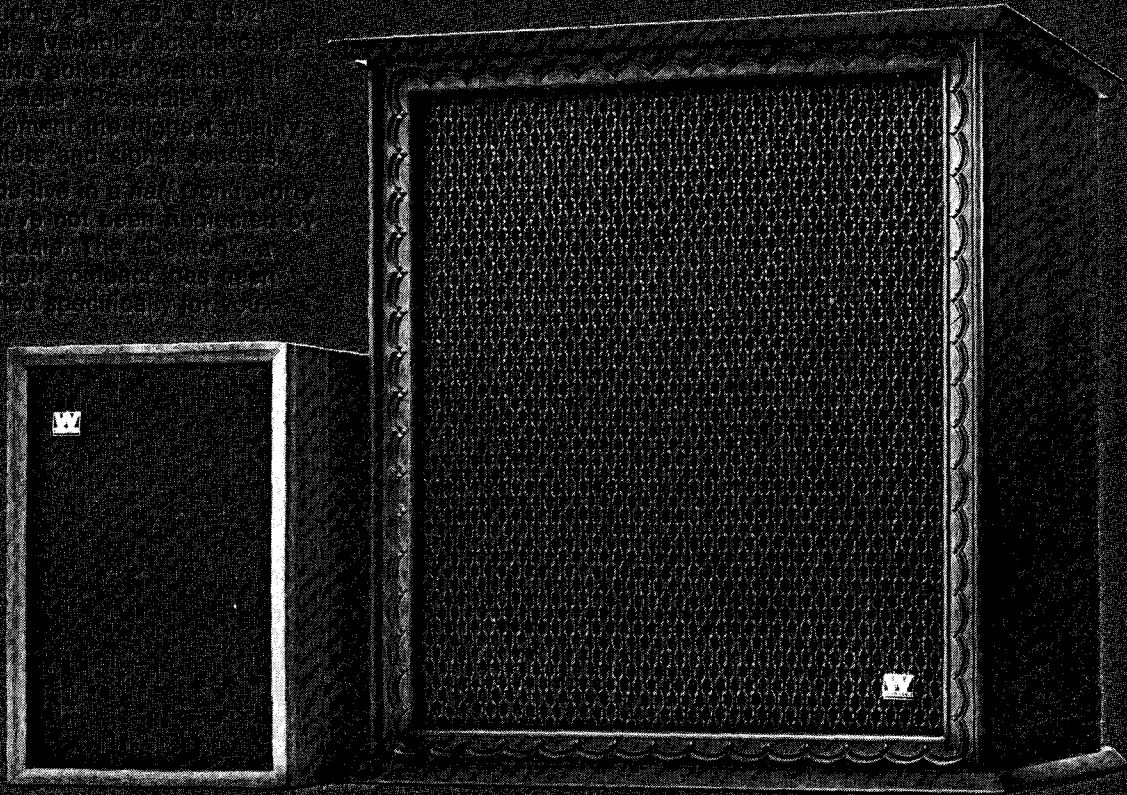
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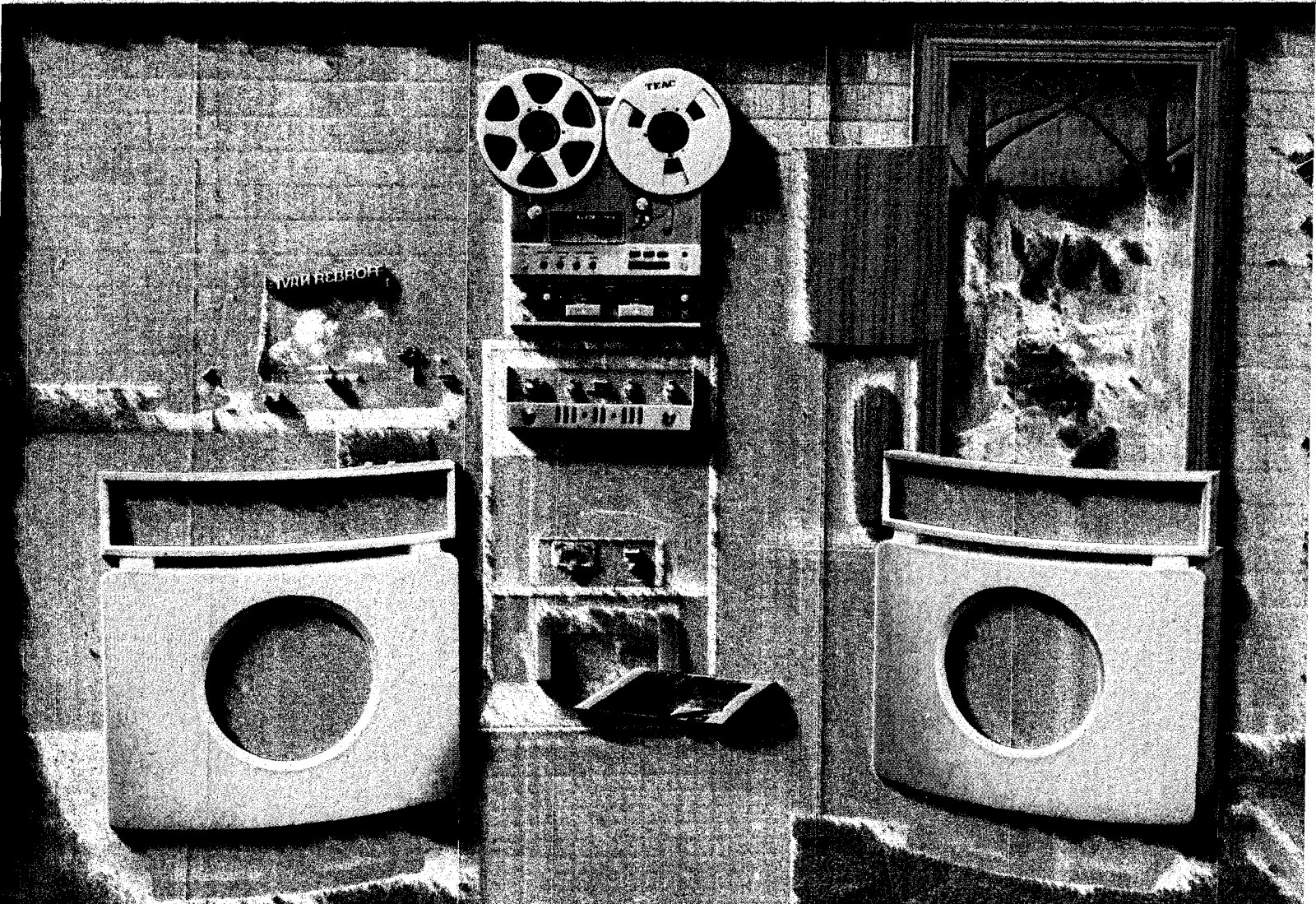
# HI-FI - a buyer's



FOR THE  
CONNOISSEUR

*Above — for sophisticated listening — Amplifier, AR; Turntable, AR; Speakers AR 3a; Headphones, Sharpe-Scintrex HA 10 Mk. II. — Price? — about \$1850.*

*Below — a system for the penthouse — Amplifier, McIntosh MA 5100 (100 watts rms); Turntable, ERA Mk. III with Stanton cartridge; Tape deck, TEAC A3300; Tuner, Wright; Main speakers, Bowers and Wilkins Model 70; Second room speakers, JBL L100; Headphones, Sharpe Model 60, Mk. II. — Price? — about \$3000.*



# guide

*"In the series of things those which follow are always aptly fitted to those which have gone before; for this series is not like a mere enumeration of disjointed things, which has only a necessary sequence, but it is a rational connection: and as all things are arranged together harmoniously, so the things which come into existence exhibit no mere succession, but a certain wonderful relationship." — Marcus Aurelius (A.D. 121-180).*

by Collyn Rivers

**L**IKE wine, hi-fi was for a time regarded as an esoteric pleasure, requiring specialised appreciation and specialised knowledge.

But, whilst the cognoscenti were exchanging pretensions, other more down to earth types realised that here was a good chance to make some money, with the fortunate result that we can now enjoy our wines and our hi-fi equipment without a deep understanding of either.

Yet, whilst extensive knowledge is not essential, some hi-fi basics will certainly help you optimize your choice of equipment, and will prove invaluable when you discuss your requirements with your hi-fi dealer.

The purpose of this article is to answer some of the most commonly asked questions that we receive, and to provide some indication of how much money you need to spend and what you can reasonably expect in return.

## HOW MUCH SHOULD YOU SPEND

The cheapest stereo outfit with any pretension to high fidelity, costs around \$150 — the most expensive costs around \$6,000. This is a price range of 40:1, and rather more than the range of prices of most other commodities. But, unlike most other commodities, the relationship of value to purchase price is only constant over a small part of this range. It is, in fact, only constant from around \$300 to

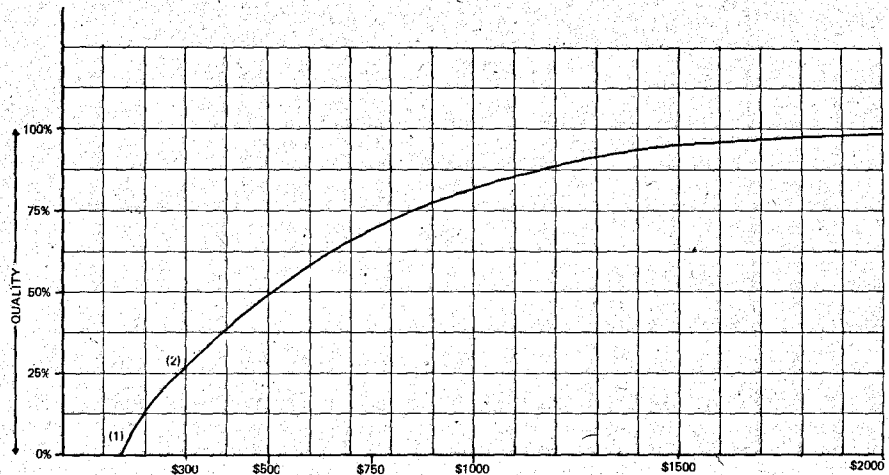


Fig. 1. This graph shows the approximate relationship between hi-fi quality and cost — note that optimum value lies somewhere between \$650 and \$1250. The cost/value relationships shown here have been arrived at following discussions with a large number of hi-fi equipment manufacturers, suppliers and users.

about \$1750, a price range of less than 6:1.

A fair analogy may be drawn between the value for money ratios of hi-fi equipment and automobiles. Figure 1 shows the general idea.

The point marked (1) on the graph is about the rock bottom price for hi-fi. It will buy hi-fi in the same sense that a ten year old Mini will provide transportation.

Doubling the expenditure to \$300 (point 2) will provide more than

double the value. In motoring terms one is in the realm of the basic Torana, Corolla, Mini-minor, etc — in other words — good value for money providing one can accept certain limitations of performance.

Four to five hundred dollars will buy the hi-fi equivalent of the full sized Holden or Falcon. There will be enough power for most situations and uses, and although there are still some performance limitations, the general quality is good.

From here up, the graph rises less steeply, but as with motor cars (where the best compromise between price and quality is around the Volvo 144, Rover 2000 mark), the value equivalent in the field of hi-fi is around \$650 to \$1000.

Between \$1000 and \$1500 there is still a substantial difference in quality

## WHAT IS HI-FI?

Quite simply, high fidelity means a high degree of faithfulness to the original recorded sound. The improvement in reproduction that can be obtained from high fidelity as opposed to conventional equipment is dramatic.

Modern high fidelity equipment is invariably stereophonic (i.e. two channel), but stereo equipment may not necessarily offer high fidelity.

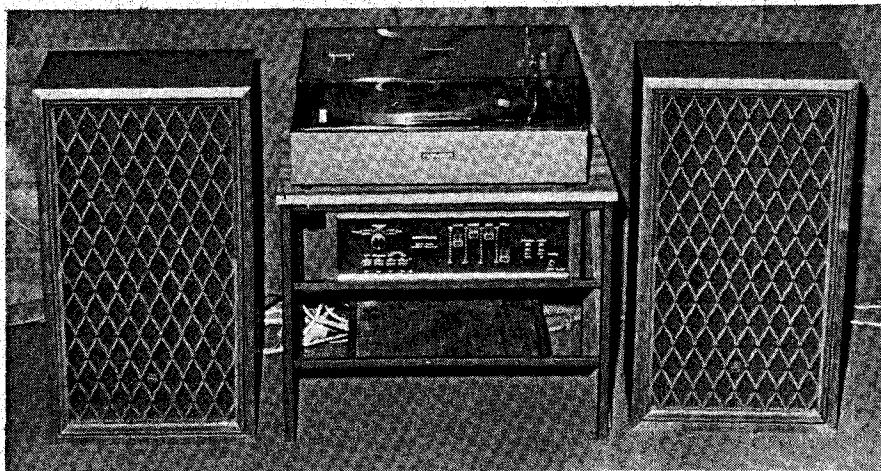
The expression 'high fidelity' is commonly abbreviated to 'hi-fi'.



UNDER  
\$425

Amplifier — Pioneer SA 500  
Turntable — Pioneer PL 12  
Speakers — Peerless 12"

# Hi-Fi-a buyer's guide



**UNDER  
\$400**

*Amplifier — Monarch SA-600  
Turntable — Pioneer PL-15  
Speakers — Pioneer CS-33A*

— but the difference is of the same order as that existing between say, a Mercedes 230 and a Mercedes 280. If you can afford the upper price, then fine, if you can't, you will still have extremely good quality.

Above \$1500 to \$2000, the increments in performance are there, but less obviously. This area is for the connoisseur or the very rich (who may buy their Mercedes 600s for reasons other than that they are very fine examples of automobile engineering).

## HOW TO APPORTION THE MONEY

Within our 6:1 price range, a very good rule is to spend 45% to 55% of the total price on the speakers (you need two, remember!), and then to split the remainder more or less equally between the amplifier and the turntable. Unless your budget is restricted to the lower end of our price graph, you do not need to worry too much about power levels providing you follow this guide.

## HOW MUCH POWER

Some excellent transistor amplifiers are marketed in the \$130 to \$175 price range — with power outputs ranging from 15 to 25 Watts per channel and this is sufficient power to reproduce *most* programme material at realistic levels in a normal size room.

We emphasize *most* programme material, for reproduction of full orchestral climaxes, or the lowest notes of an organ, requires a lot of power. It also requires some pretty costly speakers, but following our costing guidelines your correspondingly increased expenditure on the amplifier will bring with it the increase in power required, for to a large extent, the power output of an

amplifier is related to its price.

There is a big trap here for the unwary. Many amplifier manufacturers play different variations of the Great American Numbers Game (or its Tokyo equivalent) and a \$150 amplifier may be described as anything between 15 Watts and 90 Watts depending entirely upon the method of measurement and the imagination of the manufacturer's sales department. (See also article 'How Many Watts, ELECTRONICS TODAY, May 1971). And to many of our readers who ask what is the Australian method — the answer is that there isn't one.

The only really meaningful figure is one given in Watts (average), this is sometimes quoted as Watts (rms) and

If you are upgrading your existing equipment, start off with a new turntable and stylus. You may not notice any great improvement in reproduction until you upgrade the rest of your gear — but at least you will have some playable records when you do!

whilst the latter term is a technical misnomer, the manufacturers mean the same thing. As a rough guide, high fidelity amplifiers of average to good quality sell for between \$5 and \$8 per Watt (average) per channel.

Once you have established your price range, choosing an amplifier is relatively simple. Some amplifiers are better than others, but for over \$130 or so you would be very unlikely to find a bad one. One amplifier may have a total harmonic distortion of 0.1%, another may have 0.2%. But you'd need a very well trained ear to detect the difference. In our experience, providing power is adequate, the choice of amplifier makes less difference to the final sound than the choice of the loudspeakers and pick-up cartridge.

## RADIO TUNERS

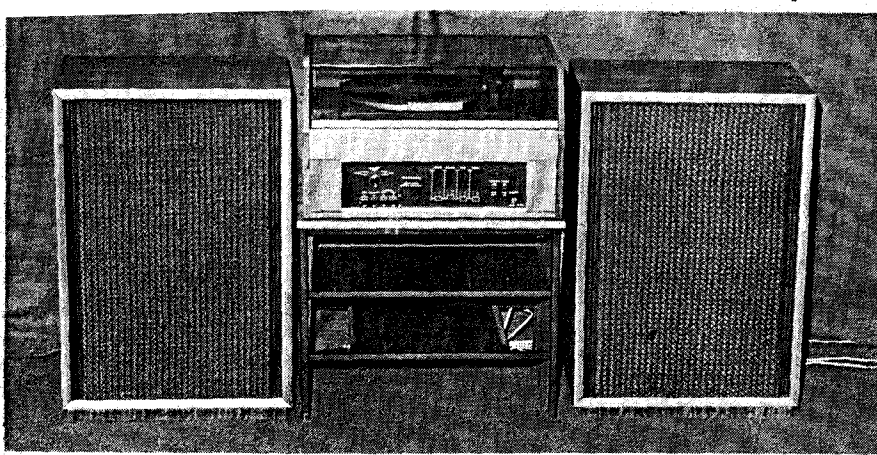
Despite the restricted bandwidth of AM broadcasting, surprisingly good reproduction can be obtained by connecting even a standard radio receiver to hi-fi equipment. (Hi-fi amplifiers have a 'tuner' input for this purpose). Even better reproduction can be achieved by using a radio tuner specifically designed for the purpose, or by purchasing an amplifier with tuner built-in. (If the latter course is chosen allow a further \$50 or so on the price of the amplifier).



**UNDER  
\$1500**

*Amplifier — TEAC AS 100  
Turntable — Pioneer PL 15  
Cartridge — Stanton BC  
Tape deck — TEAC A120  
Tuner — Audiosound Mk II  
Main speakers — Bowers and Wilkins DM3 Secondary Speakers — Bowers and Wilkins DM1.*





**UNDER \$350**

*Amplifier — Monarch SA-600  
Turntable — Dual 1210  
Speakers — Magnavox 8-30*

One objection to tuner-amplifiers is that even if the tuner has both AM and FM bands, there is a possibility that Australian FM broadcasting may be at frequencies above those that most existing FM tuners can receive. But the objection is rather academic, as we are unlikely to have FM broadcasting for several years yet.

### CHOOSING LOUSPEAKERS

This is more difficult than selecting an amplifier, for amplifiers with similar specifications sound much the same but speakers are more individualistic, and there may be clearly audible differences between speakers of similar specifications and prices.

In general, the more expensive speakers have greater power handling capability, better bass response, and generally less colouration than the cheaper units. (Colouration from a loudspeaker sounds like speaking through cupped hands).

More than any other item, the loudspeaker determines the quality of the final sound. The difference in sound between the average \$50 speaker and the average \$250 speaker is dramatic, and usually astounds people who believe these differences to be marginal. But good speakers demand an equal standard of excellence from the associated amplifier and record player, otherwise the increased frequency response will merely highlight deficiencies elsewhere. Hence our 50/25/25 ratio should be maintained; unless you have sufficient experience to be certain that one or other items that you are buying is exceptionally good value for money.

A rough idea of a speaker's sound can be obtained by studying level recordings of the response. These are graphs that show the speaker's level of sound plotted against constant input power over a frequency range that is continuously swept from twenty Hertz to about twenty thousand Hertz. (Hertz is the term now used in place of

cycles per second — the lowest note on a piano is 27.5Hz — the highest is 4186 Hz).

As a general rule a speaker that has a flat-topped response curve, with few dips between 80 Hz and 12-14 kHz, will have little colouration. A response curve of this type of speaker is shown in Fig. 2. Listening tests confirm that speakers of this type have broadly similar characteristics. They may be described as 'musicians' speakers', and many people find their type of sound very satisfying for reproducing classical music. Others, whilst accepting that this type of speaker faithfully reproduces the original sound, find that the uncoloured response is too 'clinical'.

For these people, a speaker with a response curve that rises between 1kHz and 5kHz, may be preferred. A response curve of this type of speaker is shown in Fig. 3. This slight rise in the response curve adds a certain amount of 'warmth' to the reproduced sound, and some people prefer this to the theoretically truer sound\* of the

**UNDER \$500**

*Amplifier — Pioneer SA 500  
Turntable — Pioneer PL 15  
Speakers — CS 33A*

more analytical type of speaker — especially for jazz and pop music.

My own preference is for something like the AR3 (Fig. 2) for classical music, especially for music of the Baroque period, for solo voice or for solo instruments, and also for the cooler forms of jazz. But for hard rock and pop music I prefer the JBL type of sound (Fig. 3). But each to his own tastes.

Until a few years ago hi-fi speakers were very large cumbersome devices — frequently exceeding nine or ten cubic feet. Nowadays, size is no criterion for quality of reproduction, and whilst it is still not possible to obtain a really full bass response from truly bookshelf speakers, some of the best speakers in the world are only slightly larger. At the present time the minimum size required for first-class reproduction is about 1.6 cubic feet.

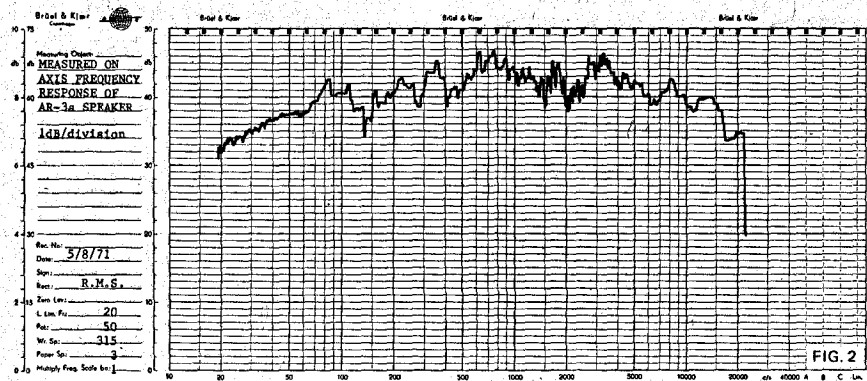
The number of drive units in a speaker enclosure is not related to the quality of sound reproduction, one of the finest — the Bose — has nine; another, very much at the other end of the quality scale, has six. It is significant that with rare exceptions most of the speakers that authorities

### CHROMIUM DIOXIDE TAPE

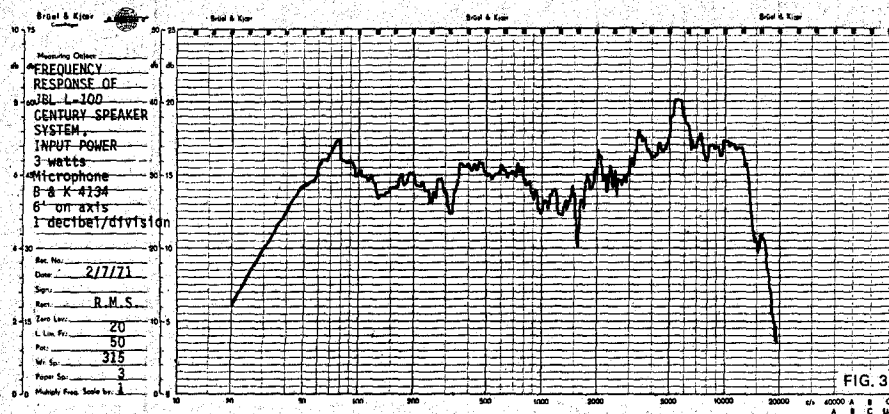
Chromium dioxide magnetic tape will dramatically improve the frequency response of cassette tape recorders; and, if various adjustments are optimized, high fidelity sound can be achieved.

Even on standard cassette recorders the use of these new tapes will provide greatly improved performance, but there may be problems in erasure.

Ideally, chromium dioxide tape should be used with cassette recorders that incorporate the Dolby or other systems of noise reduction, and that have been specifically designed for use with this tape.



# Hi-Fi - a buyer's guide



**UNDER \$600** Amplifier — J E Sugden A21  
Turntable — Connoisseur BD2  
Speakers — Celestion Ditton 15

medium. Recent developments in chromium dioxide recording tape, and the commercial introduction of high quality 'Dolbyized' cassette recorders make its position certainly less secure than a year or two ago, but the long playing record is unlikely to be rendered obsolete for many years to come.

Until recently, no hi-fi enthusiast would ever consider purchasing a record player with an automatic changing mechanism. There was some justification for this attitude because very few high quality units were produced that included this facility.

The highest quality units made today are still non-automatic in operation, but there are nevertheless some excellent record players available that do include an automatic facility.

There are a few valid objections to automatic players and the strongest of these is that the tone arms on automatic players usually require a higher tracking pressure than otherwise. Another objection is that as records pile up on the turntable, the stylus attack-angle changes.

The most frequently voiced objection to automatic changers is that records may be damaged as they drop onto the ones beneath. This objection is no longer valid as all modern discs have a raised lip around the periphery — and this prevents the grooves of one

**UNDER \$950**

Amplifier — Lux SQ 38 DF  
Turntable — Micro MB 300  
Cartridge — Grace 840  
Speakers — Lowther PM7

recognize as excellent, have only two or three drive units.

To some extent the power handling capability of modern speakers is related to their price, i.e., an expensive speaker will have a wide frequency response — this will require a fair amount of power — which the speaker must by definition be capable of handling. It's a circular argument, but applicable to most speakers.

Magazines, such as ELECTRONICS TODAY, publish tests of various makes and types of loudspeakers. Both subjective and objective results are usually quoted and these results are invaluable for determining the frequency response, the standard of construction, and whether or not the speakers are good value for money.

But in the end you must decide which speakers you like by listening to them.

Decide how much you are prepared to spend, and then visit a reputable hi-fi dealer. Hi-fi dealers are generally very helpful and will usually be only too pleased to let you compare one speaker against another. Don't try to compare more than three speakers in any one day. Also listen to all speakers at about the same sound level, for otherwise the louder of any two speakers will usually appear to have the better response.

The relationship of value to money is possibly rather looser with loudspeakers than most other items of hi-fi equipment. Whilst our 50/25/25 will work very well indeed for the great majority of loudspeakers, there are a few loudspeakers that are better value for money than most. Our product reviews indicate which these

are — and in such cases one's calculations must be based on the normal prices of speakers competitive in quality with the ones chosen, rather than with actual selling price of the speakers concerned.

There are also one or two other types of speaker, such as the Bose, that require much more powerful amplifiers than are generally required. These types of amplifier may cost more than half the price of the speakers and in such cases our 50/25/25 pricing guide may not work. But these types of speakers are rare exceptions, and our proposed costing system is surprisingly accurate and effective in nearly all cases.

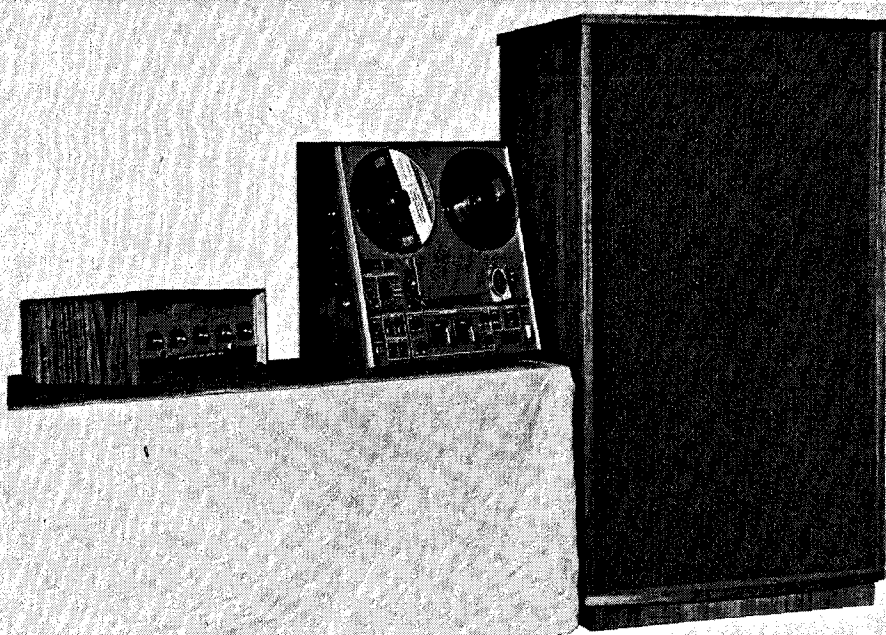
## THE RECORD PLAYER

Despite competition from reel-to-reel and cassette tape recorders, the long playing gramophone record is still by far the most popular recording



**ABOUT \$2850**

Preamp — Crown IC 150  
Amplifier — Crown DC 300  
Turntable — Thorens TD 125  
Speakers — Bose 901



**UNDER  
\$1200**

*Amplifier — Leak Stereo 70  
Tape deck — Sony TC 366  
Speakers — Tannoy folded horn*

record touching the grooves of another.

The non-automatic players usually offer better value for money — but if you really do want the automatic facility you may not be sacrificing all that much in quality of reproduction.

There are two main problems to watch for when shopping for a record player. These are rumble, and wow and flutter. Rumble, is a very low frequency noise generated by mechanical components in the drive system. It is a common problem with cheap turntables, but fortunately rumble occurs at such a low frequency that speakers of corresponding quality have a bass response inadequate to reproduce it.

Rumble may be a serious problem if one attempts to use a poor quality turntable with a good amplifier and speakers. Our suggested pricing formula will nearly always ensure that this problem will automatically be avoided.

Wow and flutter is again more common, with low priced machines, but unlike rumble, wow and flutter will be reproduced through even the cheapest of amplifiers and speakers.

Both effects produce a wavering in the pitch of the reproduced sound, and are caused by the turntable varying (or fluctuating) in speed. Wow is a low speed phenomena often occurring at turntable speed or multiples of turntable speed. It is frequently caused by mechanical friction in bearings and gear drives. It can also be caused by warped or eccentric records.

A good test for wow is to listen to a

recording of a piano — the effect will be apparent on sustained notes which will waver in pitch — they will have a "sour" quality.

Turntable faults causing pitch variations faster than 10 Hz. are known as flutter. They are most generally caused by resonances in turntable driving belts, but there are also many other causes including lack of precision in gear cutting, etc.

Flutter may be detected by listening to a sustained wind instrument such as an oboe, the resultant sound will have a "vibrato" effect if flutter is present.

*A top turntable*



**ABOUT  
\$400**

*Thorens TD 125.*

Do not pay too much attention to statements that the wow and flutter of turntables fitted with heavy flywheel type platters must be lower than turntables with pressed steel platters. The statement is generally true, but by no means always true.

One practically essential feature, if you value your records, is an automatic system for raising and lowering the tone arm. These are standard fittings on nearly all top-class units, and are often fitted to the cheaper units as well.

A lot of emphasis is often placed on the ability of a particular tone arm and cartridge to 'track' a record at less than a gram. (Tracking weight is the downward weight measured at the stylus). The minimum tracking weight is largely unimportant (as long as it does not exceed 2 grams), in fact, distortion, and even record wear, is often increased at very low tracking weights as the stylus jumps around in the groove. A realistic tracking weight for most good quality cartridges is about 1½ grams. There is no particular advantage in having a cartridge that will track at less than this.

## CASSETTE RECORDERS

At first sight the tape cassette seems a simpler and more convenient recording medium than the gramophone record. And so it is.

But whilst some major developments are currently taking place in both recording tapes and cassette recorders, the majority of cassette recorders on the market at present cannot be seriously regarded as hi-fi reproducers. Almost all have claimed frequency responses up to 12 kHz or so, yet very

# Hi-Fi—a buyer's guide

few indeed have any useable output above 6 kHz, and the only way most of them could generate a 12 kHz signal is by dropping them down a lift shaft.

A new generation of cassette recorders is gradually coming on the market — and these are characterised by Dolby or Philips noise reduction systems, and the use of chromium dioxide tape. We have experience of two of these machines so far. A full test of one — the Advent — was published in our November issue — it was a very favourable review. Another that we tried was, on the other hand, almost unbelievably bad. It showed that if you add a Dolby system to a lousy tape recorder, all that you have is a lousy tape recorder with a Dolby system. (The Dolby system is a method of recording and reproduction that decreases tape and record surface noise).

We believe that whilst the cassette recorder may yet supercede the record player, it is unlikely to do so for some years.

At the present time the quality of reproduction that can be obtained from good records and turntables is ahead of even the best casset players. However, if you are prepared to sacrifice some quality of reproduction for convenience, then the cassette player has definite advantages. Developments in this field are taking place very rapidly, and it is quite possible that cassette players may equal the quality of reproduction of top quality turntables in the very near future.

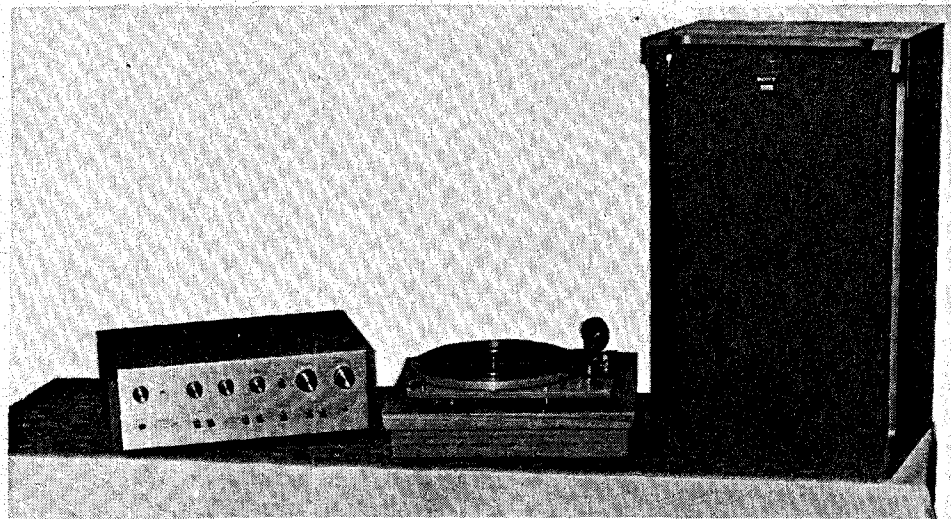
## FOUR CHANNEL EQUIPMENT

This is a contentious subject.

Many companies, mainly in the USA and Japan have developed systems that reproduce sound from four separated points. Some of these systems use four-track tape recordings, others use specially made 'four-track' records, whilst yet another class of systems synthesize four-channel sound from normal two-channel stereo recordings.

The system is being held back commercially by incompatibility between the competing systems.

It is very difficult to assess



UNDER  
\$750

Amplifier — Pioneer SA 600  
Turntable — Dual 1218  
Cartridge — Shure 93E  
Speakers — Sony 7320

four-channel sound unless it is heard within the confines of a well furnished living room. Four-channel sound usually sounds dreadful in a dealer's showroom — it seems to require dead surroundings to be effective.

At the present time there are no standards, and it is too early to tell whether or not the system will become widely accepted. If you want to get some vague idea of what it sounds like, a system requiring only two extra speakers and a few feet of wire was described in ELECTRONICS TODAY's August issue.

Most authorities in the field of hi-fi feel that for any four-channel system to be widely accepted it must be largely compatible with existing two-channel record players, tape recorders, etc. ELECTRONICS TODAY's opinion is that four-channel sound is eventually inevitable, but whilst some extra equipment may be required, existing purchases will not become obsolete.

Unlike some other consumer product industries, the hi-fi business is a reasonably gentlemanly affair. It is very competitive, yet lacks the high pressure salesmanship that you would likely to encounter at a motor car showroom.

The quality of service and technical knowledge is again much higher than in most other retailing businesses, and the majority of hi-fi dealers have good service departments.

Occasionally the identical goods can be bought at a lower price from a discount store — possibly more frequently since the abolition of retail price maintenance. But generally the price difference will be small, and whilst you may have no absolute

guarantee that a hi-fi dealer's after sales service will be any better than that from the discount house, our experience shows that it almost invariably will be.

Our advice is to buy your gear from an established hi-fi dealer, unless you know exactly what you want and are prepared to undertake all service yourself. (A good hi-fi dealer can usually be recognised by the quality of the agencies that he holds. If these include several top names then it is a fair bet that his is a good reputable business).

## INSTALLATION

Installing hi-fi equipment is usually a simple operation — and can be completed by practically anyone within an hour or two. Some manufacturers, such as Sansui, provide detailed pictorial instructions — others leave rather more to be explained by the hi-fi dealer.

But the operation is not difficult and you can almost certainly rely upon your dealer to assist you if you find any difficulty. ●

*Electronics Today acknowledges the assistance of the following companies for advice and assistance in the preparation of this article.*

*Simon Grey Pty. Ltd., W. C. Wedderspoon Pty. Ltd., Convoy International Pty. Ltd., Sydney Hi-Fi Pty. Ltd., Audio Engineers Pty. Ltd., Encel Electronics Pty. Ltd., Auriema Pty. Ltd., Astronics Pty. Ltd.*

Hi-fi equipment specifically named or shown in this article, has been included solely to illustrate certain points. The inclusion of any item should not be taken as an endorsement of quality, nor as any recommendation to purchase. Nor should it be assumed that other equipment — that has not been included — is in any way inferior.

UNDER  
\$1425

Pre-amp — Radford SC 24  
Amplifier — Radford SPA 50  
Turntable — Micro MR 311  
Cartridge — Grace F 8  
Speakers — Celestion Ditton 25

# OTARI

## SERIES MX 7000

### *The Professional Tape Deck*

OTARI series MX7000 Professional Tape Decks are ruggedly designed for hard and continuous operation. The Transport Base is made of heavy aluminium die casting, which is precisely machined to accommodate all fixed and movable guides, rollers, levers, as well as head assembly. Electronically the MX7000 series has all solid state circuits, and utilizes an all push button control system. The heads are designed for quick interchangeability from 1 to 4 channels. The capstan is operated by a 3 speed hysteresis synchronous motor. The speeds are automatically equalized. Features such as sound with sound and reversible components to produce a vertical or horizontal cabinet configuration are standard equipment. The MX7000 series is as practical as it is beautiful, and will satisfy the most exacting user.

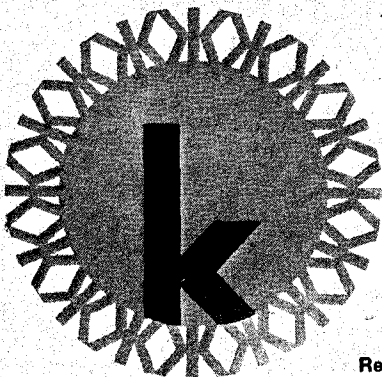


# OTARI

## SERIES MX 5500

### *Compact Professional Tape Deck*

The Otari MX-5500 comes from a long line of industry-accepted high-speed tape duplicating systems and is designed for the fastidious audiophile. Three motor system mounted on heavy Aluminium Die Cast Frame. The capstan is operated by a 2 speed Hysteresis Synchronous Motor. Amplifier has a three-stage directly connected IC, in addition, extra circuits such as Sound on Sound, Echo and Auto-Reverse as well as Bias change-over are provided. The MX-5500 compact professional tape deck will satisfy the most exacting user.



Please phone or write for brochures giving full specifications.

W.A. AGENT: Severin Distributors, G.P.O. Box E 3002, Perth. 6001.

## **KLARION ENTERPRISES PROPRIETARY LIMITED**

Regent House, 63 Kingsway, South Melbourne, 3205, Australia. Phone 61 3801 Cables Klariionmelb

Please Santa  
leave me a  
**KENWOOD!**

## The 'ACTUAL-SOUND' reproducers

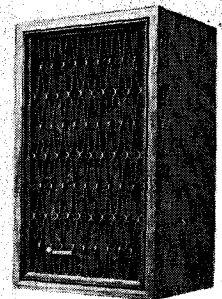
... that's what the name KENWOOD means to music devotees all over the world ... supreme quality in sound reproduction. If you want to give (or receive) sound equipment, reveal yourself as a connoisseur and check the full range now at any KENWOOD SOUND CENTRE in time for Xmas. (Ask especially to see and hear the new 'JUMBO' Stereo Receiver.)

**KP-3021 Auto. Turntable.** Kenwood has brought reliability, smoothness and durability to the KP-3021 with a high quality 24-pole synchronous motor employed exclusively for the tone arm operation. All automatic operations—auto-play, auto-return, auto-repeat, auto-stop—are performed electrically. Freq. response 20-20,000 Hz.



**KA-2002 Stereo Amplifier.** Has 13 watts per channel output in a compact 13" wide, tastefully designed cabinet. Freq. response 17-50,000 Hz  $\pm$  2 dB. Precise tone control ... push-type switches for loudness, mode, and tape monitor.

**KL-3080 3-Way, 4-Speaker System.** Damped pipe duct speaker system that perfectly covers wide 40-20,000 Hz. Each elegantly styled enclosure contains 10" woofer, 5" cone-type midrange and two 1 1/2" cone-type tweeters. Max. input 15 watts R.M.S. Four-step tone selector for your choice of tone characteristics. Size 13" (W) x 22 1/2" (H) x 11 3/4" (D).



*the sound approach to quality*



# KENWOOD

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Please send me details on Kenwood  KA-2002,  
 KP-3021,  KL-3080 (tick models required) and  
location of nearest Kenwood Sound Centre.

NAME .....

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JM/K-3 ET1271



# ELECTRONIC PAIN KILLER

**New electro-medical discovery could mean relief for victims of chronic pain**

**H**UNDREDS of thousands of people suffer from pain so intense that they can neither work nor sleep. And whilst drugs provide some temporary relief, the amounts and side effects may be of such magnitude that the palliative may be little better than the pain.

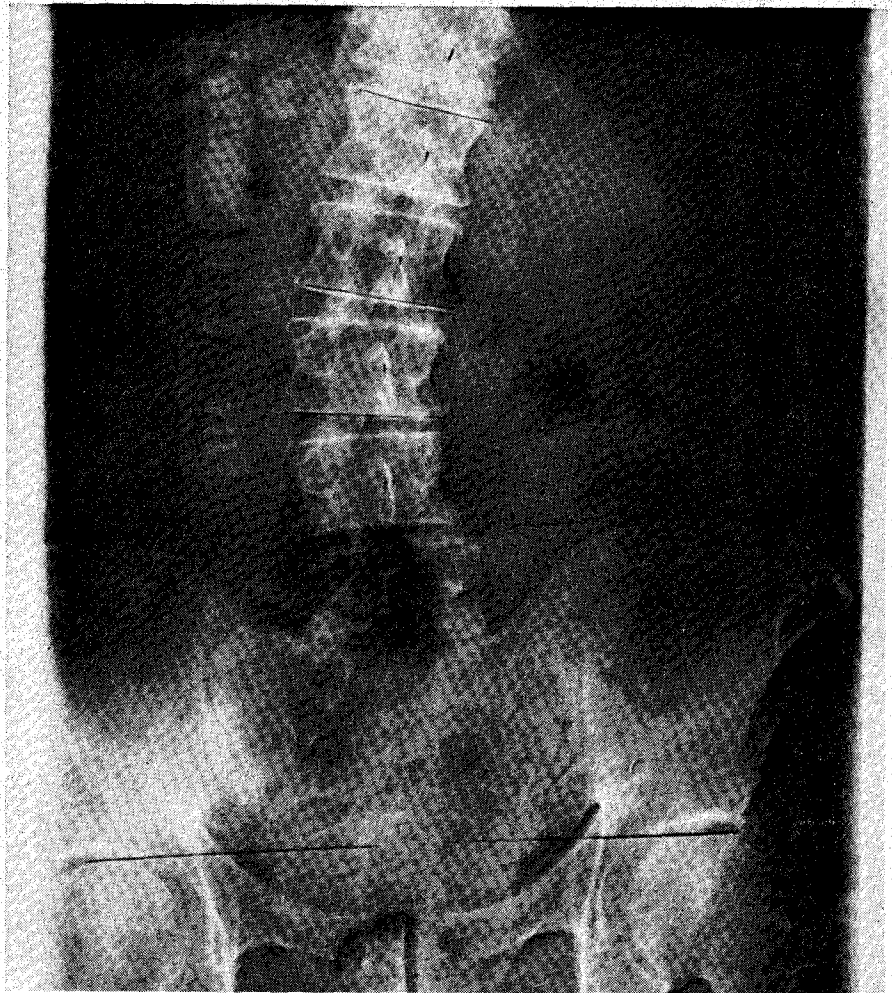
But a recently developed electronic stimulator may be able to control chronic pain in patients for whom other measures have not been effective. Whilst the technique is still under active development it has proved very successful and over 60% of several hundred experimental patients found that chronic pain was substantially reduced. Of the failures, a substantial proportion had complicated psychiatric problems.

The technique operates by electrically stimulating the dorsal surface of the spinal cord.

The spinal cord consists of a bundle of nerve tissues which carry messages to and from the brain. Pairs of peripheral nerves leave the spinal cord to be distributed throughout the body. Messages travel along these nerves as electrical impulses, and whilst the original input to the nervous system may have been mechanical, electrical, thermal, chemical, osmotic or whatever, the actual signal media will always be electrical.

Nerve tissues consist of numerous cells (called nerve cells) with branching, thread-like extensions. Every nerve cell is in contact with others by means of these extensions. The points where nerve cells make contact are called synapses.

The long extension of a nerve cell is called an axon, and it is by means of the axons that the electrical signals are transmitted. The conduction and insulation efficiency of axons is very poor — about a million times worse than copper wire of the same cross-sectional area.



To compensate for this electrical inefficiency, each axon acts as an amplifier with approximately unity gain, i.e., the signal leaves the axon at about the same signal level at which it entered the axon.

Axons will not transmit any signal less than a certain minimum level. Either the input signal is strong enough to trigger off the axon's firing, or it is not. It is in fact a digital, rather than an analogue system.

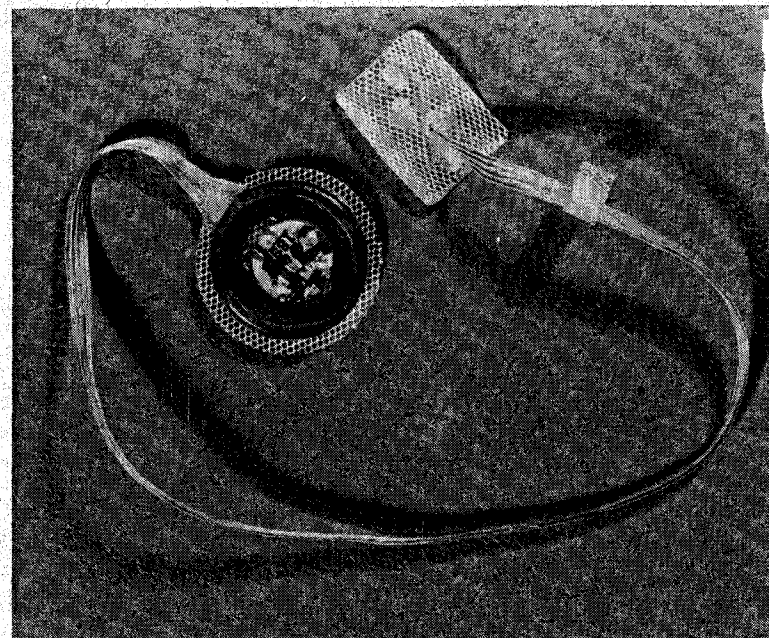
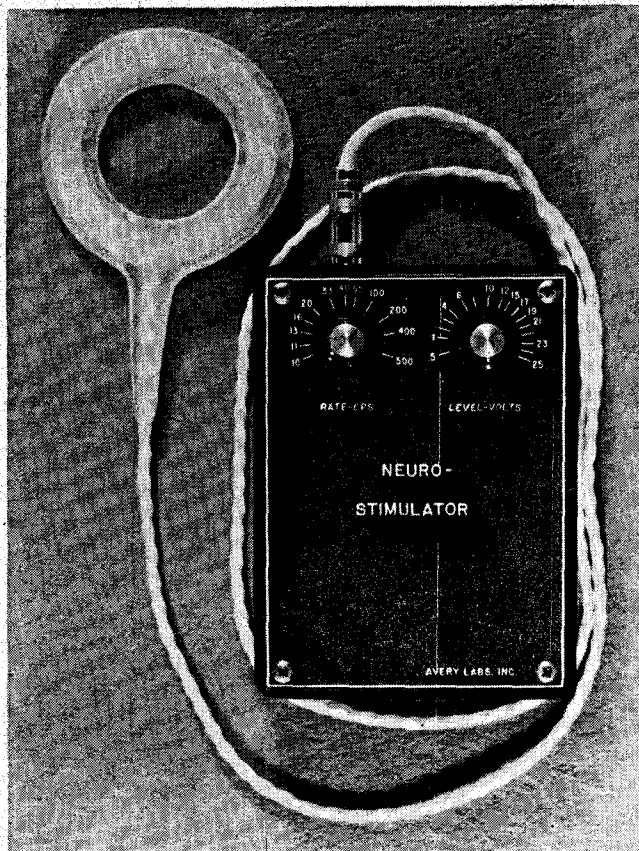
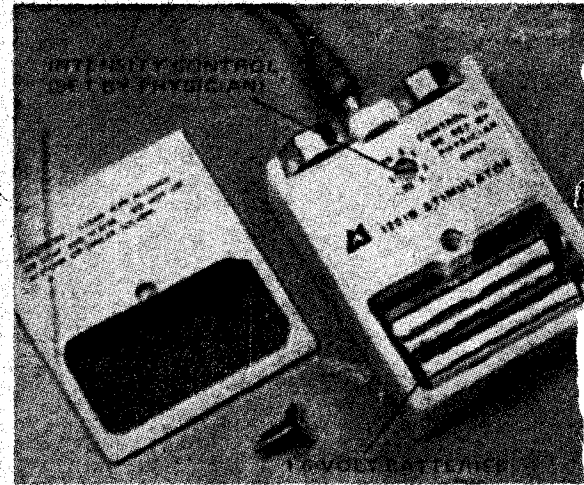
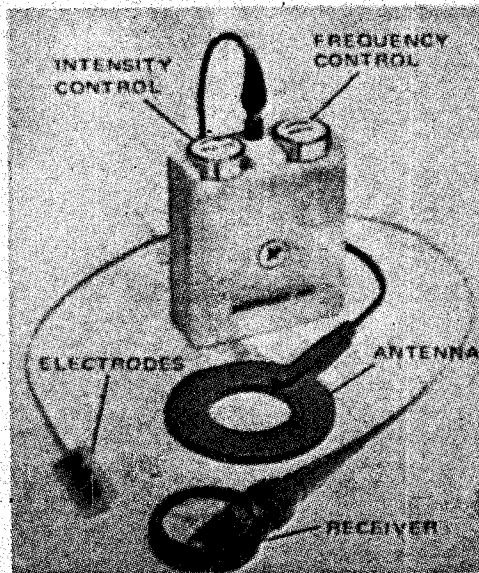
More than this in fact, for the pulse 'generated' by an axon is always of approximately the same length. Unlike the Morse code the system can only

transmit dots — there are no dashes. The dots are all of the same length and all of the same magnitude. The only way in which the intensity of a stimulus can be increased is by an increase at which the frequency of the axons fire. In human beings this upper limit is somewhere around 100 pulses a second.

The speed at which the electrical impulses travel to the brain is, by normal electrical practice, very slow indeed — at the very highest it is less than 300 feet a second — at the slowest it may only be a few feet per second. The speed of propagation is

# ELECTRONIC PAIN KILLER

*This neuro-stimulator unit is made by Medtronic Inc., in Minneapolis USA. Unlike most implanted medical devices, both the Medtronic and the Avery units use an external power source — thus obviating further operations for battery replacement.*



*The receiver of the Avery unit is encapsulated in epoxy resin.*

*Transmitter of neuro-stimulator made by Avery Laboratories at Farmingdale, New York. Power is radiated to the implanted receiver by the circular antenna.*

largely a function of the diameter of the nerve fibre; the larger the fibre — the quicker the speed. A higher velocity is also produced by a myelin (fatty) layer.

It has been discovered that if an electrical stimulus is applied to the large fast-conducting fibres, this will block (or gate off) the transmission of impulses from the slower fibres. And it is these slower fibres that predominantly carry pain-causing impulses.

In the pain killing experiments the fast-conducting fibres are stimulated by injecting an electrical square wave that is variable in voltage, frequency and pulse width. The action connection to the nerve fibre is made via a number of platinum discs bonded to a layer of dacron mesh coated with silastic (Fig. 1).

Wires from the electrodes are taken, beneath the skin, to an RF receiver implanted just below the rib cage. As with a crystal radio set, power is

supplied to the implanted RF receiver by a small battery powered transmitter carried in the patient's jacket or shirt pocket.

The patient can energise the transmitter whenever he requires. He is also able to adjust the voltage from 0.3V to 30V and the frequency from 9 to 550 Hz. The pulse width can be altered, but only by the physician, from 100 microseconds to 800 microseconds. In use the patient adjusts the controls to achieve



## HOW THE SYSTEM IS IMPLANTED

(A medical description)

The preoperative evaluation consists of history, physical and psychiatric examination, roentgenograms of previous areas of spinal trauma or surgery. Myelograms in those patients having had or suspected of having intraspinal disorder, complete urological evaluation including cystometrograms and intravenous pyelography.

The electrode is implanted via a high dorsal laminectomy for pain in the lower part of the body, and in the cervical region for arm pain.

optimum pain reduction. Usually this is obtained with the voltage set between 0.5 and 3V; frequency between 15 and 100 Hz and a pulse width of 200 microseconds. The parameters vary from patient to patient and also within the same patient from day to day, depending upon the degree of pain and the efficiency of the battery used to power the stimulator.

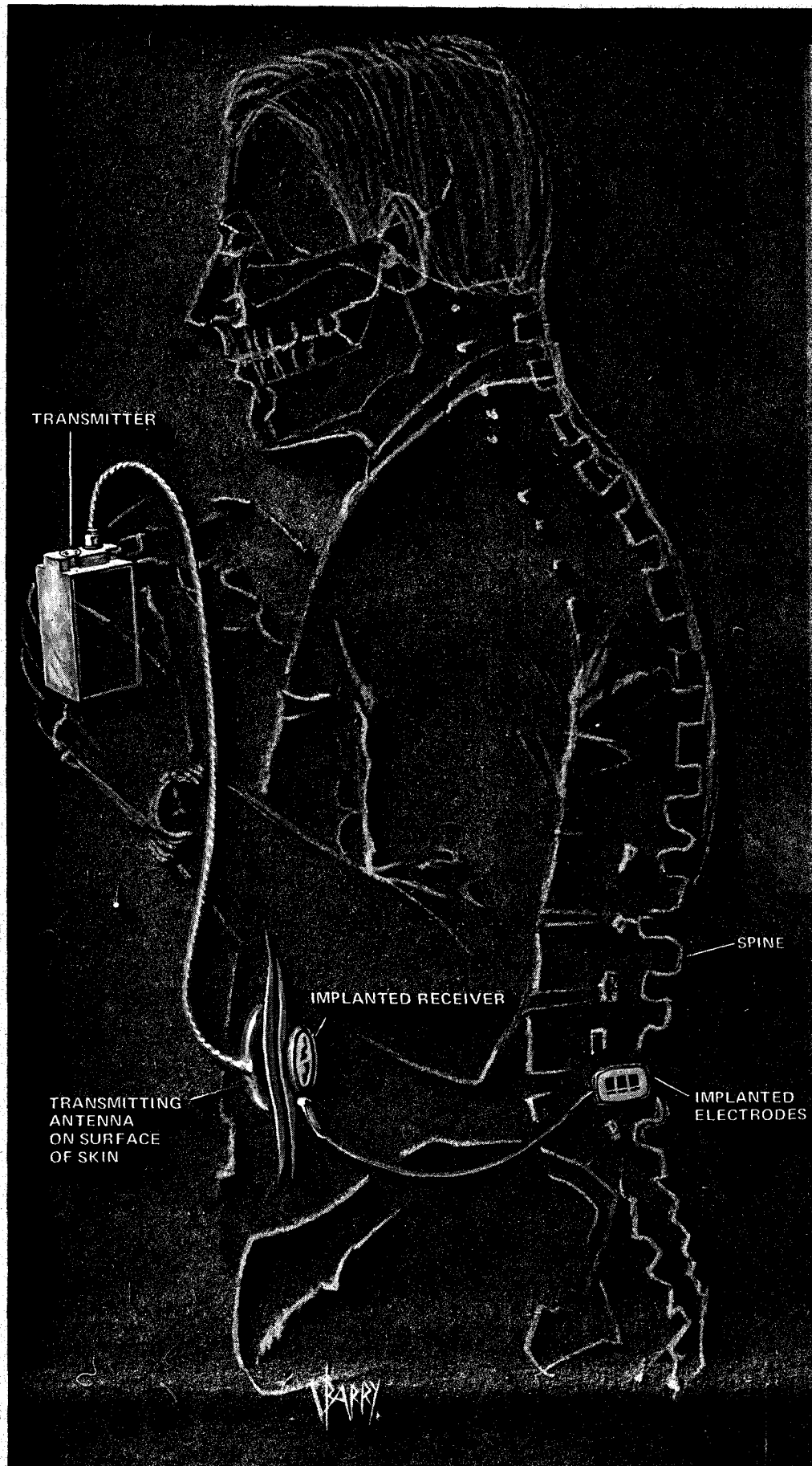
Patients differ widely in the amount of stimulation required to obtain pain relief. Some have excellent relief with a constant stimulus during the waking hours, others require intermittent periods of stimulation lasting from fifteen to sixty minutes with pain relief outlasting the stimulation from one to five hours.

The sensation described by the patient is usually a very mild continuous electric shock — many describe this as a mild tingling feeling — when the stimulator is being used at therapeutic levels. One patient described the feeling as being similar to that on the surface of a cat's throat when it purrs.

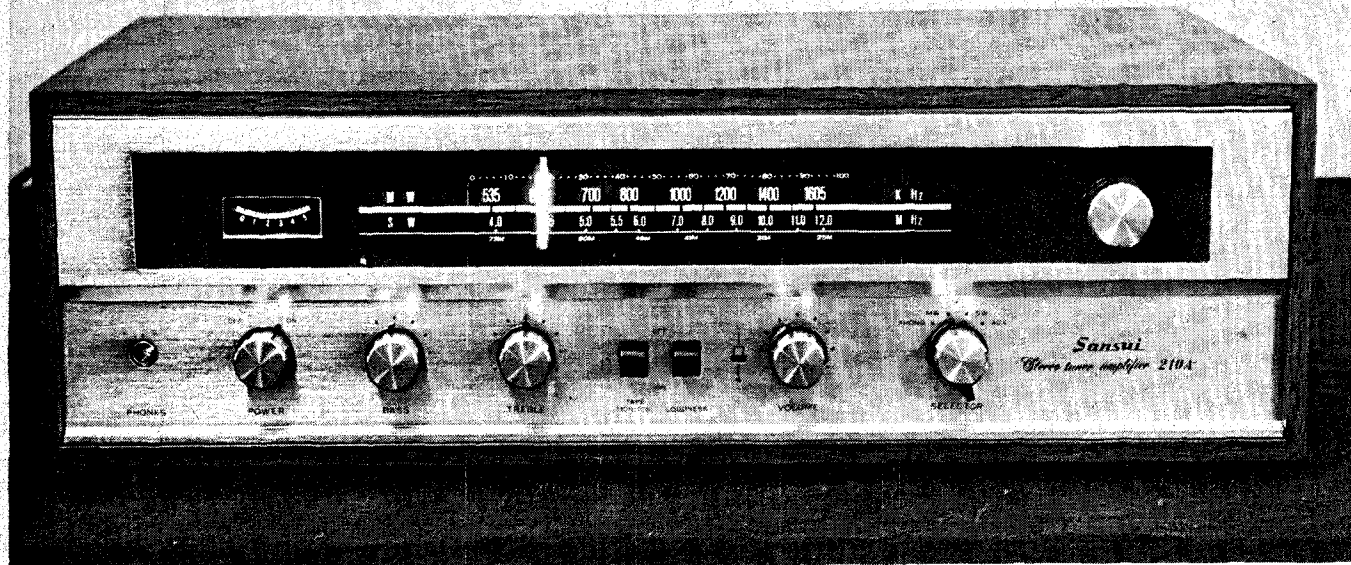
The technique does not completely reduce pain, but for the 60 to 65% of people for whom it has been proved to work it does reduce it to a level at which the patient can live a normal comfortable life. It is especially effective for patients with spinal and back problems.

At the present time the technique is limited to fairly simple applications but it is quite probable that cancer victims may be helped within the near future.

The system is however regarded as experimental and whilst neurosurgeons see the technique as 'the answer to chronic pain not responsive to other known treatment' it is seen as a last resort rather than a routine practice.



This sketch — by one of our staff artists — shows how the receiver and electrodes are implanted. The patient is shown adjusting the transmitter — normally carried in the patient's coat or shirt pocket.



We test Sansui's low cost, high performance tuner amplifier.

# THE SANSUI 210A TUNER AMPLIFIER

**M**ANY people use their hi-fi equipment to listen to radio broadcasts — in fact, many use this facility more frequently than for listening to their records or tapes.

This is recognised by the hi-fi industry and many manufacturers now produce amplifiers with built-in radio-tuners.

The Sansui 210A tuner amplifier maintains the Sansui Company's reputation of producing well designed articles offering above average performance.

The external appearance is good, with a well balanced front panel

layout framed in the oiled timber edging of the wooden cabinet. The brushed aluminium front panel is divided into two distinct parts. The top half contains a dark-tinted transparent plastic panel, behind which is located the tuning meter at the right end and the medium wave and short wave scales in the centre. An aluminium tuning knob is located at the right hand end. The tuning dial and meter are effectively illuminated from the rear when either MW or SW settings are selected. The illumination which is exceptionally clear, is in yellow and green colours.

The bottom half of the panel, is

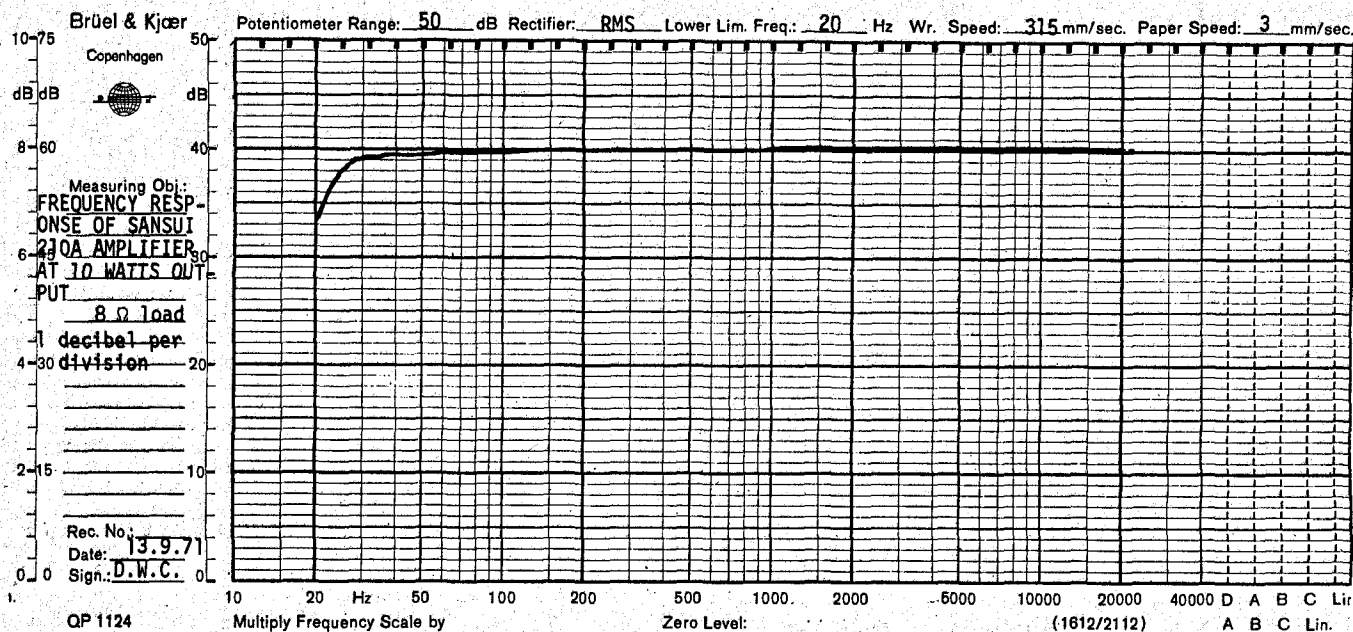
recessed in by approximately ¼" with respect to the top panel and contains the following controls:—

- a) headphone jack socket
- b) power on/off rotary switch
- c) bass control knob
- d) treble control knob
- e) tape monitor on/off switch
- f) loudness control on/off switch
- g) dual concentric volume control
- h) rotary selector switch with four positions; namely, phono, MW, SW, and auxiliary input.

All input and outputs, with the exception of the headphone jack, are located on the main chassis at the back of the amplifier. Plastic-capped screwed terminals are used for the external antennae connections, the external earth connection and the speaker connections.

RCA type coaxial sockets are provided for the phono input, auxiliary input, tape monitor input and tape record output. A 'DIN' type socket is also fitted so that a combination record/playback patchcord may be used with tape recorders equipped with this facility. No facility is provided for paralleling inputs. This means that a mono signal needs to be fed to both auxiliary inputs to drive both channels.

Two power output sockets of the Japanese two pin type are also included on the back panel for powering either a tape recorder and/or a record player. Only one of these outlets is switched through the amplifier "power on/off" switch. The correct operating voltage is adjusted by varying the position of a multipin plug. This provides 100V, 110V and 220V or 240V mains voltage transformer tapings as required.



## electronics TODAY product test

The amplifier performed admirably when subjectively tested at home and in the initial laboratory tests. The only fault that we could find was the construction of the dual-concentric volume control knob which was very awkward and a trifle annoying to adjust to obtain optimum balance between channels, particularly for someone with large hands.

Accurate location of any station is possible with the aid of the tuning meter and the exceptionally smooth tuning mechanism.

The illumination of the tuning dial and meter has been carefully designed so that it is not masked by strong room lighting and conversely, is not too bright in the dark.

The internal wiring and circuitry is well laid out and readily facilitates fault finding should the need arise.

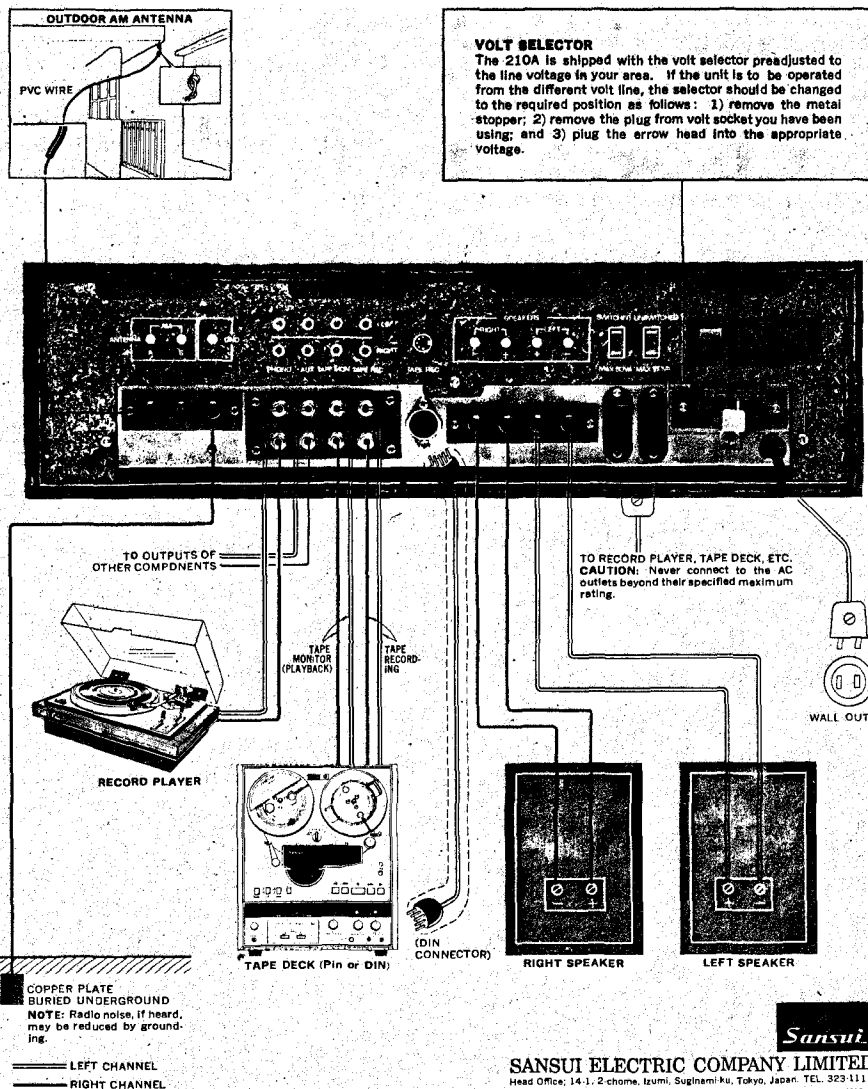
Two horizontal printed circuit boards located in the bottom of the chassis contain all the circuit components with the exception of the power transistors, mains transformer, fuses and control potentiometers.

Unimpeded access is possible to both sides of these printed circuit boards once the amplifier cabinet has been removed.

### THE RECEIVER

The receiver stage utilizes the latest high stability ceramic filters. These filters have a double hump-shaped,

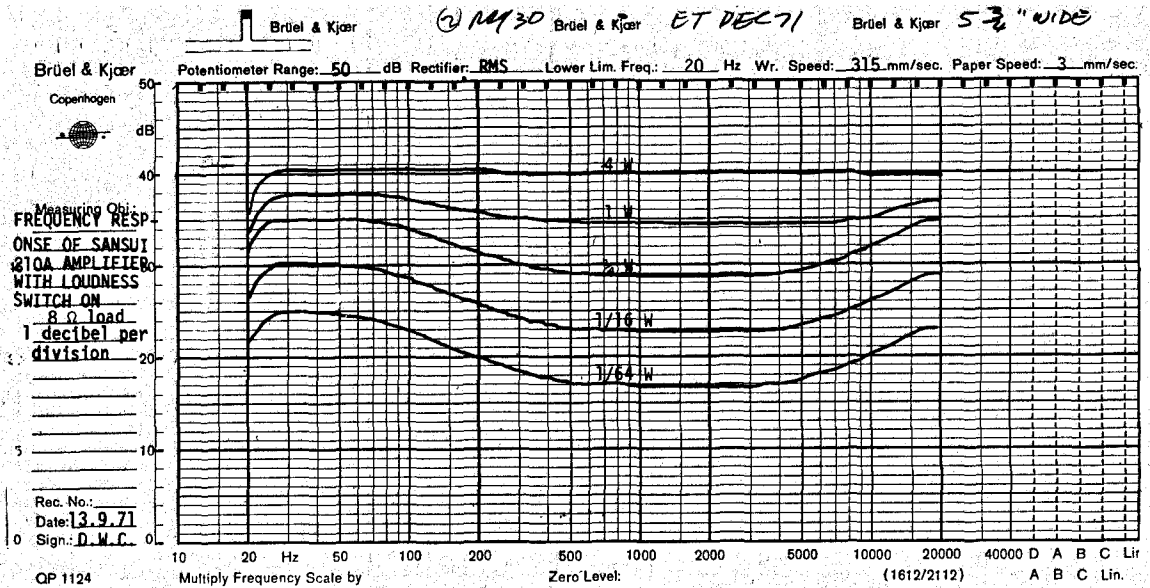
## SANSUI 210A COMPONENT CONNECTIONS



A plasticised card supplied with each unit shows, clearly and simply, how various units are connected together.

**Sansui**  
SANSUI ELECTRIC COMPANY LIMITED  
Head Office, 14-1, 2-chome, Izumi, Sugnamachi, Tokyo, Japan. TEL. 323-1111  
Printed in Japan 4101041

# THE SANSUI 210A TUNER AMPLIFIER



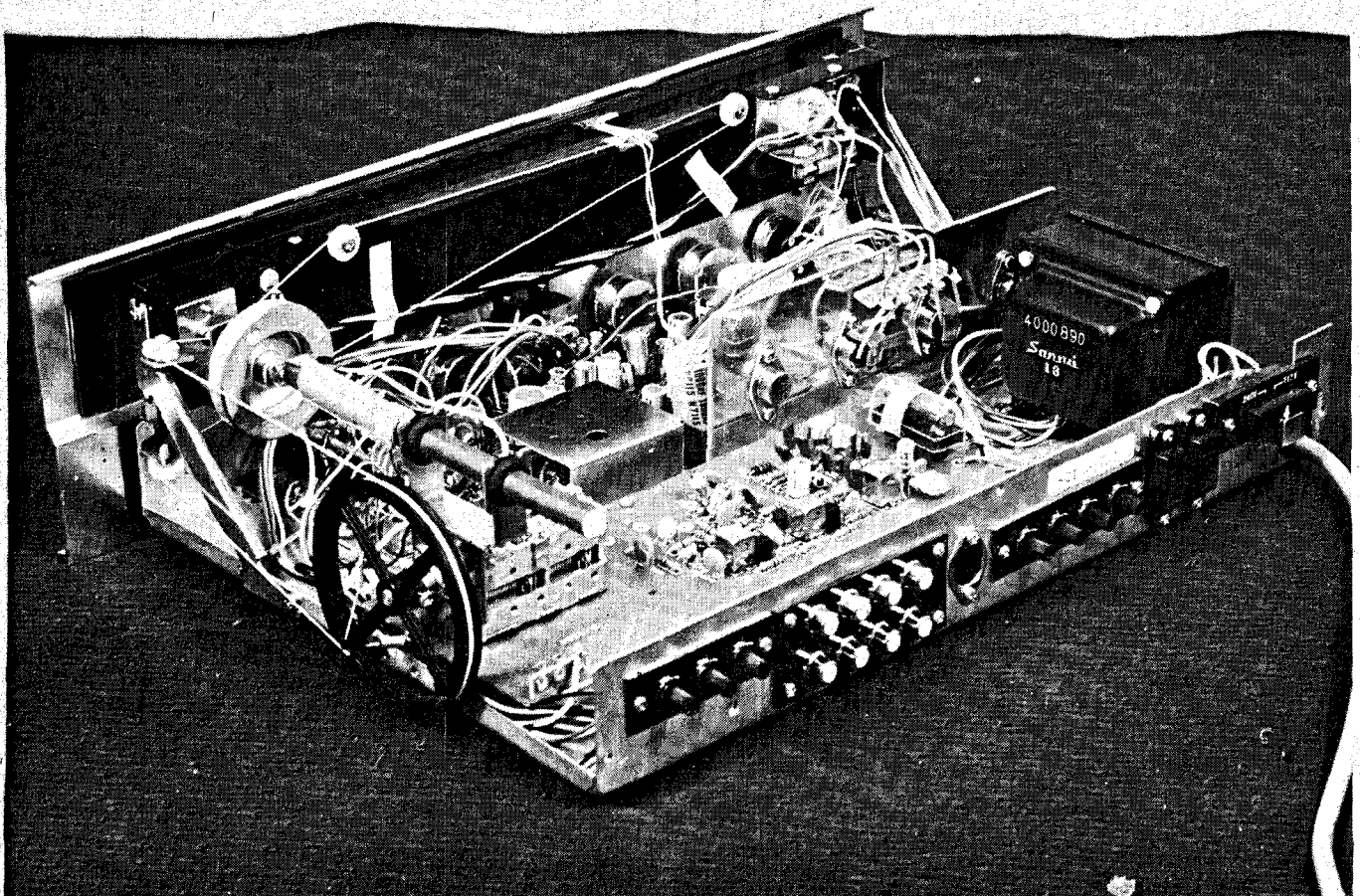
filter crest with exceptional cutoff characteristics. However, the bandwidth is limited to approximately 6 kHz. The power output stages utilize single ended push-pull transistor configurations similar to the circuitry used in the AU101 amplifier which we reviewed in May. Quick acting fuses are fitted in the dc supply to the power transistors. The power supply to the preamplifiers and receiver stages is stabilized by an npn transistor operating as a stabilizer and a capacity

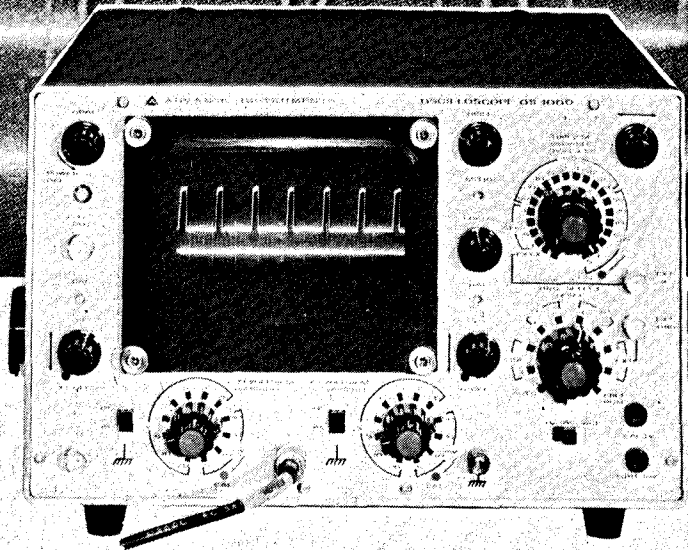
multiplier filter. All of the semiconductors are silicon with the exception of the two pnp drivers.

The three stage IF is effective and the image rejection is better than 52 decibels.

The input circuitry consists of a ferrite "loop stick" with an additional winding for the connection of an external antenna but is subjectively still above average with the loop stick alone.

As with all Sansui amplifiers a comprehensive 14 page "Operating Instructions and Service Manual" and a general information card is supplied. In addition the general information card, which is 11" x 8 1/2" and plasticized, gives on one side graphic information for all external connections and on the other side a detailed description of each knob and switch function. This card system now used on all Sansui equipment is an ingenious feature, which eliminates the



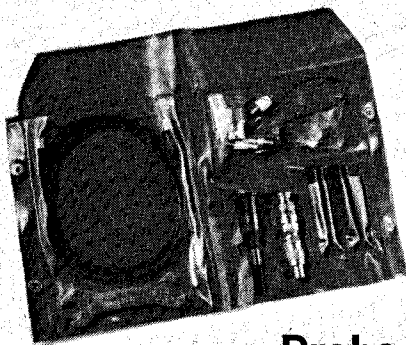


Another  
**ADVANCE**  
'scope for

# precise waveform measurements

## OS1000 oscilloscope 15MHz, 7" high

Here is a small size, lightweight 5mV/cm dual trace oscilloscope offering wide time base ranges and comprehensive trigger control combined with broad bandwidth and calibrated deflection factor. Solid state circuitry makes the OS1000 ideal for servicing or laboratory use.



### Probe Kit

An accessory probe kit is available for use with the entire range of Advance oscilloscopes. This provides for a standard compensated test lead which may be terminated at one end with BNC or UHF type connectors and at the probe end may be fitted with probe bodies of x1 and x10 ratio. Spring-loaded hook, needle, 4mm plug and alligator tips may be fitted to the probe, which also has provision for a grounding lead connection adjacent to the probe tip. All the parts are supplied in a plastic wallet suitably compartmented.

#### DISPLAY:

10cm x 6cm rectangular tube with 4Kv overall E.H.T.P.31 (standard) or P7 (long persistence) phosphors available. With dark grey filter as standard. Brilliance, Focus and Graticule illumination by normal controls.

#### EXTERNAL Z MOD:

AC coupled rear panel socket. 1vpk.pk for visible modulation, 60V for blanking. Input impedance 1M $\Omega$ .

#### DISPLAY MODES:

SINGLE TRACE: Y1 or Y2.

DUAL TRACE: Alternate sweep or chopped mode (250KHz) automatically selected by time base setting:

Alternate sweep—0.5 $\mu$ S/cm to 0.5mS/cm, chopped mode—1mS/cm to 1 sec/cm.

X-Y mode—via Y1 and Y2 inputs—selected on time base range switch. Bandwidth DC to 1MHz.

#### Y DEFLECTION:

Dual channels—Sensitivity—5mV/cm to 20V/cm  $\pm$  3%. BANDWIDTH: DC to 15MHz.

INPUT Z: 1M $\Omega$ /30pf.

INPUT COUPLING: AC/DC/Ground.

#### X DEFLECTION:

TIME BASE: Ranges 1 sec/cm to

0.5 $\mu$ S/cm with X10 Expansion  $\pm$  5%.

TRIGGER MODES: (i) Internal Y1 + or - (ii) Internal Y2 + or - (iii) External + or - (iv) Line + or -

LEVEL CONTROL: (i) Manual or (ii) Auto with automatic free run in absence of signal.

EXT. TRIG.: Input Z. 100k $\Omega$  15pf.

EXTERNAL X: Via external X input, sensitivity 1V/cm. Input resistance 100k $\Omega$ , bandwidth DC to 2MHz.

#### GENERAL INFORMATION

#### CALIBRATORS:

(i) CAL.: Line frequency square wave 1V pk.pk  $\pm$  2% rise time approx. 20 $\mu$ S.

(ii) PROBE TEST: Time base gate waveform + 10V.

#### SUPPLIES:

95-111/103-121/111-130.

190-222/206-242/222-260.

Selected by rear panel switch.

45-440Hz. Approx. 35VA.

#### OPERATING TEMPERATURE RANGE:

0 to + 40 $^{\circ}$  C.

#### WEIGHT:

20 lb.

#### SIZE:

7" x 11 $\frac{1}{2}$ " x 17".

(H) (W) (L)

Further information available from:

# JACOBY MITCHELL

SYDNEY	630 7400	BRISBANE	21 0586
MELBOURNE	30 2491	PERTH	28 5725
ADELAIDE	93 6117	LAUNCESTON	2 5322

JM/61-71



# BRIDGE RECTIFIERS



IR has a proven record of supplying new and unusual designs to meet stringent or unorthodox parameters. For further assistance in ordering or detailed design information call your local **WARBURTON FRANKI** office

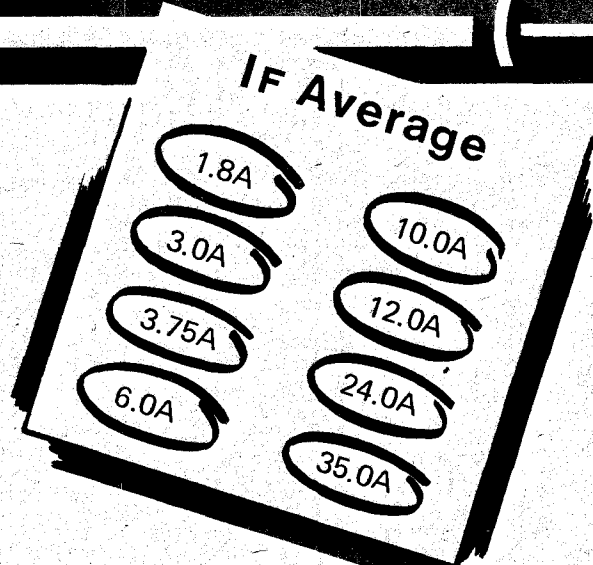
Ratings — Absolute Maximums

## BRIDGE CIRCUIT ASSEMBLIES RATINGS AND CHARACTERISTICS

Part Number (1)	18DB	30DB	50FB	60FB	100PB	B6F	B12F	B70H
$I_T$ (av.)—Max. average output current (A) (1)	1.8	3.0	3.75	6.0	10.0	12	24	35
$I_{FM}$ (Surge)—Max. peak one cycle surge current (A)	40	70	200	150	300	—	—	—
$i_{FM}$ —Max. repetitive peak current (A)	5	5	20	—	60	—	—	—
$T_A$ —Ambient Operating temp (°C)	-40° to 140°	-40° to 140°	-20° to 140°	-65° to 150°	-65° to 150°	—	-65° to 180°	-65° to 180°
Case (pp. 13-15)	D-2	D-12	D-13	D-14	(2)	D-10	D-10	D-10

(1) — Suitable safety factors — both voltage and current — commensurate with individual application conditions must be applied to the absolute maximum ratings to safeguard against voltage transients and current surges.

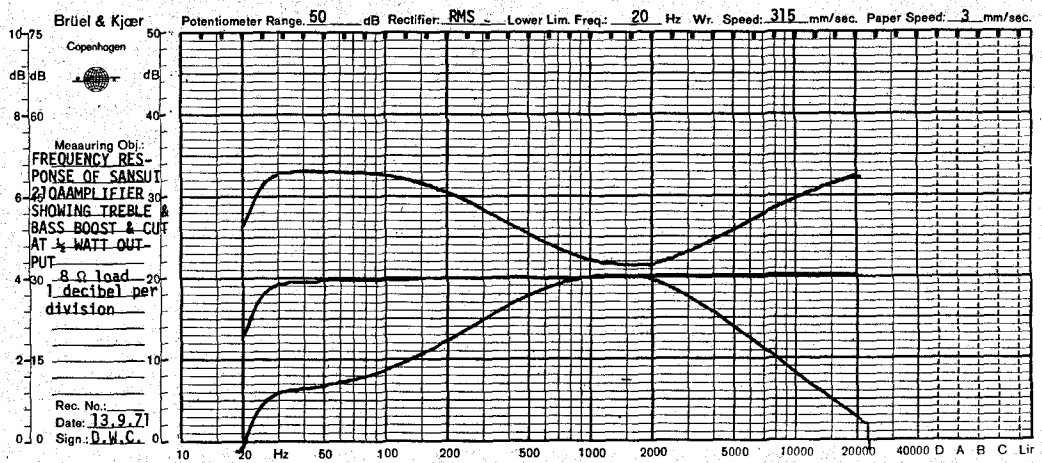
(2) — For D-4 Case, use "P" suffix. For D-5 Case, change suffix to "L".



## WARBURTON FRANKI

- ADELAIDE 56-7333
- BRISBANE 51-5121
- HOBART 23-1841
- LAUNCESTON 31-3300
- MELBOURNE 69-0151
- NEWCASTLE 61-4077
- MOUNT GAMBIER 2-3841
- SYDNEY 648-1711
- WHYALLA 45-0216
- WOLLONGONG 2-5444

# THE SANSUI 210A TUNER AMPLIFIER



## MEASURED PERFORMANCE OF SANSUI TUNER AMPLIFIER — MODEL NO. 210A, SERIAL NO. 821050771

Frequency Response:  
= 30Hz to 20kHz  $\pm 1/2$ dB — auxiliary input to output

Harmonic Distortion at rated output

100Hz	0.15%
1kHz	0.25%
6.3kHz	0.4%

Channel Separation at 1kHz

auxiliary input	51dB
phono input	38dB

Weighted Signal-to-Noise ratio

auxiliary input	68dB (A)
phono input	62dB (A)

Output for recommended input

Input	Output	
Phono	3mV	8W
Auxiliary	180mV	15W
Tape Monitor	180mV	13.7W

Bandwidth 6kHz  $\pm 3$ dB

Aerial Input Sensitivity for 6 dB signal  
to noise ratio with 1kHz signal and 30% modulation level.

Medium Wave sensitivity

600 kHz	12.5 $\mu$ V
900 kHz	12.5 $\mu$ V
1500 kHz	7.5 $\mu$ V

Short Wave sensitivity

4MHz	2 $\mu$ V
9MHz	10 $\mu$ V
12MHz	18 $\mu$ V (due to slight misalignment)

Bass Control

13dB boost at 80Hz
12dB cut at 50Hz

Treble Control

10dB boost at 10kHz
12dB cut at 10kHz

Loudness Control at 0.03 Watts output

8dB boost at 50Hz
3dB boost at 10kHz

Dimensions 5" H x 17-1/8" W x 11-1/8" D  
Weight: 13.5 lbs.  
Price: \$185 approx.

need to refer to the manual for basic operational instructions.

The manual covers such subjects as installation, operation and maintenance and includes specifications, circuit diagrams, wiring and board layouts with component part lists.

This tuner amplifier is the first Japanese unit we have seen which has a 24 months warranty on parts as well as the normal 12 months free labour. Spare fuses and pin plugs and a polishing cloth are supplied with the unit.

### PERFORMANCE

The amplifier performed well when subjected to all of our various laboratory tests with most of the measured parameters being equal to or exceeding those claimed by the manufacturers.

Power output varied considerably with the different inputs driven at the recommended input levels.

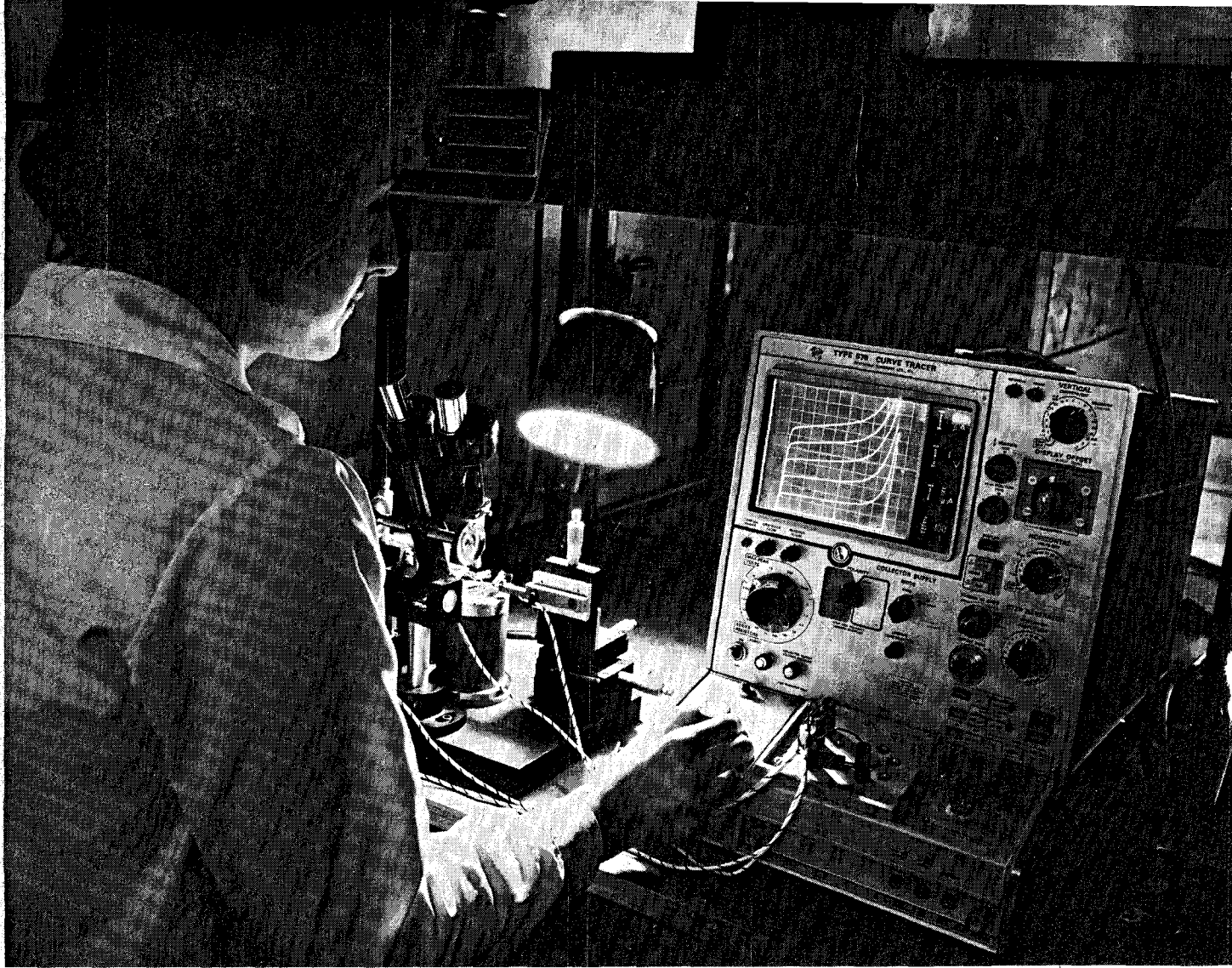
Frequency response and harmonic distortion were much better than the manufacturer's claims.

Signal-to-noise ratio and channel separation were approximately equal to the manufacturer's specification.

The loudness control became progressively effective below 4 watts output.

The oscillator tracking on short wave showed signs of a slight maladjustment of one trimmer and whilst not seriously degrading the performance, resulted in a slight loss of sensitivity above 9MHz.

This tuner amplifier is an extremely good low cost high performance unit. Like its brother the AU101 amplifier, it is very good value for money and should make many people reconsider the advantages of a tuner amplifier as compared to a straight amplifier in the home high fidelity system. ●



# ***SINGLE CHIP COMPUTERS***

British company make world breakthrough with new integrated circuit design.

**A** SEVERE blow to the USA's already ailing microcircuitry business was delivered last week by Britain's Ferranti Corporation.

For the news that Ferranti engineers had developed a totally new bipolar integrated-circuit manufacturing process coincided with the shock announcement that USA's General Electric Company had closed its integrated circuits department with a loss of over \$50,000,000.

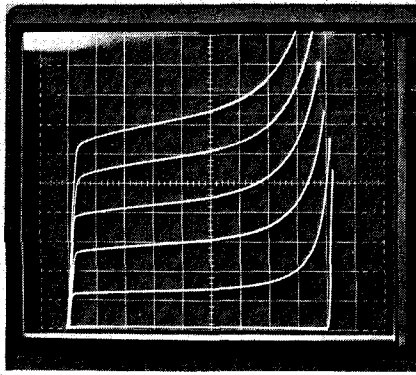
The development work at the Manchester factories of Ferranti has

created a world breakthrough that can only be compared in significance to the development of the first metal oxide silicon integrated circuit.

But the new process opens up markets that were previously impossible using the conventional metal-oxide-silicon technique.

David Grundy, manager of the company's integrated circuit engineering group says that one immediate application would be a single chip, combining both digital and linear functions, to yield an





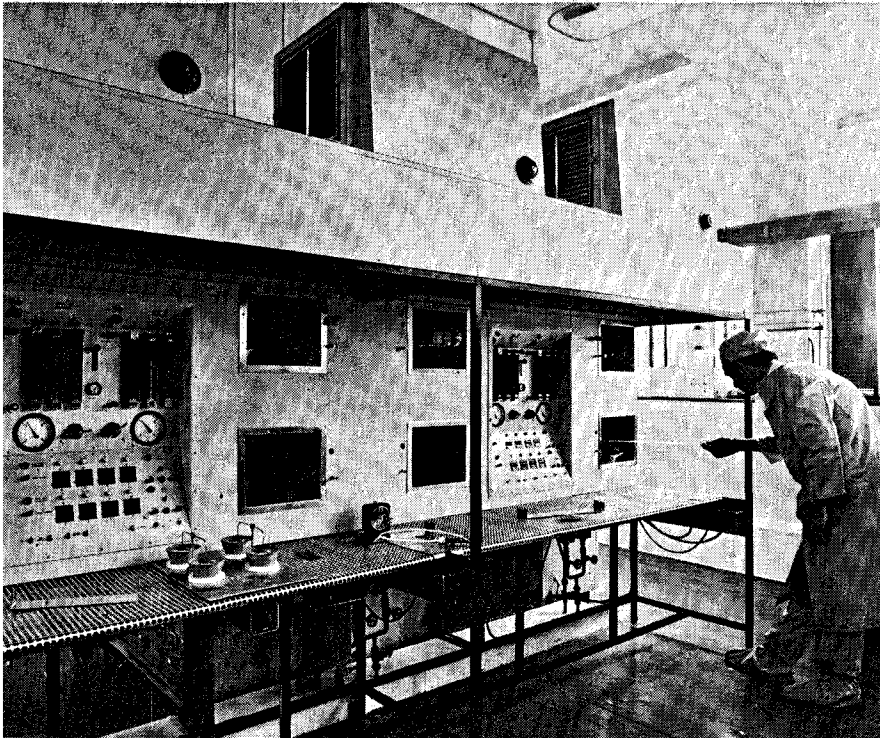
**ABOVE:** Close-up of a curve tracer displaying the collector-emitter characteristics of a CDI transistor in a digital array.



**RIGHT:** Physical inspection of rubyliths of a 1,024-bit shift CDI register.

**LEFT:** An operator carrying out a process control check using a curve tracer which shows the collector-emitter characteristics of a CDI transistor in a digital array.

**BELOW:** View of part of the pre-production line for CDI bipolar integrated circuits in the Electronics Department of Ferranti Ltd.



automobile fuel injection control system that could solve most of today's exhaust pollution problems.

The new technology offers previously unobtainable versatility of design and application which must ensure its acceptance in areas as diverse as desk calculators, high speed random access memories for computers, random logic arrays, automobile and aircraft electronic systems, and telecommunications — through to consumer products.

The new technique could well provide the first high performance

'computer on a slice', or even on a single chip!

#### HOW IT WORKS

Over the past three years, Ferranti's semiconductor division has devoted intensive effort aimed at meeting the fast-growing demands of the international electronics market for a low cost means of achieving higher function density integrated circuits with an accompanying improvement in component performance.

Conventional bipolar integrated-circuits provide high

switching speeds, single logic supply rail, linear performance, and combined digital and linear functions on one chip, but have the major drawback of requiring complex masking and diffusion operations which limit manufacturing efficiency on digital arrays of metal oxide silicon complexity.

Consequently, Ferranti commenced extensive development on the Collector Diffusion Isolation process originated by the USA's Bell Laboratories.

The collector diffusion isolation (CDI) process requires only five masking operations compared with the nine steps involved in current bipolar processing.

A severe limitation of the original CDI system was the requirement for a three volt power supply. Ferranti recognised that this difficulty was not insurmountable and a major process development programme was undertaken, resulting in the perfection of a truly TTL compatible, five volt CDI process.

This new technique represents a world breakthrough in bipolar technology because it makes possible, for the first time, the practical manufacture of LSI (large scale integration) circuits that combine the very high complexity of conventional metal oxide silicon techniques with the performance advantages of current bipolar devices. These include high switching speed, digital and linear functions on the same monolithic chip, and high current capability. Even more significantly, a supply voltage range of one volt up to five volts not only ensures a single five volt supply rail that is truly compatible with TTL logic systems, but also allows battery operation.

As a bipolar technology based on the bulk properties of semiconductors, Ferranti CDI possess the high stability and ruggedness of conventional bipolar devices. This allows simple, low cost packaging, which is an advantage over technologies like metal oxide silicon that are based on the surface properties of semiconductors and consequently are more susceptible to ionic contamination.

Initially, the Ferranti organisation are producing a library of basic functional building blocks — such as gates and flip-flops, taking advantage of the unique properties of CDI devices to achieve minimum area consumption.

Ultimately, a large part of the market for the new technology may lie in custom development for specialised applications. In fact, rumours in the electronics industry suggest that the British Government may soon subsidize development of a large solid state memory system. ●

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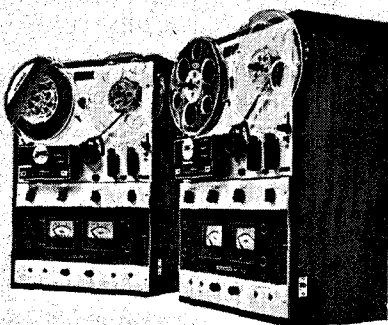


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and stereo headphone jacks . . . the list goes on and on but our heavily discounted stocks must run out soon. Hurry. Reach for the savings!

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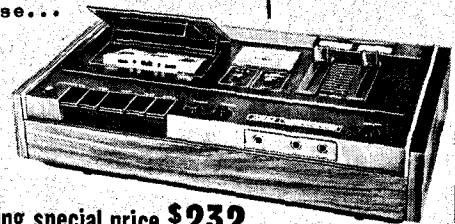
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4-TRACK, 3 MOTORS, STEREO.

Here's a model to give you a truly professional touch — with true Concert Hall Sound! Features 4-track stereo monaural recording and playback, Cross Field Head System with 3-heads, 3-speeds, 3-motors, auto. stop, auto. pinch wheel release, track selector and tape lifter. 40 W Music Power solid state amplifier with two integrated circuits.

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# AKAI LOUDSPEAKER TYPE SW 155

*Akai's SW155 speakers have a fine appearance and combine reasonable performance with low distortion.*

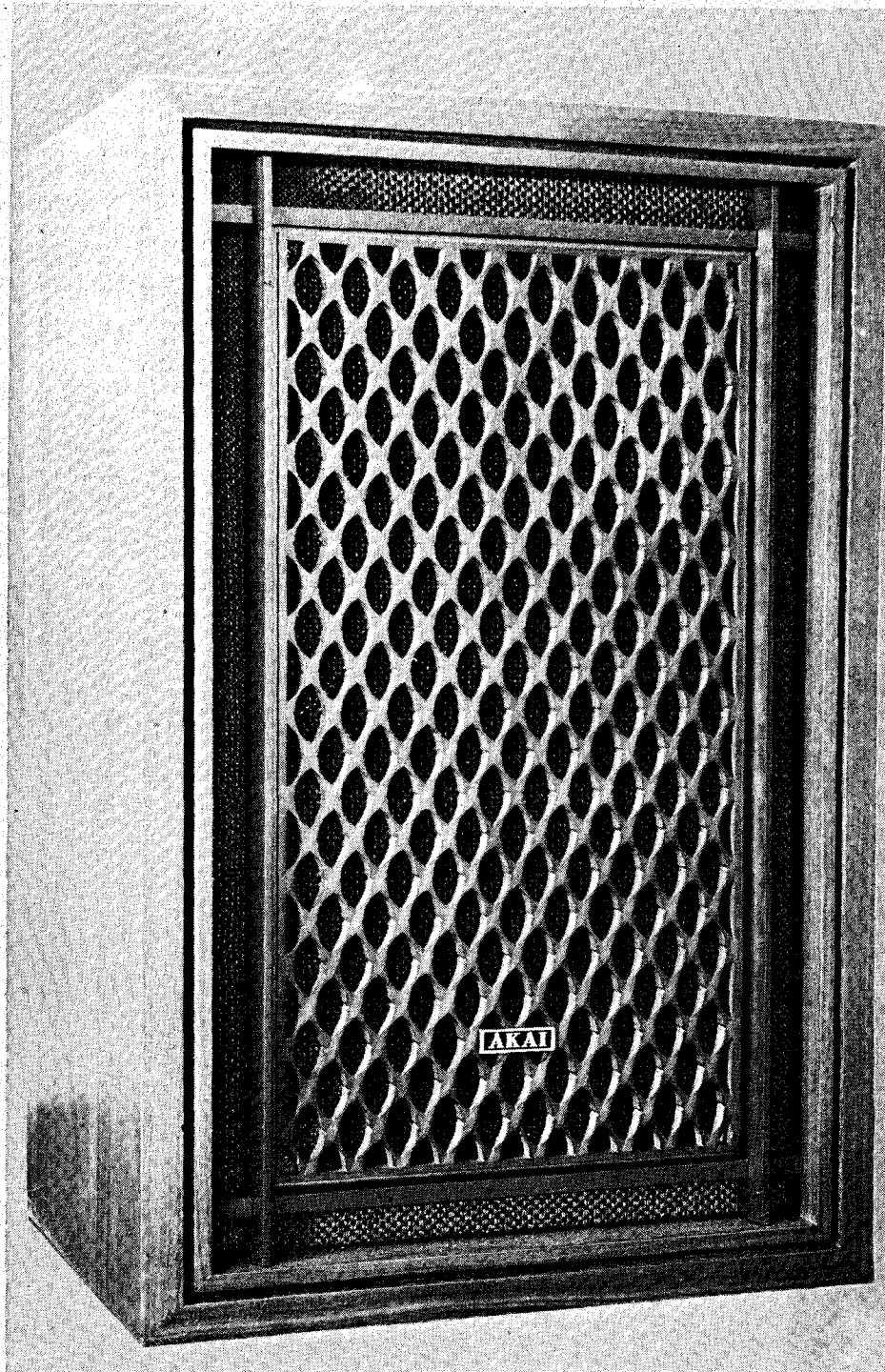
**T**HE Akai SW155 speakers are one of the more recent types of speakers which are designed with striking front grilles. They are designed to be an additional piece of furniture with an emphasis on the quality of external finish. The dark grille cloth of these speakers is deeply recessed — to approximately 1½" — and covered with a heavy carved timber grille. This deeply recessed front considerably reduces the available internal volume (by about 200 cubic inches).

The striking appearance of these speakers may limit to a minor extent their use in some rooms. The main box is constructed from 1" thick veneered plywood which also forms the heavy timber surround to the front panel. The enclosure is of the vented design and has a third bonded fibre lining, which provides some internal damping.

The speaker complement consists of four units:—

The largest speaker is a 12" woofer having a 6 ohm impedance and 25 Watt nominal rating, with a magnet measuring 4¾" diameter by 5/8" deep.

The next speaker is a 5" midrange unit, L.C. coupled, with an 8 ohm wire wound potentiometer wired in parallel.



**AKAI  
LOUDSPEAKER  
TYPE  
SW 155**



The midrange speaker rather surprisingly, has a 3 Watt nominal rating and an 8 ohm impedance with a magnet assembly measuring 2 3/4" diameter x 3/8" deep. This speaker operates in the range between 1200Hz and 5000Hz at which point the 2" Horn type tweeter takes over via a second L.C. crossover network and another 8 ohm wire wound potentiometer.

The 2" horn type tweeter has a 1 3/4" diameter by 3/8" deep magnet assembly: this is relatively large for a tweeter.

The final speaker in the network is a conventional design 2 1/2" cone-type tweeter capacity coupled to the 2" horn type tweeter and designed to be effective above 15,000Hz.

The mid-range and high-range controls are mounted on a recessed panel in the back of the speaker. This recessed panel also contains a pair of spring loaded terminals as well as a practical tip and sleeve jack socket which Akai alone use on loudspeakers. The speaker comes complete with a cable fitted with a tip and sleeve plug each end to facilitate connection of the speakers to an amplifier with similar facilities.

A set of six felt pads with adhesive backing are supplied with each speakers. These pads which are 3/4" in diameter by 1/8" thick may be used if one wishes to stand the speakers on the floor.

Subjective A - B tests with our control monitors indicated a loss of low frequency response which could be partially corrected with bass boost. Further subjective tests in the home showed evidence of a very slight colouration and a lack of presence and brilliance with the mid-range and high-range controls set at the normal setting. By adjusting these controls to their maximum positions there was a slight improvement in the presence and brilliance. There was a notable difference in the frequency response between the two speakers.

The mid and high range controls provided some boost and, rather surprisingly, exceptional cut. In fact, with the circuit arrangement used (refer Fig. 1) the minimum settings of the mid-range and high range controls isolated the mid-range speaker and the two tweeters. In most speaker systems we have seen, the potentiometer is connected in series with a fixed resistor thereby limiting the effective range of the potentiometer.

An intriguing feature of the speakers

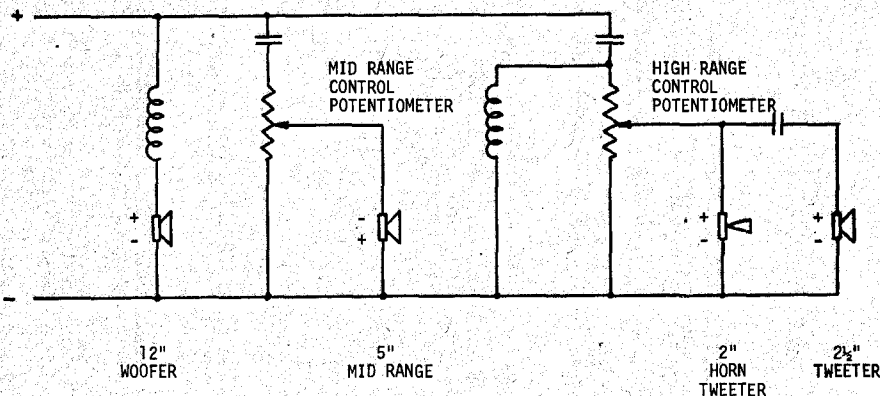
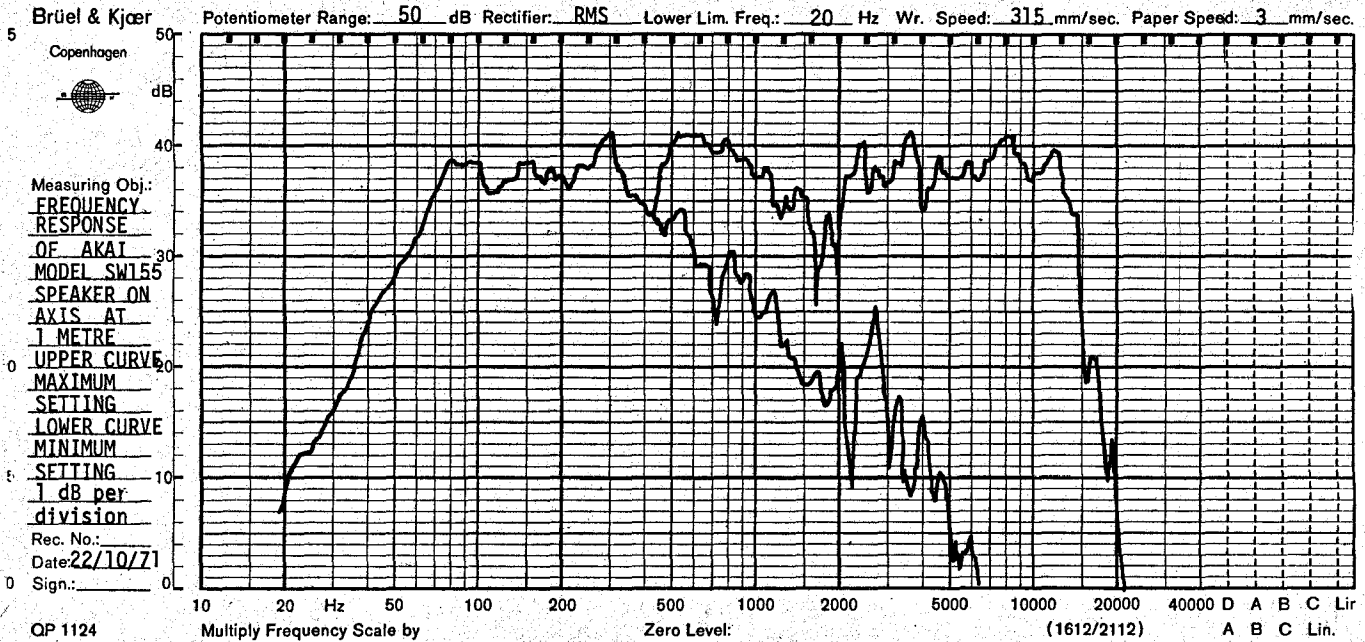
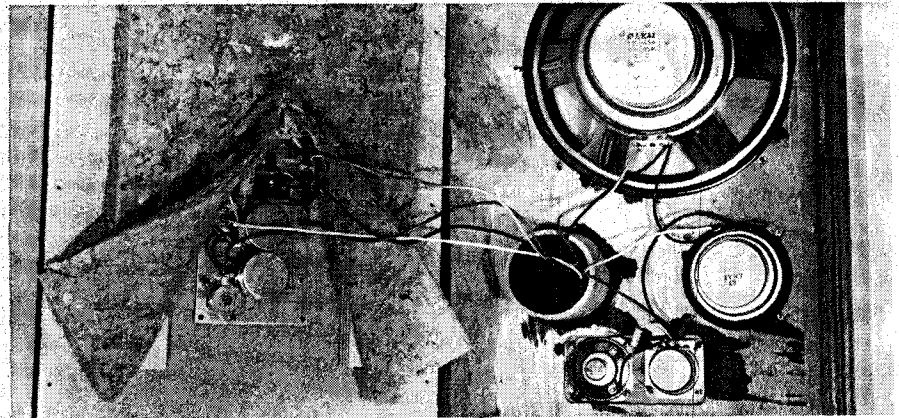


Fig. 1. Akai's method of interconnecting the various drive units provides an unusually large range of mid-range and treble attenuation.



was the wiring of the mid-range speakers which appeared to be intentionally wired up so as to be 180° out of phase with the other speakers. Both speaker units tested were wired in this fashion. The measured frequency response confirmed the lack of low frequency performance with a noticeable roll off below 80 Hz.

The measured crossover frequencies were approximately 1600Hz, 4000Hz and 14,000Hz, which is in close agreement with the catalogued data. The 2½" tweeter had a very low sensitivity as is shown by the sharp drop off above 15 000Hz. But as most people above the age of 25 years (and



many below) cannot hear frequencies above 15,000Hz we are confused as to the reason for including the second tweeter.

Between 100Hz and 15,000Hz the response is relatively flat and comparable with most speakers in its price bracket.

A noticeable peak occurs around 100Hz and can be attributed to the vent pipe diameter and length. A slight reduction in diameter of this pipe, or an increase in its length, would optimise its performance and would extend the low frequency responses of the system.

For the housewife who wants a set of speakers to complement her furnishings, and for the husband who wants a reasonable performance with low distortion then the Akai SW155 speakers would fit the bill. ●

#### Measured Performance of Akai Speaker Type SW155 Serial No. 1555806

Frequency response	50 Hz to 15 kHz ± 6dB
Harmonic distortion at 10 Watts input	
100Hz	0.6%
1kHz	0.27%
Harmonic distortion at 20 Watts input	
100Hz	1.0%
1kHz	0.4%
Electroacoustic efficiency	0.7%
Dimensions:	25" H x 16" W x 11 1/4" D
Weight	39 lbs.
Price	\$351 pair
Speaker type SW155 serial No. 1559824 was also used for the subjective tests	

# A PRACTICAL GUIDE TO ZENER DIODES

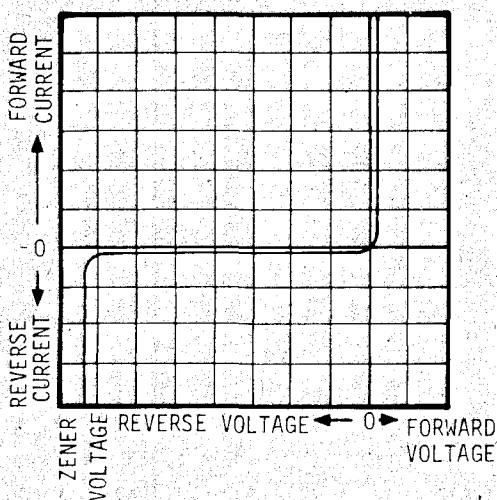


FIG. 1

*In this two-part article we explain how to use this versatile circuit component*

**L**IKE the Establishment, but of more obvious value, Zener diodes remain constant and unperturbed by external change.

Zener diodes — named after Dr. Carl Zener — are used primarily as voltage references. They are devices that maintain an almost constant voltage across them despite various changes in circuit conditions.

Externally, Zener diodes look much the same as conventional diodes and are manufactured in axial lead, and stud mounting forms; furthermore Zener diodes are capable of rectifying alternating current into pulsating direct current as are their conventional counterparts.

But unlike conventional diodes,

Zener diodes are deliberately intended to be used with the anode connected to a negative potential and the cathode connected to a positive potential.

When connected in this manner, Zener diodes have a very high resistance below a certain, critical, voltage (called, appropriately, the Zener voltage).

But if this critical voltage is exceeded, the dynamic resistance of Zeners drop to a very low level. And in this region, essentially constant voltages will be maintained across the Zeners, and these constant voltages will be maintained despite quite large changes in the applied currents.

This characteristic is illustrated graphically in Fig. 1 from which it may be seen that beyond the 'Zener voltage' the reverse voltage remains practically constant despite changes in reverse current.

Because of this characteristic, Zener diodes may be used to provide a constant voltage drop, or reference voltage, across their internal resistance.

Zener diodes are manufactured in a number of wattage ratings and with Zener voltages ranging from 2.7 Volts to 200 Volts. (In practice, Zener diodes with ratings exceeding 30 Volts are rarely used.)

## THE BASIC CIRCUIT

A basic voltage regulator circuit, using one resistor and one (idealized) Zener diode, is shown in Fig. 2. In the example shown, the Zener diode is rated at 5.6 Volts and the applied

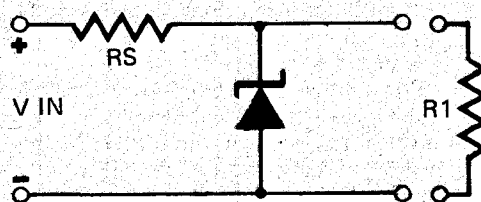


FIG. 2

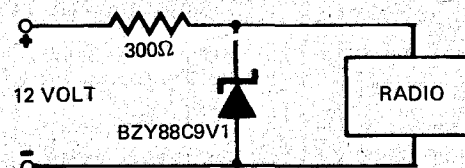


FIG. 3

voltage  $V$  in is 8.0 Volts. With no load applied to the output terminals, 5.6 Volts will be dropped across the Zener diode and the remaining 2.4 Volts will be dropped across resistor  $R_s$ .

If the input voltage is now changed, say, from 8.0 Volts to 9.0 Volts, then the voltage drop across the Zener will still remain at its nominal 5.6 Volts but the voltage drop across  $R_s$  will increase, from 2.4 Volts, to 3.4 Volts. The voltage drop across the (ideal) Zener will remain constant.

In practice, the voltage will increase slightly due to the dynamic resistance of the Zener. (The method of calculating the change in Zener voltage is simply to multiply the dynamic resistance of the Zener diode by the change in Zener current.)

The resistor  $R_1$ , in Fig. 2, represents an external load. If this load is connected across the circuit, then some of the current that was flowing through the Zener will now pass through the load. Providing the current in  $R_s$  is greater than the load current, some current will still pass through the Zener and a substantially constant voltage will be maintained across the Zener/load.

The series resistor  $R_s$  is selected so that the minimum current passing through the Zener is not less than the level required for stable regulation.

This level begins just below the 'knee' of the reverse voltage/reverse current curve (as shown in Fig. 1). Curves such as this are available for all makes and types of Zener diodes.

It is also necessary to ensure that the value of  $R_s$  is such that current flow

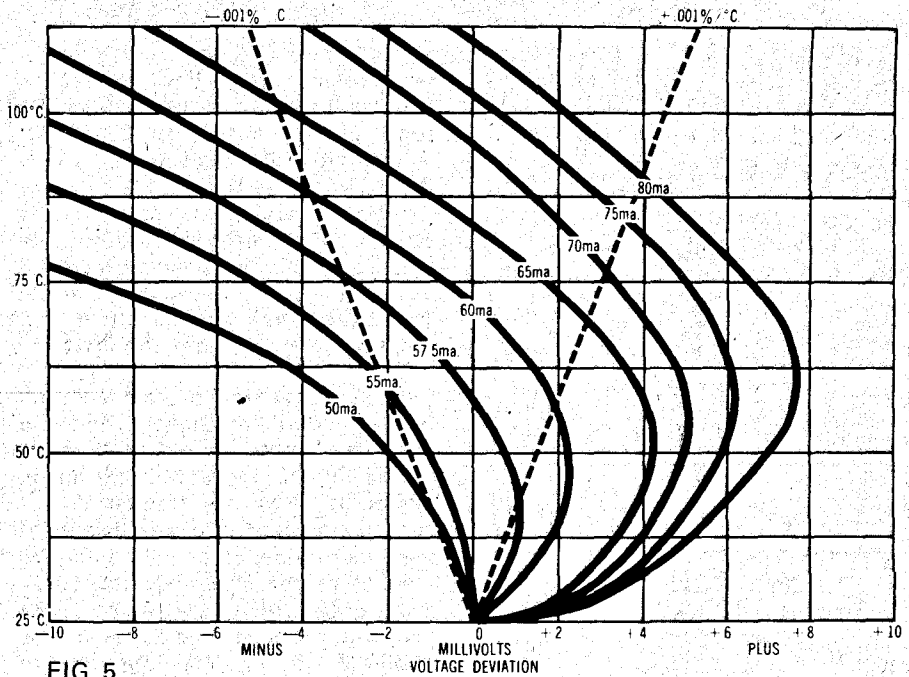
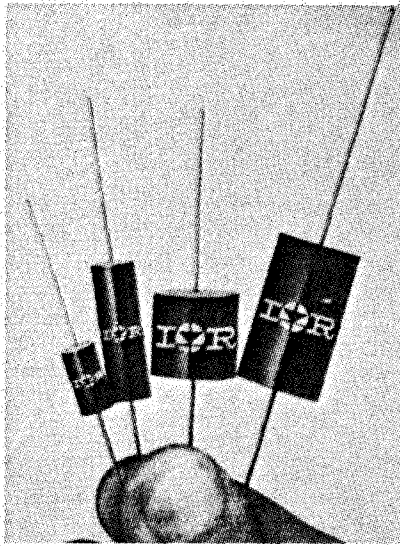


FIG. 5

through the Zener diode cannot exceed its specified power rating: which is the Zener voltage multiplied by the Zener current. In the circuit shown in Fig. 2, maximum current will flow through the Zener diode when the load is disconnected.

The design procedure for this circuit is quite simple.

1. Specify the maximum and minimum load current ( $I_L$ ), say 10 mA and 0 mA.
2. Specify the maximum supply voltage that is likely to occur (say, 12 Volts), but ensure that the minimum supply voltage will always be at least 1.5 Volts higher than the Zener voltage of the diode to be used.
3. In the circuit shown in Fig. 2, the required output voltage, and hence the Zener voltage, is 5.6 Volts, and the specified minimum Zener current is 100 microamps. Thus the maximum Zener current is 100 microamps plus 10 milliamps — which is 10.1 milliamps.

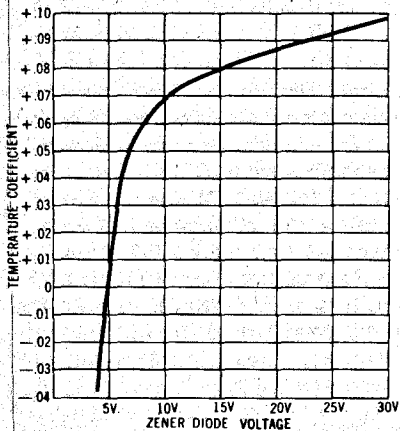


FIG. 4

4. The series resistor  $R_s$  must conduct 10.1 mA at the lowest input supply voltage: and so allowing 1.5 Volts minimum voltage drop across  $R_s$  (i.e. input voltage minus Zener voltage):—

$$R_s = \frac{1.5}{10.1 \times 10^{-3}} = 148.5 \text{ ohms}$$

5. The value of  $R_s$  is thus 148.5 ohms, and the nearest preferred value to this is 150 ohms.
6. At the maximum supply voltage (12 Volts), the voltage drop across  $R_s$  is  $I_z R_s$ , ( $I_z$  being Zener current):—

$$\text{thus } I_z = \frac{(12 - 5.6) \text{ mA}}{150} = 42.6 \text{ mA}$$

7. This is the maximum current that will flow through the Zener at any time, i.e., maximum input voltage and zero external load. The power dissipated by the Zener under these conditions is:—

$$I_z V_z = 5.6 \times 42.6 = 238 \text{ mW}$$

8. Having calculated that the correct value for  $R_s$  is 150 ohms, and that the Zener diode must be capable of dissipating 238 mW all that remains is to choose the correct type of 5.6 Volt Zener. This is, in fact, well within the capabilities of most small Zener diodes which are generally rated at 400 mW.

### A PORTABLE RADIO IN YOUR CAR

A practical example of the circuit described above is illustrated in Fig. 3. This shows how to run a transistor radio from your car's power supply.

The voltage required for the radio is 9 Volts — and the nearest Zener diode to this is 9.1 Volts.

The maximum current drawn by the radio is measured at — say — 10 mA, and, as the load does not vary greatly, this is also the minimum current. (As 10 mA is well above the 'knee' current of most small diodes, the addition of a minimum operating current is not required.)

The maximum supply voltage is around 14 Volts, (when the battery is fully charged).

Thus the series resistor  $R_s$  must conduct 10 mA at the lowest supply voltage (12 Volts) and its value is calculated by:—

$$R_s = \frac{12 - 9.1}{10 \times 10^{-3}} = 290 \text{ ohms}$$

At the maximum supply voltage (14 Volts) the voltage drop across  $R_s$  is  $I_z R_s$ :—

$$I_z = \frac{(14 - 9.1)}{290} = 16.8 \text{ mA}$$

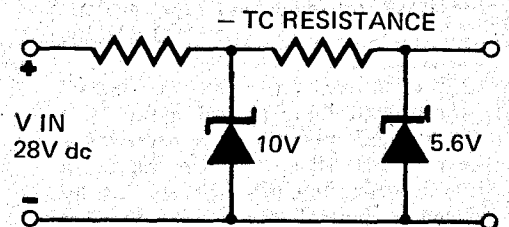


FIG. 6

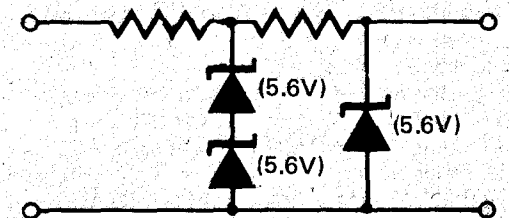


FIG. 7

# A PRACTICAL GUIDE TO ZENER DIODES

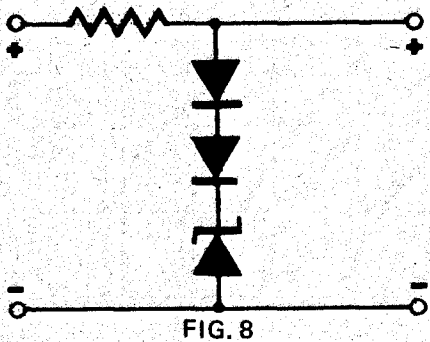


FIG. 8

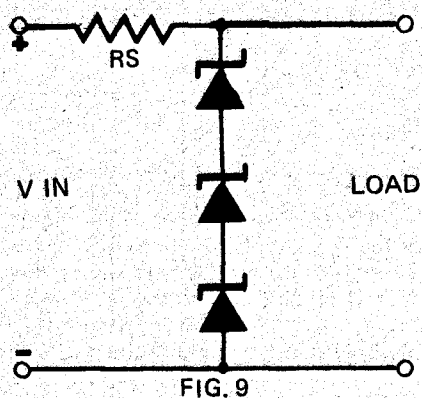


FIG. 9

The maximum power dissipated in the Zener is:—

$$9.1 \times 16.8 \text{ mA} \\ = 152.8 \text{ mW}$$

This is well within the capabilities of a standard 400 mW Zener, such as a BZY 88 C9V1.

## TEMPERATURE DRIFT

Although Zener diodes are relatively immune to changes in supply voltage and load, they are to varying extents affected by changes in ambient and operating temperature. Fig. 4 shows a typical Zener diode temperature coefficient curve, and, as can be seen, the coefficient, although approaching 0.1% per degree Centigrade at the higher voltages, passes through zero at about 5 Volts and then becomes negative for lower voltages, reaching -0.04%/C° at approximately 3.5 Volts.

The transition between a negative and a positive temperature coefficient is not well defined and a 5.6 Volt Zener may have either a positive or negative coefficient depending upon the current flow through it. But by careful control of the operating current it is possible to hold a standard 5.6 Volt Zener diode to a temperature coefficient of  $\pm 0.001\%$  over a temperature range of +25°C to +75°C (Fig. 5 refers).

The only difficulty is to provide a constant current source for the Zener diode. One method is to use a 10 Volt Zener diode to act as a regulator for the reference diode. (Fig. 6). The

current limiting resistor between the two diodes should have a negative temperature coefficient to compensate for the positive (+0.07%/°C) temperature coefficient of the 10 Volt Zener.

A second method of stabilizing the current to the Zener diode is shown in Fig. 7. In this arrangement two 5.6 Volt Zeners, each having practically zero temperature coefficient, in turn stabilize the current through the voltage reference.

Another approach to compensation for temperature change is shown in Fig. 8 where the temperature coefficient of forward-biased silicon diodes is used to counteract the opposite temperature coefficient of the Zener diode. This method may be used to compensate for voltage drift over quite wide ranges of both temperature and voltage, Zener voltage stabilities of 0.01% are readily achieved.

As can be seen from Fig. 4, the temperature coefficient of Zener diodes increases considerably at the higher Zener voltages. An alternative method of temperature stabilizing to that shown in Fig. 8, is to use a number of 5.6 Volt Zeners in series. (Fig. 9).

## TEMPERATURE SENSING

The apparent disadvantage of a Zener diode's temperature coefficient may be put to a useful purpose in the form of a temperature sensing device. Fig. 10 shows how a bridge consisting of two resistors and two similar Zener diodes may be constructed so as to indicate a temperature level when one of the diodes is held at a reference temperature and the other is subject to the conditions to be monitored. The average small 10 Volt Zener has a temperature coefficient of +0.07%/°C — this corresponds to 7 millivolts per °C change. The sensing element will, therefore, indicate an imbalance of 0.7 Volts when undergoing a 100°C temperature change.

## NON-STANDARD VOLTAGES

Occasionally it is necessary to obtain a regulated voltage other than that obtainable from a single Zener, this

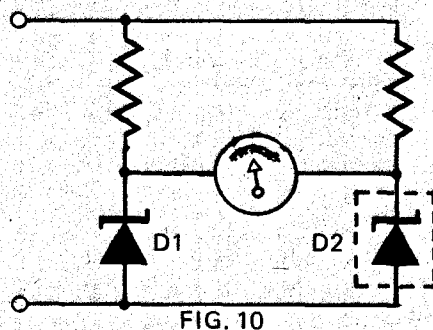


FIG. 10

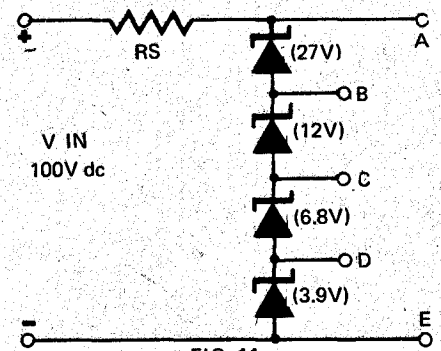
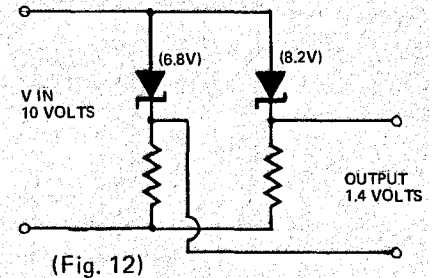


FIG. 11



(Fig. 12)

can be achieved by connecting a number of Zener diodes in series (Fig. 9). The diodes need not have equal breakdown voltages since the arrangement is self equalizing. However, the power handling ability of each diode should be the same. In addition, the current ranges should be similar or the loads so arranged to avoid damaging any of the diodes.

A group of Zener diodes may be used as a voltage divider to obtain several regulated voltages simultaneously. (Fig. 11). This circuit may be used as a meter or scope calibrator. The four diodes shown in the circuit will supply 10 possible voltages:—

Voltage	Terminals
3.9	E — D
6.8	C — D
10.7	C — E
12.0	B' — C
18.8	B — D
22.7	B — E
27.0	A — B
39.0	A — C
45.8	A — D
49.7	A — E

It may also be necessary at times to provide a regulated voltage lower than the 2.7 Volts minimum normally obtainable from a Zener diode. Voltages lower 2.7V may be obtained by using the *difference* in potential between a pair of Zeners, (Fig. 12). The temperature compensation of this circuit is excellent, for both Zener diodes tend to drift in the same direction, thus maintaining the difference voltage.

The second part of this series — to be published next month — describes various ways in which Zener diodes are used in both ac and dc applications. ●



**string classics  
or the  
sound of soul**

**hear it  
how it is on  
BASF  
LH-hifi**

The softest sound of one gently bowed cellostring. Or the full blooded beat of a soul group, at volumes which allow you to feel the rhythm through your feet. Two examples of recorded sound that demonstrate most vividly the benefits of **BASF LH-hifi Tape**. L stands for low noise . . . H is short for high output. Two special features in one recording tape. By eliminating the background noise, and increasing sensitivity BASF engineers have achieved a dramatic improvement in signal-to-noise ratio of as much as 8dB over other quality tapes. Now your recordings will take on magnificent studio quality—with greater clarity, more realism and less distortion—whether they be Rachmaninoff or rock.

Try our new sound experience . . . you'll love it. BASF LH-hifi tape also available in Compact Cassette.



Playing times:  
C30 = 2 x 15 mins. = 30 mins.  
C60 = 2 x 30 mins. = 60 mins.  
C90 = 2 x 45 mins. = 90 mins.  
C120 = 2 x 60 mins. = 120 mins.

BASF Compact Cassettes available everywhere in your choice of either "Trans", "Snap" or "Plastic Pack".



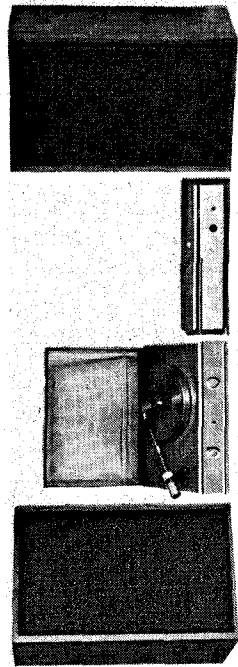
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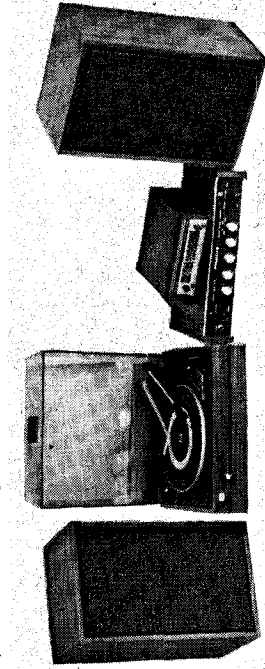


## SYSTEM No. 1 (4 piece teak or walnut)

**DE-35 SPEAKERS**  
 Speaker: 6" Twin Cone  
 Power: 5 watts  
**DE RP-1 RECORD PLAYER**  
 Turntable: 7"  
 Tone Arm: Counterbalanced  
 Cartridge: Sapphire  
**DE-1 AMPLIFIER**  
 Power Output: 6 Watts Stereo  
 Freq. Resp.: 65 - 18,000 Hz.  
 14Hx9Wx6D 12Wx3Hx8D

**NORMAL PRICES**  
 2 speakers : 50.00  
 1 amplifier : 35.00  
 1 Record player : 49.50  
**\$134.50**

Special price if you buy the entire system complete. Only \$99.00  
 Save \$35.00



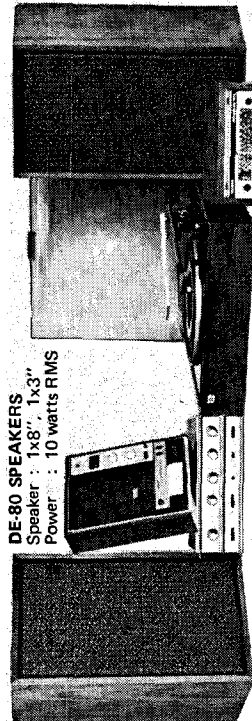
## SYSTEM No. 2 (5 piece teak or walnut)

**DE-80 SPEAKERS**  
 Speakers: 1x8" 1x3"  
 Power: 10 watts RMS  
 18H x 11W x 9D.  
**DE-418 RECORD PLAYER**  
 GARRARD: 2025T  
 Cartridge: Ceramic  
**PHODIS AMPLIFIER**  
 Power Output: 8 watts x 2  
 Freq. Resp.: 55 - 18,000 Hz

**NORMAL PRICES**  
 2 speakers : 70.00  
 1 amplifier : 69.00  
 1 tuner : 65.00  
 1 Record player : 65.00  
**\$269.00**

Special price if you buy the complete system  
**\$199.99**  
 Save \$70.00

**TUNER**  
 550-1600 kHz

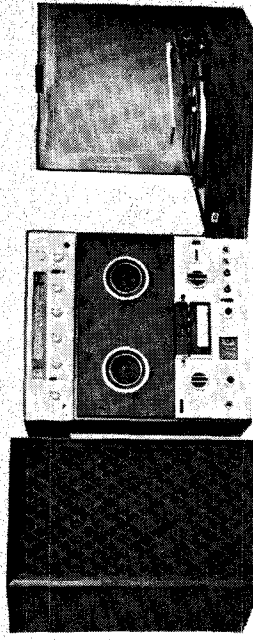


## SYSTEM No. 3 (6 piece teak or walnut)

**SOUND SAG-203**  
 Power output: 10 watts RMSx2  
 Freq. Resp.: 55-20,000 Hz  
**TUNER**  
 SHARP CASSETTE DECK  
 Freq. Resp.: 55-14000Hz  
 incorp. twin level meter  
**DE-418 RECORD PLAYER**  
 GARRARD: 2025TC  
 Cartridge: Ceramic

**NORMAL PRICES**  
 2 speakers : 70.00  
 1 amplifier : 75.00  
 1 tuner : 65.00  
 1 Cassette Deck : 115.00  
 1 Record player : 69.00  
**\$394.00**

Special price if you buy the complete system  
**\$299.00**  
 Save \$100.00



## SYSTEM No. 4 (5 piece teak or walnut)

**DE-77F SPEAKERS x2"**  
 Speakers: 2x8" 1x3"  
 Power: 20 watts  
**C-200 TUNER AMP**  
 Power output: 8 watts x 2  
 Tuning : 550-1600 KHz  
 Freq. Resp. : 35-22,000 Hz  
**DE-419 PLAYER**  
 GARRARD: 408  
 Cartridge : Magnetic

**NORMAL PRICE**  
 2 speakers : 145.00  
 1 Amp-Tuner : 115.00  
 1 Tape deck : 189.00  
 1 Record player: 89.50  
**\$538.50**

Special price if you buy the complete system  
**\$399.00**  
 Save \$140.00

**7000D TAPE DECK**  
 Freq. Resp.: 55-18000Hz  
 Twin level meters



## STEREO SYSTEM KIT No. 5 (No cabinets supplied)

**SPEAKERS**  
 2 x 8 WR  
 2 x 3 TC  
**AMPLIFIER CHASSIS**  
 Power output: 10 watts RMSx2  
 Freq. Resp.: 55-18,000 Hz  
**TUNER CHASSIS**  
 550-1600 KHz  
**RECORD PLAYER**  
 GARRARD: 2025T  
 Cartridge: Ceramic

**NORMAL PRICE**  
 2x8 WR speakers: 19.00  
 2x3 TC Tweeter: 9.00  
 1x Amp chassis: 59.00  
 1x Tuner chassis: 45.00  
 1x Record player: 49.00  
**\$181.00**

Special price if you buy the complete system.  
**\$159.00**  
 Save \$22.00



## STEREO SYSTEM KIT No.6 (No cabinets supplied)

**SPEAKERS**  
 2 x 8 WR  
 2 x 3 TC  
**AMPLIFIER CHASSIS**  
 Power output: 10 watts  
 Freq. Resp. : 55-22,000 Hz  
**TUNER CHASSIS**  
 550-1600 KHz  
**RECORD PLAYER**  
 GARRARD: 408  
 Cartridge : Mag

**NORMAL PRICE**  
 2x8 WR : 19.00  
 2x3 TC Tweeter : 9.00  
 1x Amp Chassis : 69.00  
 1x Tuner chassis : 45.00  
 1x Record player : 69.00  
**\$211.00**

Special price if you buy the complete system  
**\$181.00**  
 Save \$30.00

# JET SET PRINTER

This electronically operated printer can produce 250 characters a second.

A new electronic printer, demonstrated recently at Sydney's US Trade Centre, can operate at no less than 250 characters a second.

The printer operates by electrostatically deflecting a fine stream of ink droplets. It is primarily

intended as a means of producing copy from digital data, such as that produced by data logging systems, data terminals, computers, etc.

The Videojet process, shown schematically in Fig. 1, begins with a small, cylindrical container which has an 0.002" orifice at one end. Ink is pumped into this container which is then energized ultrasonically by a 66 kHz source. This causes the ink to be discharged through the orifice as a stream of droplets of uniform diameter, and at a rate equal to the frequency of the ultrasonic signal. If the assembly is driven at the nominal 66 kHz, the ink stream will comprise 66,000 droplets per second.

As the droplets are ejected serially from the container they pass through a pair of charging plates and each droplet accepts an electrical charge generated by an electronic character generator. The controlled droplets are then directed between a pair of fixed deflection plates, one of which is charged at a steady high voltage level.

A solid state character generator is used to convert the binary coded input information into the video signals necessary to modulate the charges on the droplets.

Each character is formed from a field of 9 x 11 dot positions, as shown in Fig. 2. The characters are formed in the vertical direction by the deflection of the jet, and in the horizontal direction as a result of the relative movement of the paper and jet assembly.

The charged droplets are deflected vertically under the influence of the electrostatic field, as a function of their individual charges. Any uncharged drops are directed to a gutter and returned to the main ink supply.

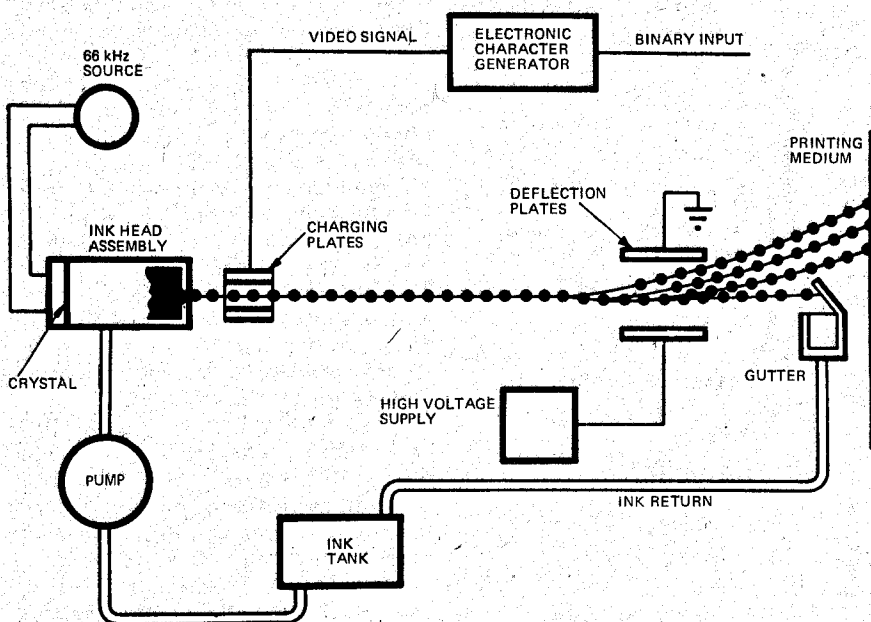
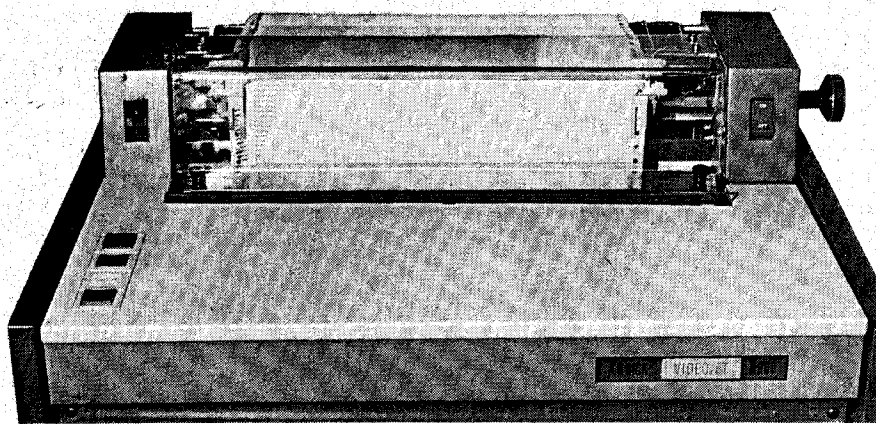


Fig. 1. This block schematic drawing shows the printing process.

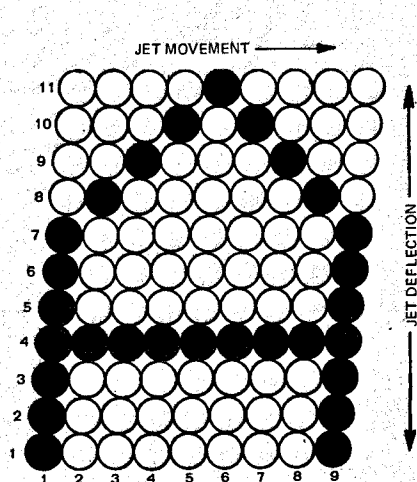
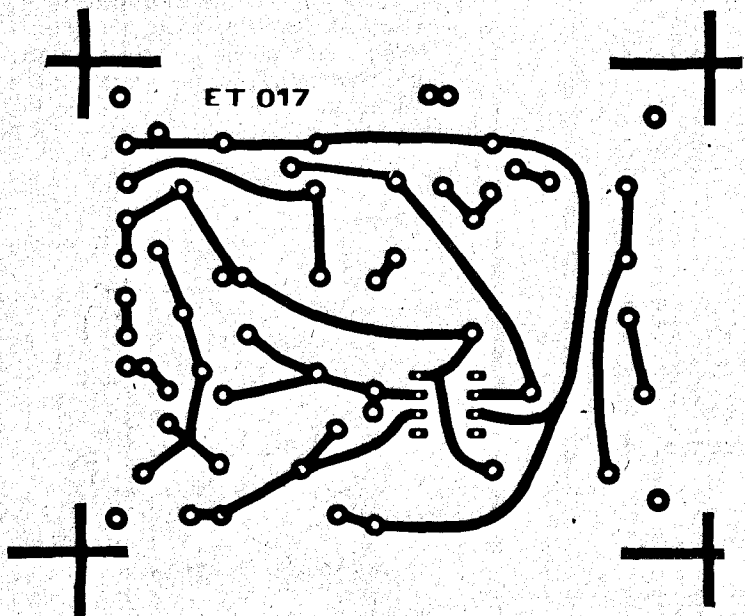
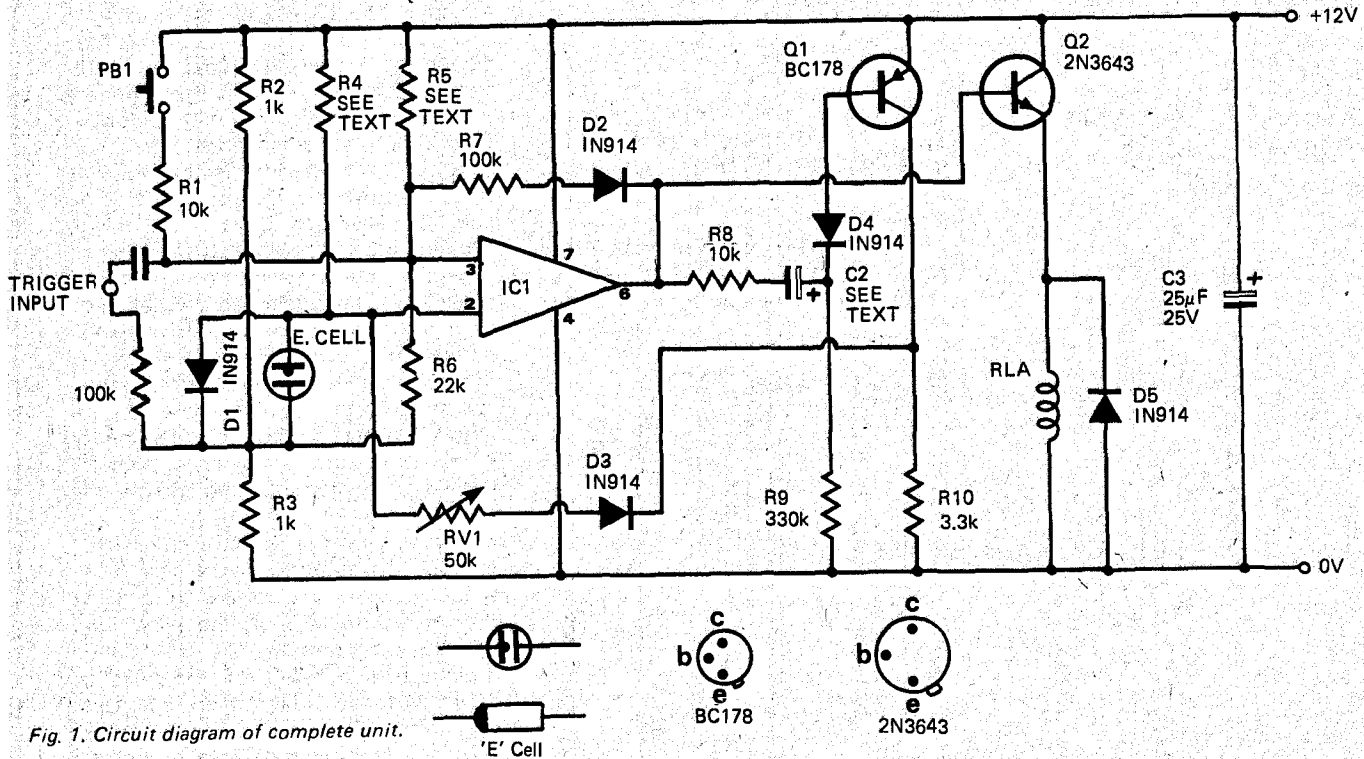


Fig. 2. The characters are formed by using a 9 x 11 matrix.

# FIFTY DAY



There are many occasions when it is necessary to obtain time delays of several hours — or even days — and hitherto this has been practically impossible using solid-state circuitry.

In fact unless computer grade capacitors were used it was difficult to obtain delays beyond four minutes with any degree of reliability.

There are many applications where a long time delay is required — switching house lights off a specific number of hours after nightfall, disconnecting burglar alarm bells after an hour or so, switching on industrial or laboratory apparatus a certain time interval after another process has started or stopped — these are only a few.

A few applications can be satisfied by electro-mechanical timers, but nearly all such devices require 240 Volts ac for their actuation and some form of mechanical action is generally required to start a timing sequence.

The timer described in this article will solve many of these problems. It can be used — quite literally — for periods from four minutes to at least fifty days — and can be initiated by

# TIMER

This totally solid-state timer will provide any required delay between four minutes and fifty days.

...and its all solid state!

## PARTS SUPPLIERS

Parts suppliers are advised that the 'E' cell specified in this project is available ex-stock from the Professional Components Division of Plessey Ducon, Birmingham Ave., Willawood, NSW Tel 72-0133.

pressing a button, applying a short voltage pulse, or from a momentary or sustained relay closure.

The moment an actuating signal is received, the output relay will close. It remains closed until the end of the preset period.

The unit may be operated from a 12 Volt battery (consumption 20-40 mA) or from the 240 Volt mains ac supply using the circuit shown in Fig. 5.

The timing period is set by preselecting the values of resistors R4 and R5, and capacitor C4 (shown in Table 1). These components determine the maximum time period; potentiometer RV1 provides an adjustment of the time delay from the maximum selected period, to 1/10th of the period.

## CONSTRUCTION

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

The simplest way to construct this unit is to mount the components on the printed circuit board, the foil pattern of which is shown in Fig. 2. The positioning of the components on the printed circuit board is shown in Fig. 3. Ensure that the diodes and integrated circuit are orientated correctly.

Many different types of output relay may be chosen for this project — depending upon the number and form of contacts required. The coil

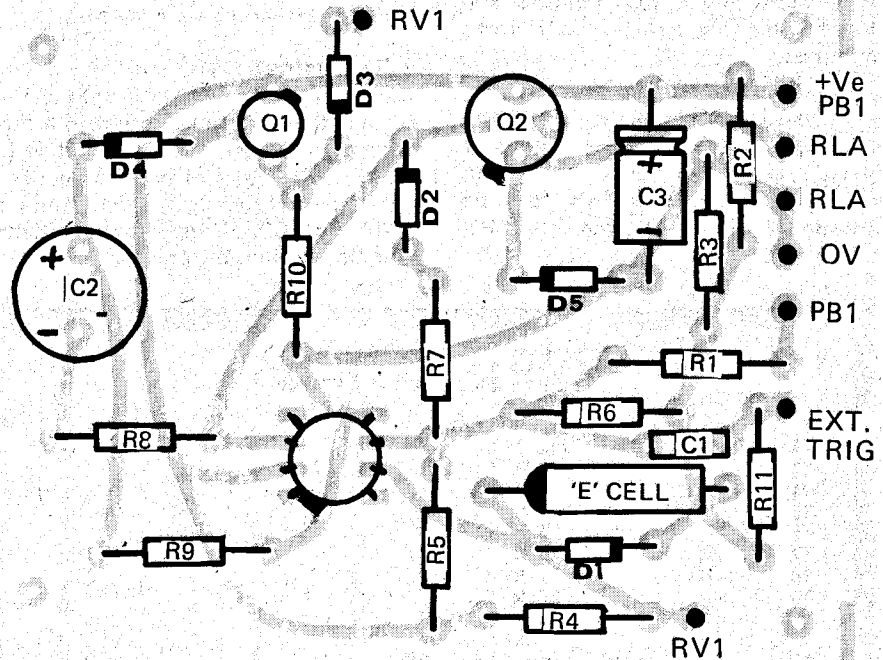


Fig. 3. This shows how the components are located on the printed circuit board.

resistance of the relay must not however be less than 220 ohms.

## THE UNIT IN USE

The delay is initiated by momentarily depressing PB1 — or by applying a positive pulse to the trigger input. There may be applications where the delay must be initiated by a relay closure of indeterminate time — in these cases the contacts of the triggering relay should be connected

between the trigger input connection and the positive rail.

The moment a triggering signal is applied, the output relay will close and will remain closed until the end of the preset period of time. The relay can be opened at any time by applying a negative pulse to the triggering input connection — but the unit is not reset to zero by this action.

If the unit is subsequently restarted the next time delay will be twice the

TABLE 1		
Time	R4-R5	C2
10 min	150k	40uF
30 min	820k	40uF
60 min	1.5M	40uF
5 hours	1.5M	200uF
12 hours	1.5M	500uF
24 hours	1.5M	1000uF
240 hours	15M	1000uF
50 days	15M	5000uF

Note R4 = R5.

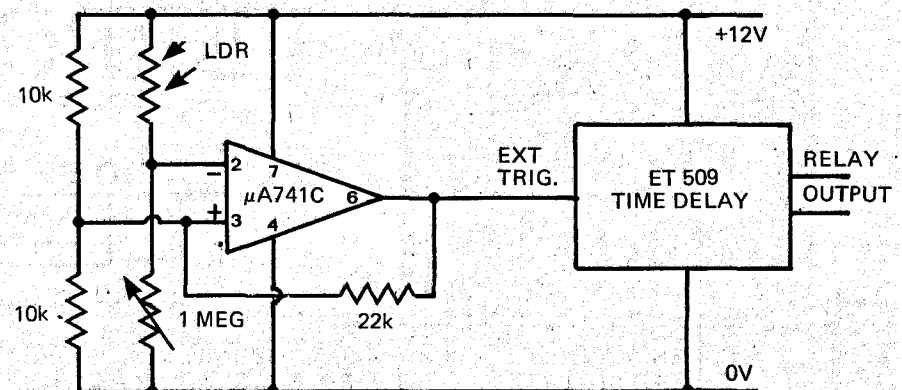


Fig. 4. The time delay circuit can be combined with the light operated switch (described in last month's Electronics Today) to turn lights on at night fall, and off a specified time afterwards.

# FIFTY DAY TIMER

normal delay minus the previous 'on' time, and the 'off' time between the two operations. The minimum period is one normal delay (e.g. if the original delay was one hour but the unit was shut off after five minutes and then restarted after a further fifteen minutes, then the new delay will be two hours minus five minutes and fifteen minutes = one hour forty minutes).

When power is connected to the unit, the delay may be automatically triggered (as indicated by closing of the relay contacts) for an undetermined delay. This can be obviated by leaving power connected to the unit at all times.

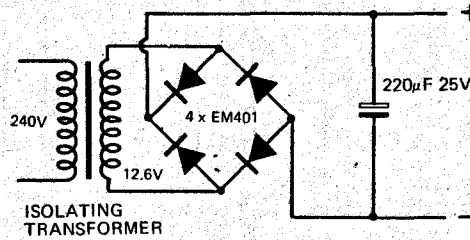


Fig. 5. The time delay circuit may be operated from this simple power supply unit if mains operation is required.

This effect is inherent in the operating principle — the only way in which the unit can be reset in a time shorter than the preset period is by turning RV1 to a higher setting, or by arranging to switch in lower values of R4/5 and C2. However once initiated the time cannot be altered. ●

## HOW IT WORKS

The main timing element is the 'E' Cell (described in detail in Electronics Today, August 1971). Basically this is a cell in which silver is transferred by an electroplating process from one electrode to another. When all silver has been transferred, the interelectrode resistance increases by several orders of magnitude.

The fact that this process is reversible enables the cell to be used as a timing element.

The circuit described in this article has a 'toggle' action in which silver is plated onto the centre electrode very rapidly, and after a short time the plating action is automatically reversed. The deposited silver is then removed very slowly, and the timing period ends when all the deposited silver is once again removed from the centre electrode. The timing period is the total time for both plating periods.

The advantage of the system is that a short time lag (up to four minutes) can be used to 'set' the E Cell, and a longer period (up to 50 days) can be used to clear the cell.

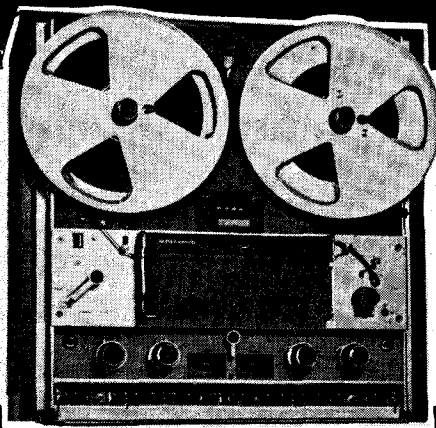
The 'E' cell is initially 'set' by current flowing through RV1 and R10 — for a period determined by the monostable Q1. This time is approximately  $0.7 \times (R4) \times (C2)$  seconds. (R is in ohms, C in Farads). The clearing current is controlled by R4. The total time duration of the circuit is

$$(1 + \frac{I_s}{I_c}) \times T$$

where  $I_s$  is the setting current,  $I_c$  is the clearing current and T is the monostable time.

## PARTS LIST ET 509

R1	—	resistor 10k ½ Watt, 5%
R2	—	" " " " "
R3	—	" " " " "
R4	—	see text
R5	—	see text
R6	—	" " " " "
R7	—	22k ½ Watt, 5%
R8	—	100k " " "
R9	—	10k " " "
R10	—	330k " " "
R11	—	3.3k " " "
RV1	—	100k " " "
C1	—	potentiometer — linear 50k
C2	—	capacitor 0.1µF
C3	—	" " see text
Q1	—	25µF, 25V electrolytic
Q2	—	transistor BC 108
E cell	—	integrated circuit µA 741C — TBA 221
D1-D5	—	'E' Cell type 560-0002 (Plessey Ducon)
RLA	—	diodes 1N 914
PC	—	relay 12V dc operation, coil resistance not less than 220 ohms, contacts to suit load.
	—	printed circuit board ET 017

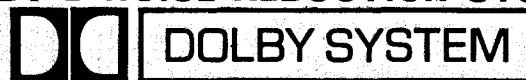


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# FERROGRAPH

SERIES SEVEN D

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The DH-03S Light-weight, fully adjustable head-phones with earpieces. Frequency 20-20000 Hz, matching impedance 4-16 ohm.



**WHY miss half the fun of your stereo system when Peak's superb stereo headphones will give new dimensions to your Hi-Fi listening? Proved on the Australian market. Competitively priced.**



The DH-08S for professional or discriminating private use. Unique mechanical two way units are fitted with independent volume controls, coiled lead. Frequency 20-20000 Hz, matching impedance 4-32 ohm.



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The Deluxe DH-04S incorporates concentric but entirely separate tweeter and woofer in each earpiece. Adjustable attenuation. Frequency 20-20000 Hz, matching impedance 4-32 ohm.

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1. **New 12P/5FX baffle board kit** for 2.65 cu.ft. enclosure. Assembled, wired and pre-tested. Frequency response 75 Hz to 20 kHz  $\pm$  6 dB or 53 Hz to 20 kHz at  $\pm$  10 dB. Power handling 15 watts RMS. Crossover at 6 kHz with a roll off slope of 12 dB per octave. Excellent overall response from such a small enclosure.
2. **New C80/2 x C3GX baffle board kit** for 1.8 cu.ft. infinite baffle enclosure. Assembled, wired and pre-tested. Frequency response 55 Hz to 20 kHz  $\pm$  6 dB or 44 Hz to 20 kHz at  $\pm$  10 dB. Power handling 20 watts RMS.
3. **C60/C3GX custom speaker kit** for 0.625 cu.ft. enclosure. Frequency response 50 Hz to 19 kHz, power handling 10 watts RMS, crossover at 5 kHz.

These three systems — as well as the new Plessey C60/C3GX complete enclosure — are available from Plessey Rola distributors and leading Hi-Fi centres.

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PLESSEY 12-INCH  
2-WAY SPEAKER  
BAFFLE KIT SET

Includes Plessey 12P woofer, 5FX tweeter,  
crossover, mounted and wired  
for recommended 2.65 cu.ft enclosure

AR45



# FERROGRAPH SERIES 7 TAPE RECORDER

This recorder has excellent performance and is a worthwhile purchase — despite manufacturer's poor quality control.



**F**ERROGRAPH taperecorders have been used by professionals for many years. They are used where exacting specifications must be met and where working conditions would wear out many competitive machines within months.

And so the latest of the Ferrograph recorders, the Series 7 aroused considerable interest among the staff when it arrived. We were curious to see what the heir to the Ferrograph name would be like.

The impression created by its appearance was not immediately favourable. It looked somewhat unprofessional and obviously intended more for the domestic market.

The deck is finished with black plastic coated steel. Adjustment of the hub level and a couple of other mechanical functions are performed through slots in the front panel. The edges of the holes were rather ragged, as though the steel had been punched with a die that did not have a good enough edge to punch the plastic coating properly. The hubs under the very smart aluminium spools were plain diecast aluminium with the webs visible.

The lower panel, the one containing the deck controls, is better finished but extremely plain. It uses an aluminium extrusion with a large head cover in the centre. This box is black on the top and sides with a hinged aluminium panel which lifts to expose

**electronics**  
TODAY  
**product test**

## FERROGRAPH SERIES 7 TAPE RECORDER

the heads. The amplifier panel is grey perspex with four pairs of concentric knobs, two VU meters and a channel selector. Beneath a hinged panel at the bottom of the recorder is a further set of controls. These include tone controls, bias adjustments, level adjustments and output selector switches.

The electrical connections are all made at the top of the recorder through yet another hinged panel. To our surprise, the main connections are made through tip and sleeve type jacks. A 7-pin DIN plug is provided which has input and outputs for both channels together with a remote control for the start-stop relay. This feature enables remote control of record or playback.

When we unpacked the handbook, we received a pleasant surprise. The book consists of 80 pages in hard bound covers complete with photographs, amendment details and truly comprehensive operating and servicing information.

### RUGGEDLY BUILT

The Series 7 recorder is extremely ruggedly built, a lot of thought having gone into its durability.

The deck is a three motor system, with a synchronous induction motor for the capstan drive and an induction motor for each spool driver.

Fast forward and reverse are achieved, not by switching as is usual, but by a potentiometer which varies the voltage supplied to each of the spool motors. This system allows easy cueing without the need for constantly operating two or more switches. High or low speed rewind are effected by simply varying the control.

The Ferrograph Series 7 tape recorder is offered with a choice of two groups of three speeds 1-7/8 to 7½ i.p.s. or 3¼ i.p.s. to 15 i.p.s., full, half or quarter track, mono or stereo and with or without power amplifiers. The unit with which we were supplied was the low speed version with quarter track stereo heads and power amplifiers. It was designated as a model 724.

The deck has separate record, playback and erase heads, with independent record and playback amplifiers thus enabling wide versatility of operation (in fact the possibilities occupy many of the 80 pages in the handbook).

Having examined the unit thoroughly, we tried a test tape on it.

The sound from it was nothing short of superb. Except for the squeaking of the tape on the take-up reel. Whilst one does not expect perfection in a cheaper machine, in such an expensive machine we would reasonably expect that the height of the hubs should be correctly adjusted for the recorder's own spools. Although this was a minor fault, it does indicate poor quality control somewhere along the line.

Major problems arose when we started to perform the technical tests. We found that due to some electronic malfunctions, the level of one channel was low and both VU meters appeared to be connected together. These two faults led to some rather strange results and a lot of wasted time.

### FLAT FREQUENCY RESPONSE

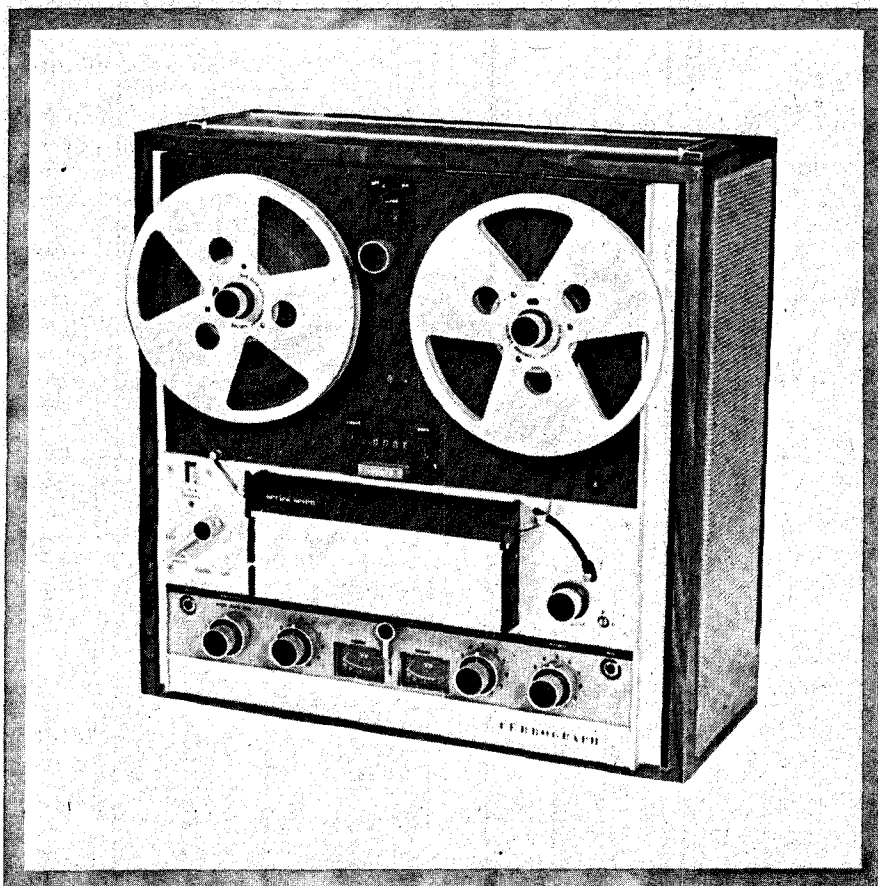
The local agent replaced the recorder with a similar unit which we found to be working correctly and we put it through its paces without a hitch.

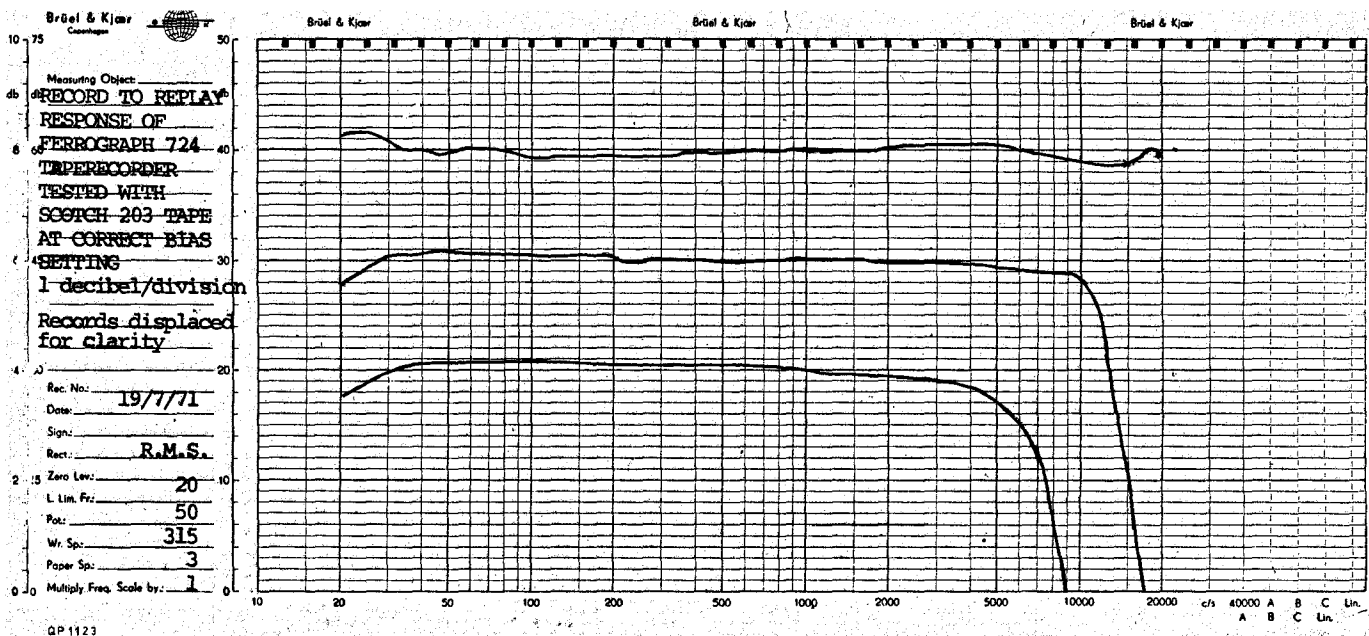
The frequency response obtained was the flattest that we have yet seen from a conventional taperecorder. This was obtained regardless of the tape we used because of the provision of a fully adjustable bias control.

We tried a range of tapes from those requiring the lowest bias to those requiring a very high bias. The tapes which were covered in the Ferrograph handbook were easy to correct for.

When the bias was adjusted to the meter reading stated in the book, the optimum frequency response was obtained every time. For the tapes not listed in the handbook, it was necessary to adjust the bias while checking the frequency response.

One very interesting feature of the Ferrograph Series 7 is the ability to replay tapes recorded to standards other than the DIN compensation to which it is normally set. Normally a recorder is only capable of reproducing optimally to one or sometimes two standards. Usually CCIR or NAB. The list of possible standards used is quite long. CCIR is commonly used in Britain, NAB in America, DIN in Germany, which is





IEC the proposed International Standard, and USA used only by Ampex. This range implies that at the three tape speeds on the recorder, there are 11 possible compensation networks required.

To build such an elaborate compensation system into a tape recorder using switched networks would be very complex. Ferrograph have overcome the problem in an ingenious way by using the recorder's tone controls. Normal tone controls have a break frequency which remains constant and independent of the setting of the tone control. The Ferrograph tone controls have both variable levels and variable break frequencies which allows the user to compensate for the recorded characteristics, or to use them as conventional tone controls.

The recorder is equipped with an ingenious system of interlocks which result in the drive system stopping and a red light coming on if there is an error. This occurs if the equalisation setting on the amplifier does not agree with the tape speed setting, if a switching foil passes over a pair of electrical contacts or if there is a loss of tape tension for more than 1/2 seconds. There is an additional interlock between fast forward or reverse and the normal play position which prevents tape spillage by moving the control too fast.

One interlock that is not provided relates to the record button. This can be depressed at any time during playback, possibly resulting in the erasure of valued tapes. But nevertheless a record button that can be depressed at any time can on occasion be quite convenient.

With the professional market in mind, a 600 ohm output is provided in addition to the normal line output and 10 watts speaker outputs. Internal 7" x 4" elliptical speakers are provided for monitoring purposes.

We found that, with the exception of threading the tape, Ferrograph Series 7 recorder is easy to use and provides extremely good results.

The recorder is heavy, weighing about 50lbs, but it can be comfortably — if not easily — carried, using the handle provided. The handle is an aluminium bar which retracts into the

top of the case in front of the input-output panel.

## THE ELECTRONIC CIRCUITRY

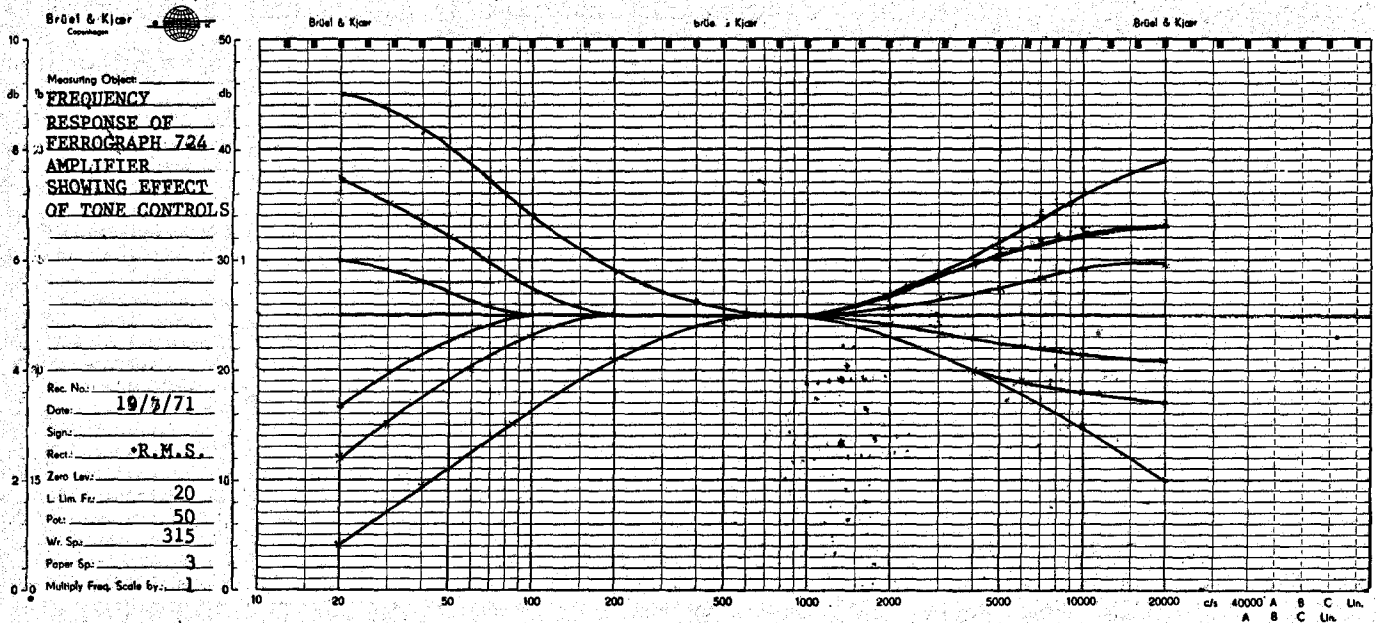
The circuitry is fairly conventional by 1971 standards. It uses silicon transistors throughout. Most of the electronics and control components are on printed circuit boards. The various sections of the internal circuitry are interconnected with plugs and sockets similar to the old octal valve bases.

One interesting feature of the

### MEASURED PERFORMANCE OF FERROGRAPH SERIES 7 (Model 724) TAPE RECORDER

Frequency response:	7-1/2 i.p.s.	20Hz to 20kHz ± 1.5dB
	3-3/4 i.p.s.	20Hz to 12kHz ± 3dB
	1-7/8 i.p.s.	20Hz to 7kHz ± 3dB
Total harmonic distortion at DVU and 1kHz:	7-1/2 i.p.s.	2% RMS
	3-3/4 i.p.s.	2% RMS
	1-7/8 i.p.s.	2% RMS
Intermodulation distortion at DVU:	7-1/2 i.p.s.	2% RMS
	3-3/4 i.p.s.	0.08% RMS
	1-7/8 i.p.s.	0.12% RMS
Wow and flutter:	7-1/2 i.p.s.	0.08% RMS
	3-3/4 i.p.s.	0.12% RMS
	1-7/8 i.p.s.	0.15% RMS
Signal to noise ratio re DVU:		57 dB
Main amplifier performance:		
Frequency response	20Hz to 20kHz ± 0.5dB	
Continuous power output into 8 ohm load	= 10 watts/channel	
Total harmonic distortion at 1kHz & rated output	= 0.2%	
Price	\$795	

# FERROGRAPH SERIES 7 TAPE RECORDER



electronic circuitry is the use of field effect transistors for the line inputs. This enables any source impedance of up to 2 megohms to be used without loss of performance. A major problem with FETs is the ease with which they can be destroyed by over-voltage, but to guard against this, a limiting diode is incorporated to ensure that the voltage does not exceed the design value. We did not attempt to find out how effective this was.

The main amplifier is well designed and gave very good performance. Unlike many monitor amplifiers, this one is good enough to use as your main power amplifier. It offers a moderate power output of 10 watts RMS per channel with low distortion. At 10 watts and 1kHz the distortion is 0.2% RMS. The frequency response of this amplifier is within 0.5dB between 20Hz and 20kHz.

What might appear to be an apparent oversight is the absence of a pickup input. If this were provided, the Ferrograph would form the basis of a Hi-Fi system. We would, however, defend Ferrograph on this point because we feel that a tape recorder offering this sort of performance would normally be used as part of a sophisticated system and therefore the internal monitor amplifier would seldom be required.

The output amplifiers can be switched from monitor input or output, independently on either

channel. The versatility of the switching provided on the electronic circuitry is greater than even the most serious amateur is likely to require. The facilities include four channel (or mono) track-to-track transfer, and echo.

We consider that the *design* of this recorder is probably the best we have yet seen.

Its measured performance is exceptional, and in all departments the manufacturer's specification is conservative.

The measured frequency response was an impressive 20Hz to 20kHz  $\pm$  1.5dB at 7½ i.p.s. The signal-to-noise ratio was 57dB with respect to a 1kHz signal at 0VU. At 0VU the harmonic distortion was 2%. The signal-to-noise ratio and frequency response are of course dependent upon the tape used and for these tests we used Scotch 203, this being one of the better commercially available tapes. Normally we use the tape which is provided with the machine or that which is recommended by the manufacturer. In the cases of the Ferrograph however, no tape is supplied and it is capable of being used with almost any tape, the results being dependent more upon the tape than the recorder.

The other parameters measured were equally good. The wow and flutter was a very respectable 0.08% RMS.

At 55dB the cross talk figure is also particularly good. While it does not need to be all that good for stereo recordings, 30dB is quite adequate, whilst for ¼ track mono recordings, the greater the better. We measured a cross talk of 55dB with respect to a 0VU signal on one channel at a frequency of 1kHz.

One design oversight which we found irritating was the high level of mechanical noise. When listening at low levels the noise intruded seriously. The reason for the noise is understandable, big motors, especially synchronous motors are usually noisy, but some thought could have been spared for some degree of silencing and better vibration isolation.

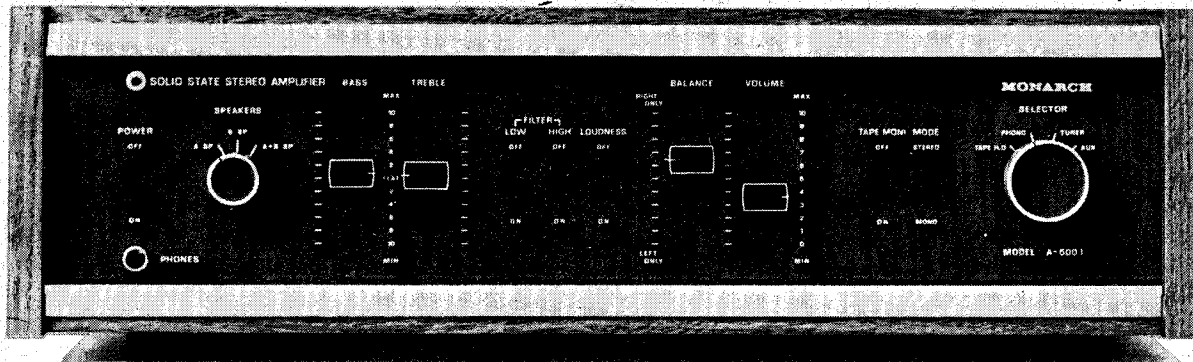
We were disappointed that a unit selling at this price and offering such impeccable performance should be supplied with three distinct faults in it.

It is, nonetheless, one of the best recorders on the market and the intending purchaser should not necessarily be deterred. But he should check the recorder he is going to buy in the dealer's show room to ensure that he is getting what he is paying for.

It would appear that the problems are not with the design but with the quality control, and therefore a recorder which is delivered without faults should give many years of excellent service. ●

# When you give the Monarch A-5000 slide controls and a beautiful new face, you also give it a new name.

## Introducing the A-5001. (\$ for \$ it's better than ever!)



**\*80 Watts of Total Music Power (IHF at 8 ohms) \*Dual-channel IC Equalizer for perfect balance \*Special Protection Circuit against over-load \*Latest all-silicon transistor circuitry**

Here is the **successor** to the highly rated and successful Monarch A-5000 Amplifier, of which **Australian Hi Fi Vol. 2 No. 3** stated: **"This amplifier is capable of providing a cleaner transient response than other amplifiers which may be twice the price"**.

By popular demand two significant changes in design have been made. Tone, volume and balance controls have been changed to slider types to allow easier visual identification of their settings. New massive heat sinks, thermally joined to the chassis have been fitted, thereby lowering operating temperature and providing even better stability at high volume levels.

The well-designed and tightly regulated power supply assures the total music power of 80 watts (IHF) into 8 ohms. The ability of the power supply is such that the amplifier runs cool with 30 watts RMS each channel operation, without causing current drain to any section of the circuitry even during high level of musical transients.

The direct coupled driver stage, because of elimination of transformers, achieves extremely low distortion. At 25 watts output level the distortion falls as low as 0.2% to produce the pure clarity of sound.

The special protection circuit is proved to guard the driver and output transistors against overload or short-circuit. This is a device to automatically reduce or cut out input signal when overload or short-circuit occurs. It is also automatically self-resetting to permit the amplifier to resume normal operation. An IC (integrated circuit) of a special type, which contains in one single unit a complement of both channel components in equalizer circuit, is used to provide perfect balance of input for optimum stereo.

Complete array of the front panel controls and switches offers versatile yet easy-to-operate facilities. Speaker selection switch provides for operation of either one or two pairs of speaker systems separately, or both simultaneously. On the rear panel a MAGNETIC-CERAMIC switch for choice of phono cartridge is provided. A continental DIN jack is also used for convenience for tape recording and playback.

Housed in the oiled walnut wooden cabinet with the distinctive style of the black panel, the A-5001 fits and enhances your decor.

**Recommended retail price \$189.**

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187 George Street,  
Brisbane. 4000

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Perth. 6000

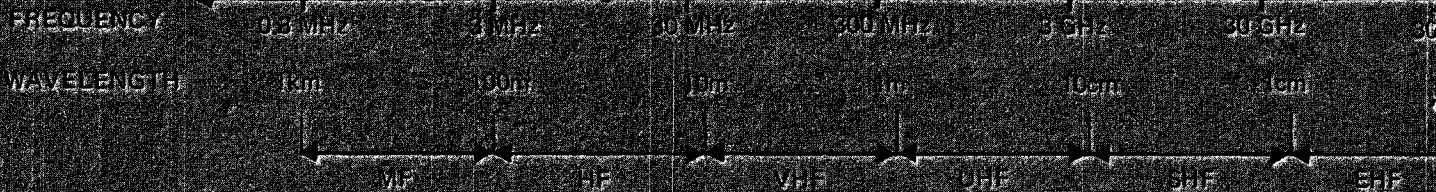
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WD22 71

IONOSPHERIC  
ABSORPTION

RADIO  
WINDOW



## AMATEUR RADIO

**E**MPLYING simple observation techniques and crude tools, ancient man tabulated and deduced a surprising amount about our solar system and the stars beyond. Indeed, Stonehenge is an ancient observatory and 'computer' capable of predicting, with remarkable accuracy, a variety of astronomical events.

Astronomy has made enormous advances in recent times and now extends into the realm of theoretical physics.

The newest tool of the astronomer is radio astronomy.

### A NEW SCIENCE IS BORN

Radio astronomy began some forty years ago when an engineer, Karl Jansky, (of the Bell Telephone Laboratories), set out to investigate the causes of interferences on transoceanic telephone links. He constructed a large steerable aerial (which he called a "merry-go-round"), and between 1929 and 1932 made a series of observations, using a frequency around 20MHz.

Jansky detected a source of noise that appeared to be fixed in space and which came from the direction of the centre of our galaxy. Upon completion of his work and the publication of a scientific paper, Karl Jansky was transferred to other work. He did not pursue the matter further and the significance of his discoveries was not realized by the astronomers of his day.

It was left to the curiosity, ingenuity and persistence of Grote Reber, a twenty-two year old radio amateur further to explore Jansky's discoveries seven years later.

*Radio astronomy is a young and virile science. It was started by radio amateurs — and is a branch of astronomy in which amateurs can make important and exciting discoveries.*

*This series explains the theory involved and provides full constructional details of the equipment required.*

# RADIO ASTRONOMY FOR AMATEURS

*a series - by Roger Harrison VK3ZRY*

Grote Reber was the world's first radio astronomer. He designed and built a 30ft. diameter parabolic dish antenna and attempted to receive cosmic noise near 3,300 MHz. The experiment was inconclusive and Reber subsequently modified his equipment for use on 900 MHz and later 160 MHz. He eventually succeeded in making what was the first map of the sky ever to be completed using radiation other than that of the visible spectrum. Grote Reber also detected and described radio emissions from the sun.

Meanwhile, in 1942, G. C.

Southworth in New Jersey (U.S.A.) and J. S. Hey in England recognised radio signals from the sun during the course of research into the jamming and interference of wartime radar receivers. Their findings were not released until after World War II and Reber's work was the first to be published (in 1944).

Following the war, scientists in England, Australia and Europe continued the work that Reber had initiated. Progress in this new science was rapid and was led by Ryle and Hey in England, Pawsey, Payne-Scott and Macready in Australia and Van de Hulst in Holland.

In the past twenty years, the science of radio astronomy has progressed rapidly. Large scale surveys have been carried out in England, Australia and America and thousands of radio sources have been located and mapped. Amongst the latest, and most



Fig. 1. This illustration of the electromagnetic spectrum shows the 'radio window' used in radio astronomy, and the 'optical window' used in optical astronomy (from earth). Also shown are the portions of the spectrum where various absorption effects limit observations.

significant discoveries are pulsars — sources which radiate a narrow beam of pulsed energy having a very stable repetition period.

### OBSERVATORIES AROUND THE WORLD

This rapid expansion has led to the development of specialised equipment to study the various sources of interest. The 250ft. parabolic dish at Jodrell Bank in England is well known, as is the 210ft. dish at Parkes and the mile-long arms of the Mills Cross at Canberra, both in Australia. The Mullard Radio Observatory in England is one of the largest and most versatile in Europe and the Radio Physics Laboratory of the CSIRO in Sydney has perhaps the most extensive facilities in the world. It was here that a radio spectrograph, developed by Paul Wild, first detected the existence of flares on the sun. (Flares are rapidly moving, bright disturbances that shoot out through the solar corona at very high speeds). Also in Australia a radioheliograph has been developed by Christiansen with which a complete map of the emissions from the sun's surface can be made.

The Owens Valley Observatory in Southern California has two large, moveable 90ft. paraboloids forming a large interferometer. There are also observatories at Palo Alto, California; Boulder, Colorado; and Havana, Illinois.

In Europe, France has a number of observatories, one in particular at Nancy has a line of 32 paraboloids operating at 169MHz. There is also an observatory at Leiden in Germany and a number in the U.S.S.R. There are radio astronomy observatories in many countries throughout the world. These are only a few.

### COSMIC NOISE

There are four main types of

radiation that can be detected by radio astronomy.

- (a) Thermal Emission (otherwise known as Ionised Hydrogen Gas Radiation).
- (b) Synchrotron Radiation.
- (c) Neutral Hydrogen Gas.
- (d) Discrete Sources.

### THERMAL EMISSION

The hydrogen gas that exists near hot stars is in such an agitated state (due to the temperature), that the electrons are ejected from the hydrogen atom leaving only the proton. In other words, the hydrogen gas becomes ionised. Under these conditions, many free electrons (and protons) will exist. The electrons, having a very small mass are very free to move about and, when an electron passes near a proton it is accelerated but may not be captured. This acceleration causes the emission of radiation with wavelengths around a few centimetres. This type of radiation is very abundant in the plane of the Milky Way.

### SYNCHROTRON RADIATION

When an electron enters a magnetic field, the field compels it to spiral around the lines of force at high speed. This causes radiations to be emitted having wavelengths around a few

metres. This is called synchrotron radiation and can be detected in the plane of the Milky Way, in the halo of our galaxy and in radiations from the planet, Jupiter.

### NEUTRAL HYDROGEN GAS

In 1945, Van de Hulst predicted that clouds of neutral hydrogen in space would emit radiations at a wavelength very close to 21 centimetres. This radiation is often referred to as the H.I. or 21 centimetre line.

Van de Hulst based his prediction on the work of Grote Reber and, in 1951, Ewin and Purcell (U.S.A.) proved the existence of this line which can be detected both by emission and absorption.

The radiation is emitted by the change of direction of the spin of the electron as it orbits the proton in a hydrogen atom. Because the emission is not a single frequency it is radically different from other emissions which are broad band (i.e. not having a definite wavelength). Because of this fact, hydrogen line emissions can be detected in other sources.

If a cloud of neutral hydrogen gas lies between another cosmic noise source and the observer, and the cloud is sufficiently thick, then broad band emissions from the other source will be absorbed at the hydrogen line wavelength (21 cm).

This is similar to absorption spectra in optical astronomy and the structure

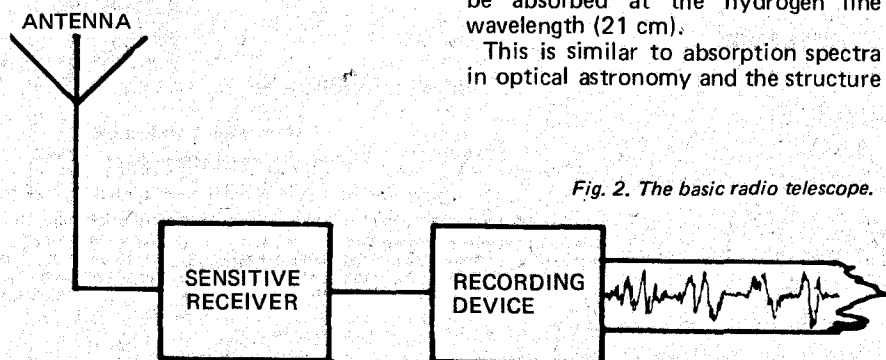
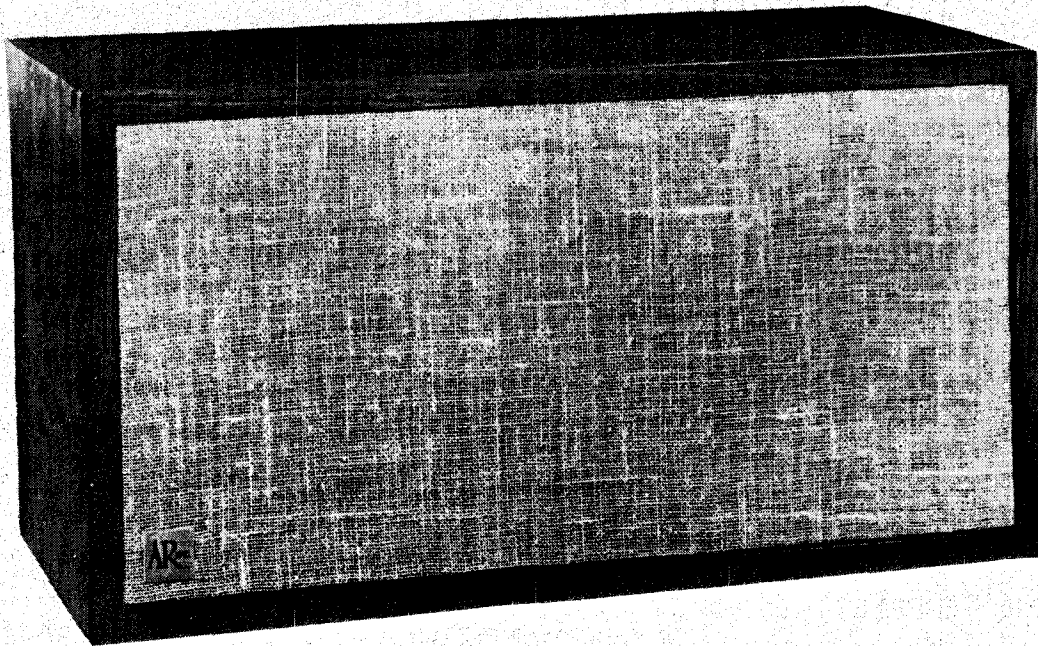


Fig. 2. The basic radio telescope.

# The Critics' Choice



## U.S.A.

### "Hi Fi Stereo Review"

"This (frequency response) would be remarkable for any speaker, and in our experience is unique for any speaker in the price class of the AR-4x. We know of no competitively priced speaker that can compare with it."

### "High Fidelity"

"To say that the AR-4 (forerunner of the AR-4x) is the best of this class would be to presume too much in the way of individual listener preference; it would perhaps be more to the point to say that we have heard nothing better, so far at least in this price class."

## U.K.

### "The Gramophone"

"The frequency response curves . . . were better than those published by the manufacturers . . . there is an audible output from 30 Hz upwards, the AR-4x reaches its full output of 50 Hz and sounds remarkably smooth through to the limit of audibility."

### "Hi Fi News"

"Extreme bass down to 30 Hz, at adequate levels to enjoy organ pedal tone in domestic surroundings, was obtained with quite small harmonic production. High frequency performance was good on all scores – smoothness, lack of colouration and distribution . . . I like the AR-4x, and it's a good loudspeaker."

## FRANCE

### "La Revue des Disques"

"There has been nothing like it, and the least I can write is that this speaker is astonishing . . . a model speaker in its class."

## HOLLAND

### "Stereo Review"

"For speakers this size, the bass is incredible – no

resonances, but beautiful, smooth, low bass notes – we would say the 4x is ahead of all other speakers this size – the 4x presents excellent value for money – ideal in an average sized room."

## AUSTRALIA

### "Australian Hi Fi"

"The subjective impression was of extremely clean, clear reproduction with a particularly low level of distortion, especially on transients. The frequency response is extremely good, being effectively  $\pm 6$  DB from 55 Hz – 20 KHz and for such a small speaker enclosure this is unusually good. The quality of their reproduction when received in terms of price is still particularly hard to beat."

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.

**AR-4x recommended retail price \$132.**



## Acoustic Research Inc.

Massachusetts, U.S.A.

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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 Photo-graphics, 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.

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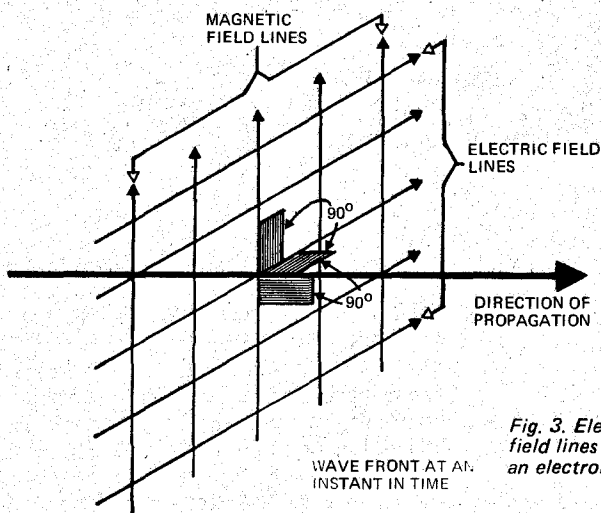


Fig. 3. Electric and magnetic field lines in the wavefront of an electromagnetic wave.

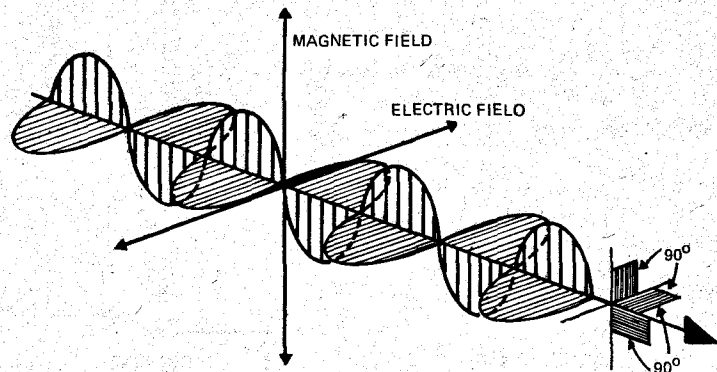


Fig. 4. Representation of an electromagnetic wave (in sine wave form) showing the alternating nature of the amplitudes of the electrical and magnetic components.

of our galaxy has been plotted using this method of detection of emission and absorption spectral lines.

### DISCRETE SOURCES

Discrete sources are those points or areas in space which emit characteristic radiations that differ from the background cosmic noise. Our own Sun is one, Jupiter another, and the radio stars in the constellations of Cygnus and Cassiopeia are others.

Other sources may be the remnants of exploding stars (Nova or Super-Nova events) while sources such as quasars and pulsars are also classed as discrete sources. Many sources have been discussed and mapped in our own galaxy and many more exist beyond it.

### THE RADIO WINDOW

The earth's atmosphere limits the range of wavelengths over which observations can be made, both optically and by radio. However, the "radio window", as it is called, covers a considerably broader portion of the spectrum than does the optical window. This is illustrated in Fig. 1.

Although this radio window extends from below 1MHz to above 30GHz, it is not possible efficiently to use all this range for radio astronomy. Generally, ionospheric absorption has severe effects on frequencies below 10MHz and still has an appreciable effect up to 40MHz. Above 10GHz absorption by particles suspended in the earth's atmosphere has a severe influence on propagation.

Thus the useable radio window extends from about 10MHz to 10GHz. Observations are made up to 30GHz but most experiments in radio astronomy are made between the frequency limits just quoted.

### BASIC RADIO ASTRONOMY SYSTEMS

The simplest radio telescope consists of an aerial system, a receiver and a recording device. Even an ordinary television set may be used as a radio

telescope if it is connected to a suitable recording device. If the antenna is mounted so that it can be aimed at any portion of the sky, an unused channel selected and a tape recorder or chart recorder connected to the output of the video detector, then you have a basic radio telescopic — and quite useful observations can be made. This is the basic form of a radio telescope (see Fig. 2) but in professional establishments, refinements are made to improve sensitivity and resolution. Special antennae are used (i.e. interferometers, aperture synthesizers, etc.) together with fairly sophisticated receiver techniques. However, an amateur can make many observations using relatively simple methods, many of which are in use at professional observatories.

For observing radiations emitted from Jupiter at 18 or 20MHz, all that is needed is a simple dipole or beam antenna and a sensitive communications receiver tuned to a clear channel. If Jupiter is visible (i.e. above the horizon) then periodic bursts of noise can be heard. These bursts are particularly strong if Jupiter is high in the sky (near the zenith).

Radiations from the sun can be observed with a good VHF or UHF converter fed into a sensitive HF communications receiver, followed by a recording device. Even a modest antenna will give quite good results. This set up will also receive cosmic noise emanating from the regions of the Milky Way.

These simple systems are known as "total power" radiometers because all the energy received by the aerial is continuously recorded. If the aerial is fixed (for instance, pointing at the zenith), the recorded result will be a "drift curve". The rotation of the earth sweeps the antenna pattern across the sky, thus recording successive changes in level of the noise as various sources pass through the antenna's field of view.

### ELECTROMAGNETIC WAVES — A brief review

In free space electromagnetic waves travel at a velocity of 300,000,000 metres per second (about 186,000 miles per hour) and can be reflected, refracted and diffracted in the same manner as light waves (also an electromagnetic radiation).

Electromagnetic waves consist of moving fields of electric and magnetic force. The lines of force of each field are at right angles (90°) to each other and the plane of the electric and magnetic fields is at right angles to the direction of propagation of the electromagnetic wave. This is illustrated in Fig. 3. The plane of the electric and magnetic fields shown in Fig. 3 is actually termed a wavefront. The plane of *polarisation* is the plane of the electric lines of force. If the electric lines of force are parallel to the ground, then the plane of polarisation is termed *horizontal*. If the plane of the electric lines of force, passing a particular point, has randomly different angles (to the ground) at different times, then the wave is said to be *randomly polarised*.

The amplitude (or the strength) of the electric and magnetic fields varies with time according to the frequency of the electromagnetic radiation. An illustration is given in Fig. 4. This shows a sine wave. The "noise" received by radio telescopes actually has a very complex form with the electric and magnetic fields having random (or quasi-random) frequency, phase, amplitude and polarisation characteristics (Except for the emissions from Jupiter, and Hydrogen line emissions).

The *medium* in which an electromagnetic wave travels influences the *velocity* of propagation. In free space it is 300,000,000 metres per second, in air it is *slightly less* and it is *much less* in substances such as plastic, earth and water.

When an electromagnetic wave encounters a good electrical conductor

(Continued on page 85)

# ONE-TRANSISTOR

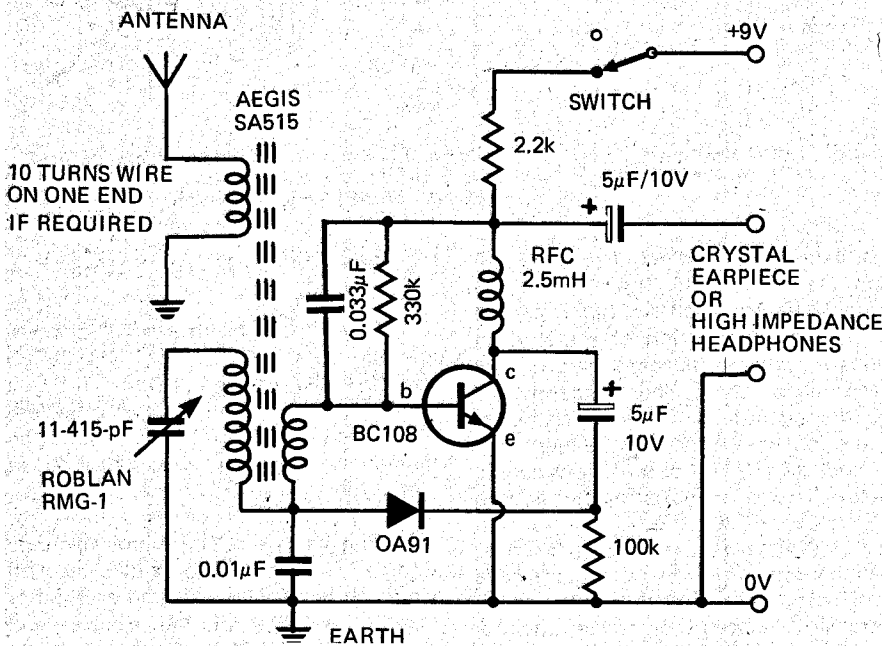


Fig. 1. Circuit diagram.

## ET PROJECT 406

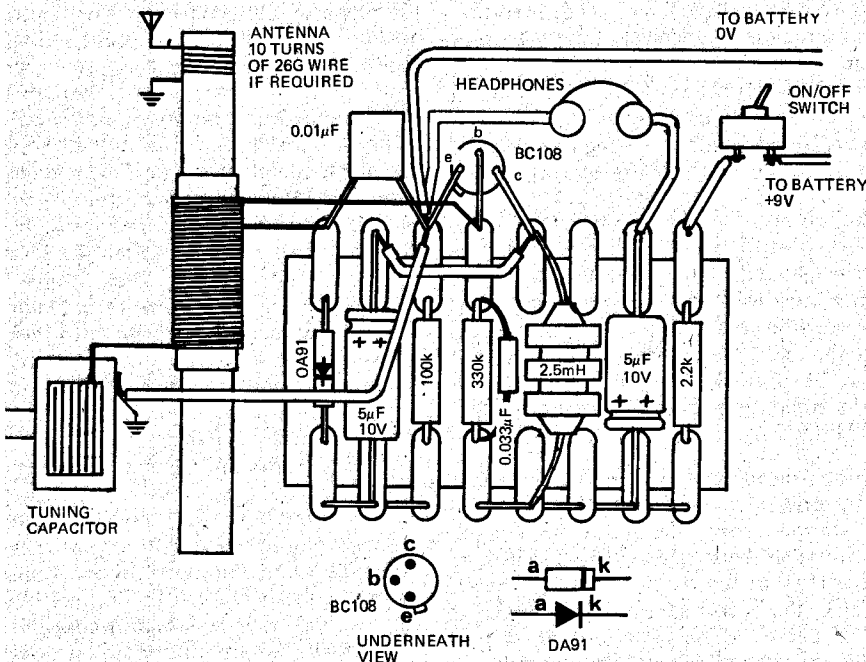


Fig. 2. The receiver may be built on tag strips or a piece of circuit board.

Here is a simple one-transistor receiver that will bring in broadcast stations with surprising clarity and strength. It can be made from readily available, cheap components, requires no adjustments, and will work straight off!

The circuit of the complete unit is shown in Fig. 1. A single transistor is used to amplify both the radio frequency signal picked up by the ferrite rod and coil antenna, and the audio signals recovered by the detector (OA 91 diode). This results in excellent sensitivity and selectivity ensuring that radio stations can be received at good strength and without interference.

### CONSTRUCTION

The receiver can be constructed on a small piece of circuit board — as shown in Fig. 2. This can be mounted, together with the ferrite rod, tuning condenser, and battery and headphone connectors, on a piece of wooden board to which a panel has been screwed. This panel can be made from plywood, fibre-board, bakelite etc.

Two rubber grommets should be fitted over the ends of the SA515 ferrite rod. These can then be fitted into the brackets (illustrated in Fig. 3) which are then screwed to the baseboard.

Take care when soldering the transistor into the circuit — leave this item until last.

### ANTENNAE

The AEGIS SA 515 ferrite rod acts as a built in antenna — and — if you live in the metropolitan area of a city, the local broadcasting stations will be heard at good strength with this antenna alone. At night some interstate stations may even be heard!

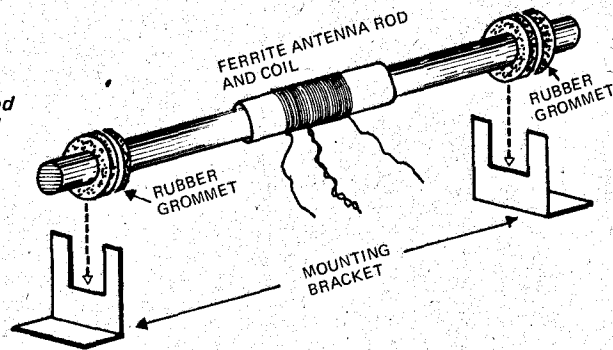
In fact an external antenna will probably be a disadvantage in city areas, because the received signal strength from nearby stations may be so powerful that distant stations will be swamped.

However if you live in a country area, then an external antenna may well be necessary.

Figure 4 shows the general idea. A length of wire, from 20 ft. to 100 ft. long should be erected, preferably in line with the nearest broadcasting stations, and as high as possible.

# RADIO

Fig. 3. The ferrite antenna rod and coil should be supported by two grommets and small metal brackets.



Insulators should be used at either end. The type of wire is not important as long as it is strong enough to withstand wind forces etc.

An earth connection may also improve reception of weak signals. Use a length of metal rod or pipe, about two or three feet long, hammered into

the ground. The surrounding soil should be kept moist. If mains water is available the water pipe will make a good earth — but ensure that it is a metal pipe. Many water systems are now being constructed using plastic pipes, and plastic water pipe is a remarkably poor conductor!

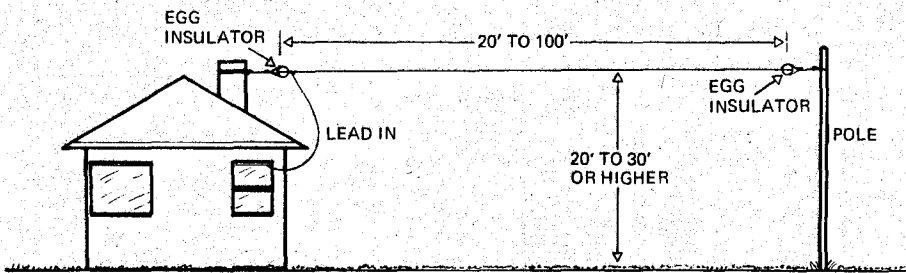


Fig. 4. How to make a simple antenna.

## PARTS LIST ET 406

- 1 resistor 2.2k ½ Watt, 10%
- 1 resistor 330k ½ Watt, 10%
- 1 resistor 100k ½ Watt, 10%
- 2 capacitors 5μF 10 Volt electrolytic
- 1 capacitor .01μF
- 1 capacitor .033μF
- 1 transistor BC 108, BC 109, 2N3565 etc.
- 1 diode OA 91 etc.
- 1 ferrite rod and coil — AEGIS type SA 515 or similar
- 1 tuning capacitor 11 — 415 pF, Roblan type RMG — 1 or similar
- 1 nine volt battery and connectors
- 1 toggle switch — single pole single throw — 1 Amp contact rating.
- 1 RF choke, 3.5 mH
- 1 crystal earpiece or high impedance headphones
- 1 pointer control knob
- Rubber grommets, screws, plywood etc.

# magraths

## 'LEADER' TEST INSTRUMENTS



### LBO-52B 5" OSCILLOSCOPE

Is designed for high performance operation. The wide band characteristics make it adaptable for maximum application in the development and testing of electronic circuits. It is especially suited for use in the examination of low level equipment such as tuners, IF amplifiers, etc.

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### LBO - 31M 3" PRIMA-SCOPE

Is a compact oscilloscope designed for all-around service. Its small and handy size will appeal to experimenters, servicemen and plant technicians who desire maximum performance with minimum space requirements.

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### LAG-53 AUDIO GENERATOR

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400/1000 Hz output for Audio Application. Wide-band frequency 120kHz to 390mHz. Oscillator for Radio circuit testing. Socket for XTAL Oscillator.

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### LDM-810 GRID DIP METER

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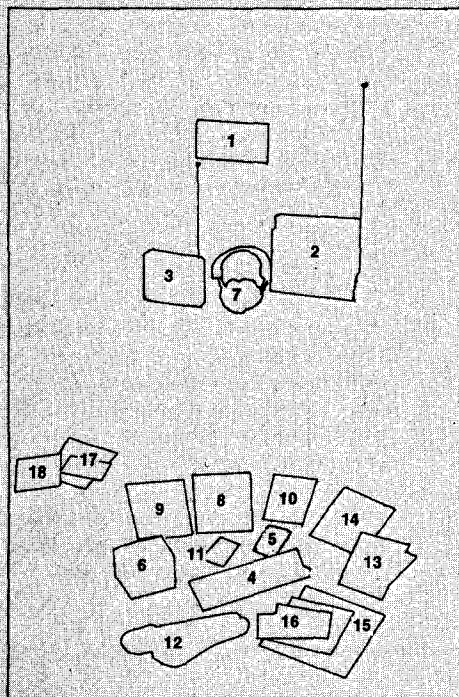
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  5. **G14-105** Goldring Stylus Mirror and Brush for checking and removing dust.
  6. **G14-109** Goldring Bulk Tape Eraser—compact, battery operated, for cassettes, 8 track cartridges and tape reels.
  7. **GR-101** Goldring dynamic Stereo Headphones—8 ohms.
  8. **GTA-21** Goldring 5 Pin Din to 5 Pin Din—Audio Connecting Leads.
  9. **GTA-12** Goldring Twin-pak Tape Kit; Head Cleaner and Lubricant.
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# BASS

## ET PROJECT 407

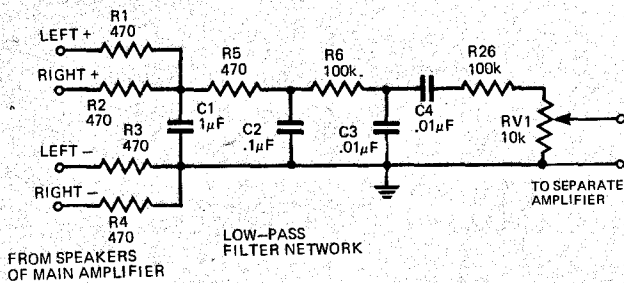


Fig. 1. This filter circuit can be used with an external amplifier.

Many economy hi-fi systems have adequate mid-range and treble response — but sound as if the bottom has fallen out of the amplifier when they come to some good solid bass.

And when you calculate the amplifier and speaker capacity required for realistic bass response you begin to appreciate why.

But all is not lost — for here is a modification that will reproduce the very deepest of bass, at levels practically guaranteed to infuriate your neighbours for life!

Unlike the higher audio frequencies, bass is largely non-directional, and, because of this, the positioning of a bass speaker is not at all critical.

The bass booster described in this project exploits this principle. Whilst

in no way affecting the normal output or stereo separation of the existing system the booster effectively combines the bass signals from the left and right hand stereo channels and, following amplification, reproduces them through a common bass speaker.

The system may be used in several different ways.

In its simplest form, the combining filter shown in Fig. 1 is connected to any spare mono or stereo amplifier (rated at 20 Watts or more) and played through a single speaker enclosure that has a good bass response.

In another form the same arrangement is used together with the speaker system specifically designed for bass reproduction (shown in Figs. 6 & 7).

But as few of us have spare

high-powered amplifiers lying around waiting for a project like this — we have designed a very simple yet effective amplifier especially for this project. Note, that for this latter arrangement the design of the filter has been changed slightly.

### CONSTRUCTION

If the booster is used in its simplest form — using a separate amplifier — the filter should be constructed on a small piece of perforated board or tag strips. The circuit is shown in Fig. 1. The layout is not at all critical.

In the form shown in Fig. 2, the amplifier and filter are constructed as one unit. This complete unit may be mounted within the new bass speaker enclosure (as we did with our

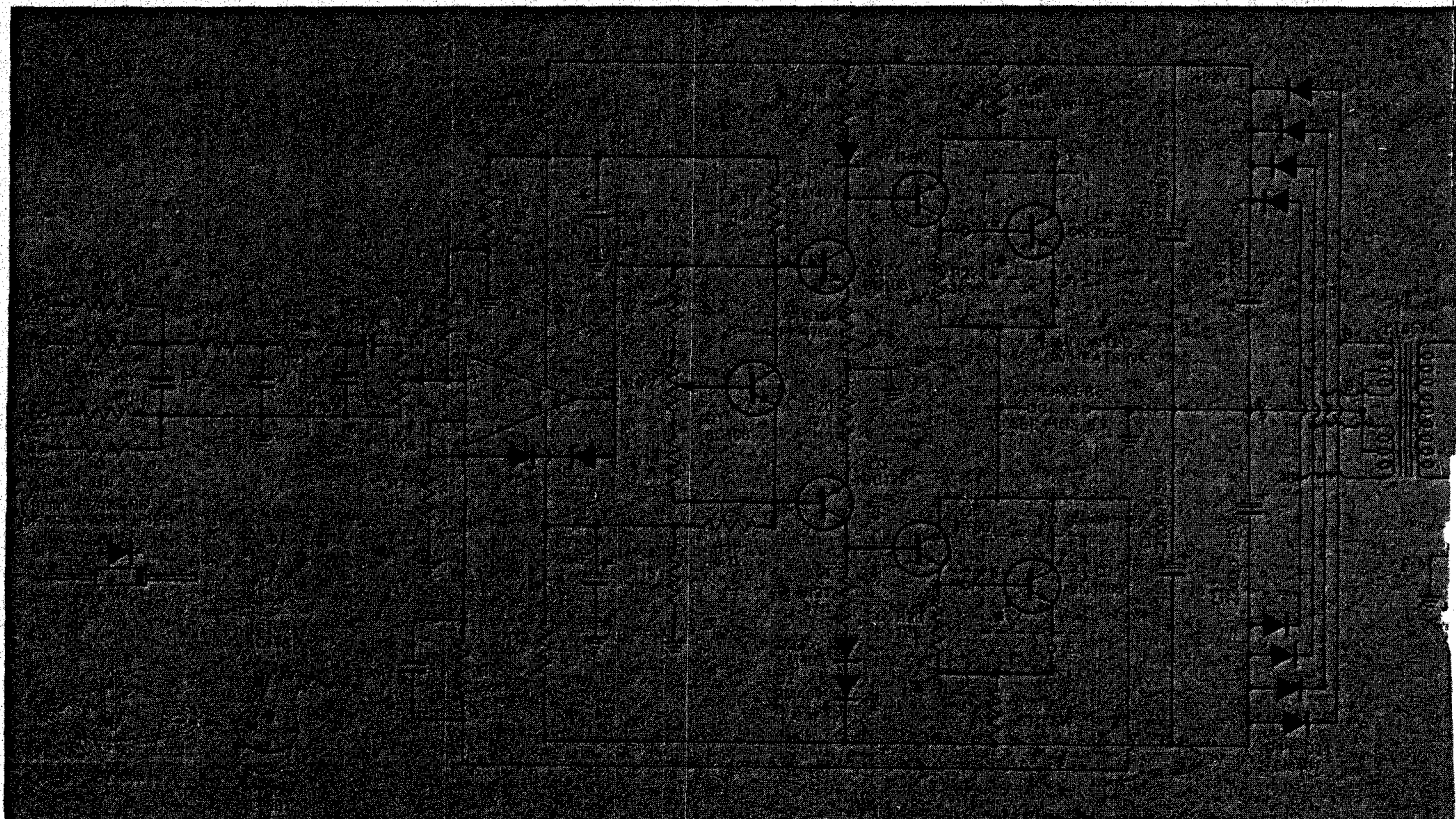


Fig. 2. In this circuit the filter and amplifier are combined as one unit.

## Modify your hi-fi system to provide some real bass performance.

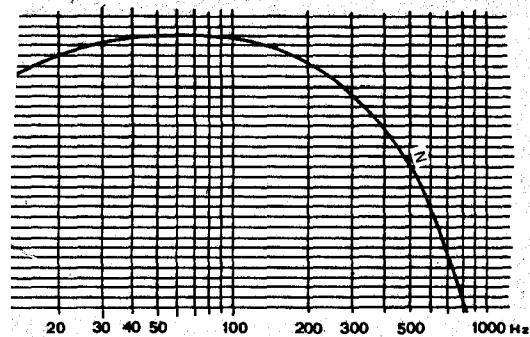


Fig. 3. This curve shows the frequency response of the filter.

prototype unit) or located in any readily accessible place.

Construction of the one-piece unit is quite simple as most components are mounted directly on the printed circuit board — shown full size in Fig. 4. The main power transformer, output transistors and control potentiometer are mounted externally — and connections to and from these components are made via the points numbered on both the component layout diagram (Fig. 5) and the main circuit diagram (Fig. 2).

Make sure that all components are orientated correctly before soldering them into the circuit.

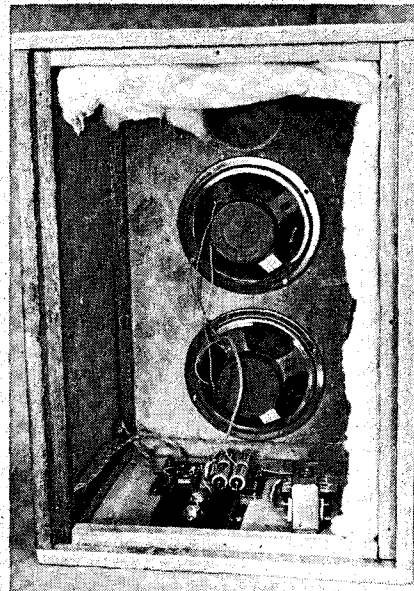
Transistors Q6 and Q7 are mounted on the heatsink — using insulating washers — and connected to pins 1, 2, 3, 4 and 5 as shown in Figs. 2 and 5.

If the amplifier is to be located within the speaker enclosure, the power transformer should be mounted on rubber.

The connections to the inputs and to the volume control should be made using screened cable.

When you are sure that all components have been wired correctly, set the wiper RV2 centre of its travel. Do not connect the speakers at this stage of the operation.

This project is intended primarily to increase the bass response of economy hi-fi systems. There is little to be gained by using this system where adequate bass already exists.



All components can be mounted within the speaker enclosure.

Switch on the main 240 Volt supply and check the voltage across the speaker terminals. This should be less than 200 mV. If it is substantially higher than this, switch off and recheck all connections. (If a voltmeter is not available, connect one side of the speaker to one side of the amplifier and momentarily touch the second amplifier lead to the remaining side of the speaker. If all is well the speaker should remain practically silent or at most produce a slight 'click' — if the speaker cone tries to fly across the room — then switch off at once and recheck all connections).

Next, if a milliammeter is available, disconnect the lead to pin 2 and measure the current in this lead. Adjust RV2 until the current is approx. 40 mA. If no milliammeter is available, leave RV2 in mid-position.

Connect the leads from the existing speakers to the filter input and connect the bass speaker to the booster amplifier. The power may now be switched on and the complete system checked out. Remember that the sound from the bass booster will be grossly distorted if this unit is used

(Text continues page 69)

### PARTS LIST ET 407

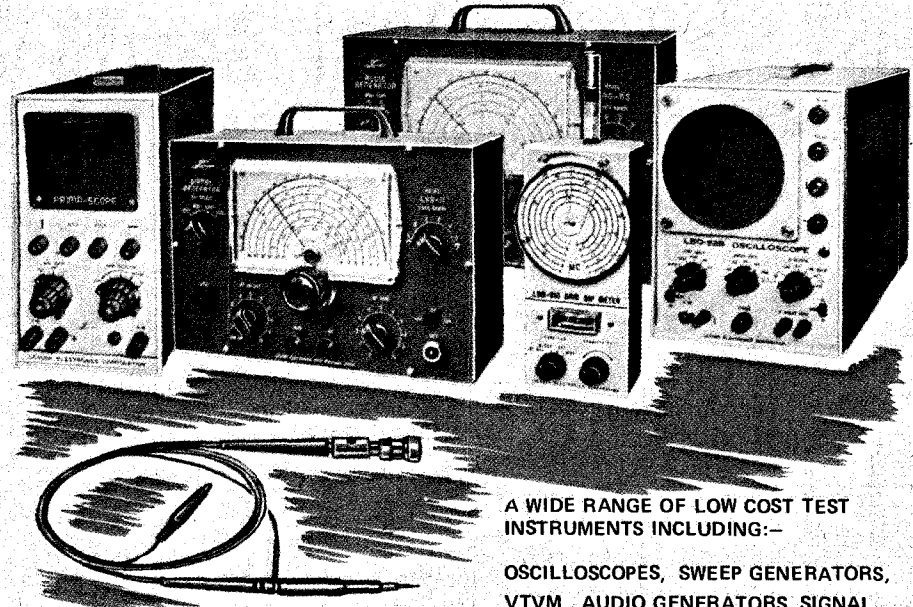
(combined filter/amplifier)

R1	— resistor 470 ohm, ½ Watt, 5%
R2	— " " " " " "
R3	— " " " " " "
R4	— " " " " " "
R5	— " 4.7k " " " "
R6	— " 100k " " " "
R7	— " 1k " " " "
R8	— " 220k " " " "
R9	— " 22k " " " "
R10	— " 1.5k " " " "
R11	— " 1k " " " "
R12	— " 1k " " " "
R13	— " 2.2k " " " "
R14	— " 2.2k " " " "
R15	— " 1.5k " " " "
R16	— " 4.7k " " " "
R17	— " 4.7k " " " "
R18	— " 47 ohms " " " "
R19	— " 47 ohms " " " "
R20	— " " " " " "
R21	— " " " " " "
R22	— " 1k " " " "
R23	— " 1k " " " "
R24	— " 0.51 ohm, 5 Watt, 5%
R25	— " " " " " "
RV1	— potentiometer 100k log.
RV2	— trim potentiometer 1k linear
C1	— capacitor 1uF 200V Elna greencap
C2	— " 0.1uF 100V " " "
C3	— " 0.01 uF " " "
C4	— " 0.01uF " " "
C5	— " 33pF " " "
C6	— " 25uF, 25V, electrolytic
C7	— " 25uF, 25V " " "
C8	— " 2200uF, 25V " " "
C9	— " " " " " "
C10	— " " " " " "
C11	— " " " " " "
Q1	— transistor BC108
Q2	— " " " " " "
Q3	— " BC178
Q4	— " TT800
Q5	— " TT801
Q6	— " 2N3055
Q7	— " 2N3055
IC1	— Integrated circuit uA 741C—
	— TBA 221
D1-D11	— silicon diodes type EM401
ZD1	— zener diode BZY88 C3V9
ZD2	— " " " " " "
Transformer	A&R PT 6534
PC	— printed circuit board ET018
Heatsink	— 4" of type 35D (35D4CB)
Insulating kits for 2N3055	
Three core flex and plug	
Terminals	
Shielded wire etc.	
Loudspeakers—	Magnavox type 8W (2 off)
Particleboard for speaker enclosure.	

### PARTS LIST FOR SEPARATE FILTER

R1-R4	— resistor 470 ohm, ½ Watt, 5%
R5	— " 4.7k " " " "
R6	— " 100k " " " "
R26	— " " " " " "
RV1	— potentiometer 10k log.
C1	— capacitor 1uF 200V Elna greencap
C2	— " 0.1uF 100V " " "
C3	— " 0.01uF " " "
C4	— " " " " " "
Tag strips	— terminals etc.

# LEADER TEST INSTRUMENTS



A WIDE RANGE OF LOW COST TEST INSTRUMENTS INCLUDING:-

OSCILLOSCOPES, SWEEP GENERATORS, VTVM, AUDIO GENERATORS, SIGNAL GENERATORS, TRANSISTOR CHECKERS, ATTENUATORS, PROBES.

### LSG-11 WIDE BAND SIGNAL GENERATOR

Probably the most popular low cost Signal Generator in the world. This signal generator has a useful frequency range from 120 kHz to 130 MHz and using an optional crystal, can be crystal controlled. Adjustable output modulation frequencies of 400 and 1000 KHz can also be used for testing audio amplifiers.

\* \$45.00  
+ S. TAX

### LAG-55 AUDIO GENERATOR

The LAG-55 is an indispensable instrument for audio work. Three different waveforms, (sine, square and complex) are available for a variety of tests. The wide frequency range from 20Hz to 2MHz and constant output levels are most desirable features of the LAG-55. Sine waves are generated with a Wien-bridge configuration and square waves by a Schmitt trigger circuit.

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### LDM-810 GRID DIP METER

The well known Leader LDM-810 Grid Dip Meter is one of the more useful instruments for checking receivers, oscillators, transmitters and circuit components. A frequency range from 2 to 250 MHz (in 6 bands) is available with an internal modulation frequency of 1 kHz.

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### LBO-52B 5" OSCILLOSCOPE

The LBO-52B Oscilloscope has been designed for high performance operation wideband, DC to 10-MHz with a high sensitivity of 10 mV p to p makes it an invaluable tool in the development and testing of electronic circuits. It is especially useful in the examination of low level equipment such as tuners, IF amplifiers etc.

\* \$295.00  
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### LBO-31M 3" OSCILLOSCOPE

The LBO-31M is a compact oscilloscope designed for all round service. Its small and handy size will appeal to experimentors, servicemen and plant technicians who demand maximum performance with minimum space requirements. Responses from 3 Hz to 1 MHz and sensitivity is 80 mV/cm.

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### LPB-10Z LOW CAPACITANCE PROBES

The LPB-10Z is a high impedance probe specially designed for Leader LBO-52B, LBO-55B, LBO-32B, LBO-33B Oscilloscopes. Its use prevents any disturbance to the circuit under test. Input impedance is 10 MΩ shunted by 18 pF and attenuation is 20 dB.

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# BASS BOOSTER

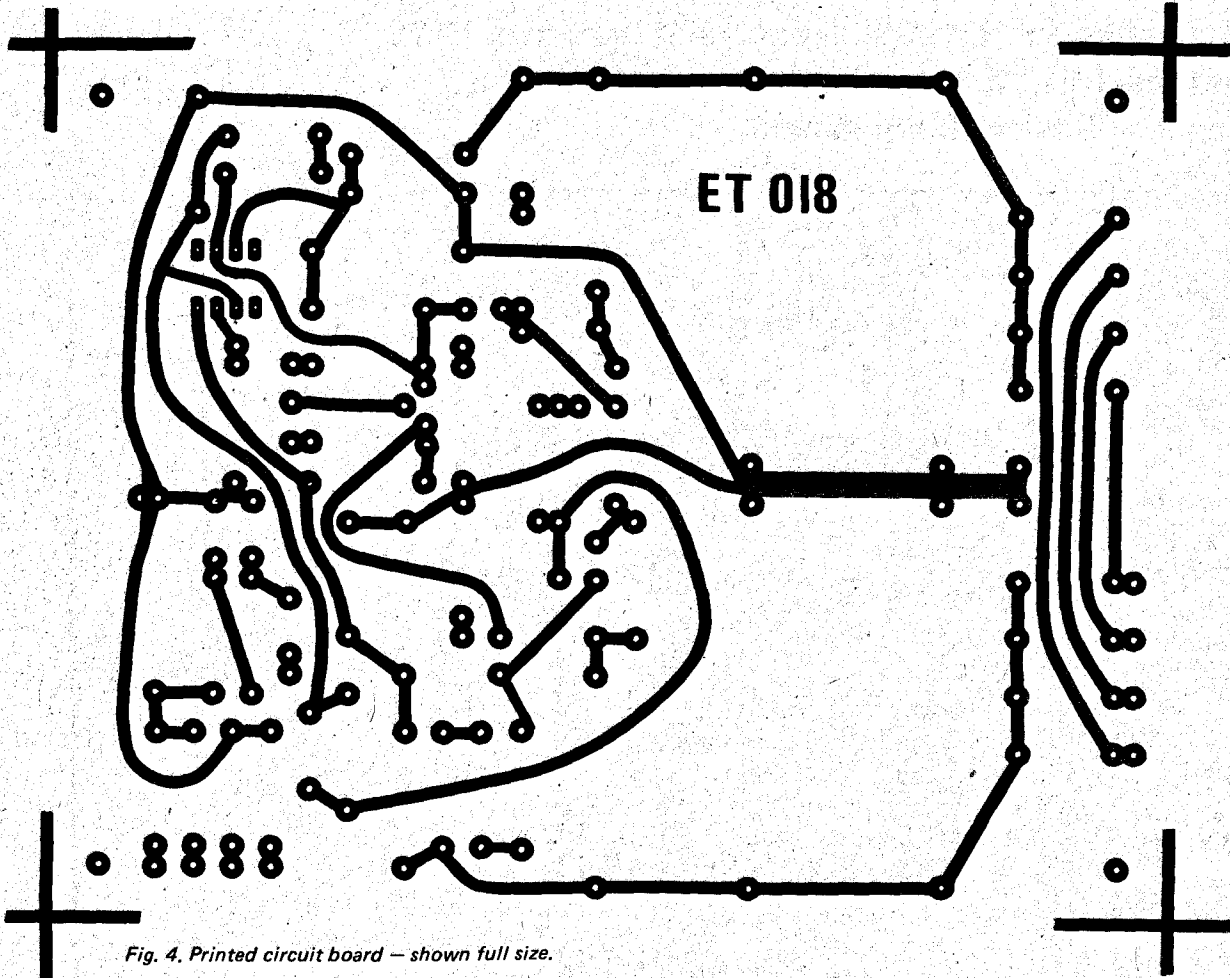


Fig. 4. Printed circuit board - shown full size.

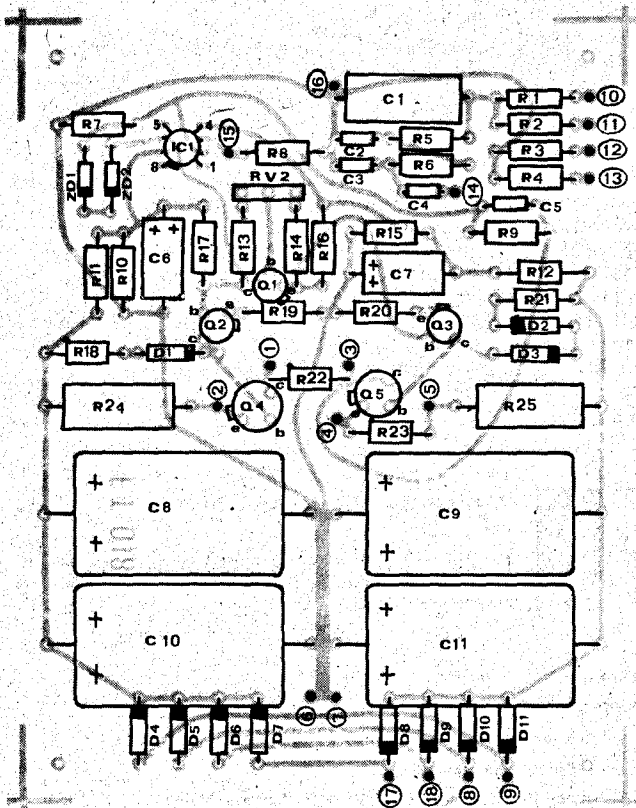


Fig. 5. How the components are located on the printed circuit board.

## HOW IT WORKS

The output from each channel of the existing stereo amplifier is combined by resistors R1-R4. Resistors R5, R6 and RV1, together with capacitors C1, C2 and C3 form a low pass filter that has a cut-off frequency around 200 Hz and a final 18 dB per octave slope.

Capacitor C4 provides a high pass filter of approximately 30 Hz to protect the speakers from large transients and dc levels. (The filter shown in Fig. 1 - intended for use with separate amplifiers - has a 20 dB attenuator incorporated before the output potentiometer - this protects the following amplifier against overloads).

The amplifier shown in Fig. 2 has a voltage gain of  $23 (R9 + R7) / R7$ , a power output of approx. 25 Watts into four ohms and a frequency response from 0Hz to approx. 50 kHz. However with the input filter incorporated, the frequency response of the amplifier is that of the filter - shown in Fig. 3.

The main voltage gain of the amplifier circuit is provided by Q2 and Q3. Q4 and Q5 provide the necessary current gain to drive the output transistors Q6 and Q7. Transistor Q1 stabilises Q2 and Q3 while D1 compensates Q4, D2 and D3 compensate Q5 and Q7.

Zener diodes ZD1 and ZD2 protect Q2 and Q3 by limiting the output voltage swing of the IC.

The amplifier described in this project may also be used - without the filter - as a straightforward 25 Watt mono amplifier - in this case diode D2 or D3 (but not both) should be removed from its location on the printed circuit board and relocated on the heat sink.

The power required by the amplifier is greater than can be supplied by a single network of EM 401 diodes, but rather than going to the expense of high current diodes, a circuit has been devised using pairs of EM 401s and a double secondary transformer to provide the correct current sharing.

**Herbert von Karajan has led the world's great orchestras and opera companies in their own halls and theatres. At home, he listens to them with Acoustic Research equipment.**



Few musicians have achieved the international distinction accorded Herbert von Karajan. His performances of **Wagner's Der Ring des Nibelungen** cycle at The Metropolitan Opera parallel his remarkable series of recordings of the same cycle, released by Deutsche Grammophon. These recordings, together with a large number of others of the classical symphonic literature, stand as a musical landmark to the world's listeners. Herr von Karajan is also a man of unusual technical proficiency, being thoroughly familiar with the engineering aspects of recording and sound reproduction. His technical understanding is not limited to books, either; he is an adept jet airplane pilot, for example.

At his home in St. Moritz and in his Essex House suite in New York, he uses a high-fidelity system consisting of an AR turntable, AR amplifier, two AR-3a speaker systems, a Sony TAH-10 headphone adapter and Sennheiser MDH-414 headphones.

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WD10-PP

# BASS BOOSTER

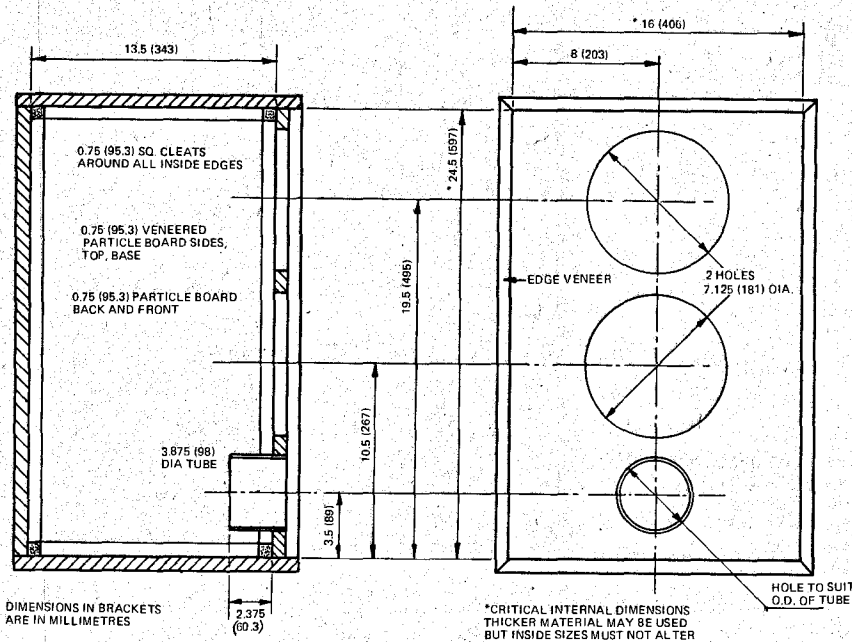


Fig. 6. Constructional details of recommended speaker enclosure.

Fig. 7. Exploded view of speaker enclosure.

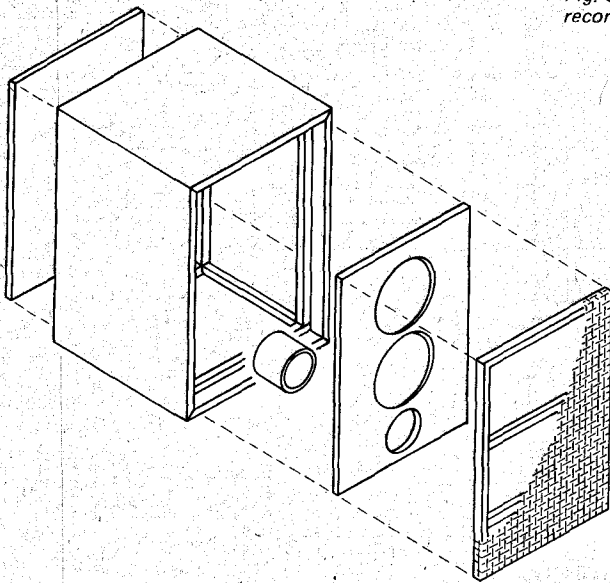


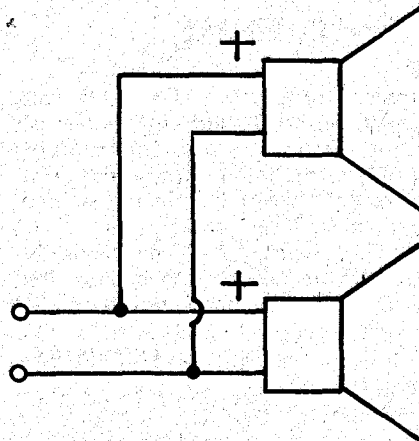
Fig. 8. How the speakers are interconnected.

alone — but when mixed with the sound from the existing two speakers in your stereo system it sounds just great.

## BASS SPEAKER ENCLOSURE

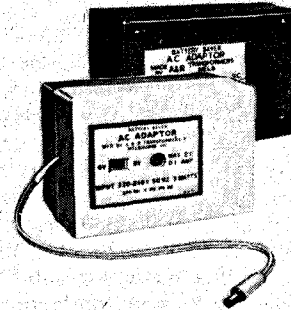
The enclosure recommended for use with this system is shown in Figs. 6 and 7. The speakers used are two 8 ohm Magnavox type 8W connected in parallel, thus having an effective impedance of 4 ohms.

The inside of the speaker enclosure should be lined on at least three non-facing surfaces. (e.g. side, top and rear). Use Innerbond or similar material.

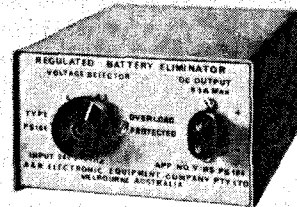


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# Electronics in Education

**A** NEW audio-visual unit from Japan's Ikegami Tsushinki company enables composite video tapes (or live programmes) to be produced from a number of different inputs including 16mm and 35mm projectors, opaque projectors, and live TV cameras.

The basic unit contains a 16mm film projector, a 35mm slide projector, and an opaque projector, the outputs of which are fed through a multiplexing mirror system to a TV camera which becomes one of several inputs to a mixing and special effects generator. A number of external TV cameras may also be connected to this unit. Provision is also made for sub-titles and captions to be superimposed over the projected material.

Optical effects such as split screen superimposition, horizontal, vertical and corner 'wipes', fade in - fade out and lap dissolve facilities can readily be achieved.

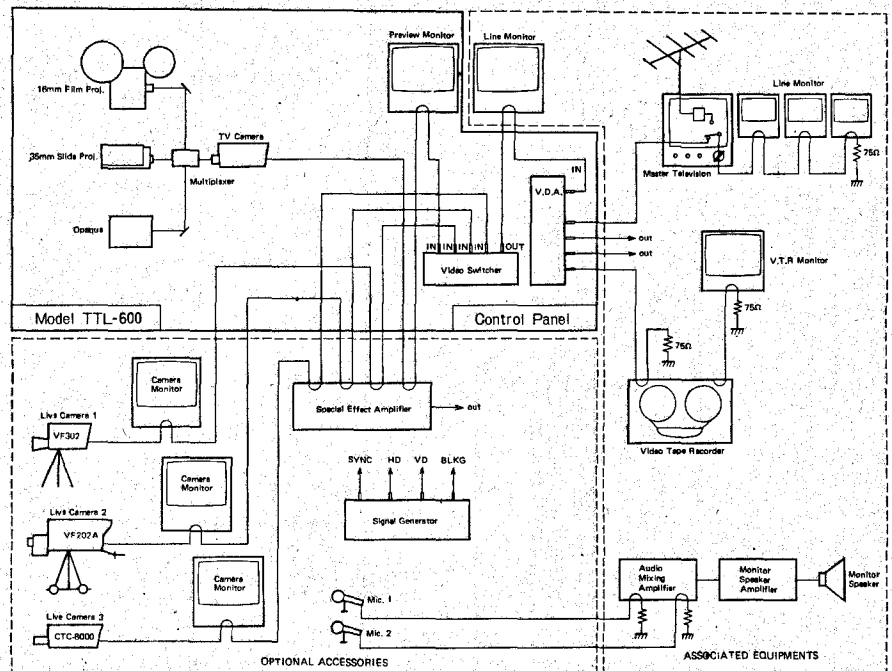
The new unit in effect produces a complete and fully edited video tape - or in other applications, such as school broadcasts, enables extra material to be added to or superimposed over existing footage.

The new TTL - 600 has particular application in CCTV systems concerned with the production of training tapes, educational programmes and pilot television advertisements. It would also find many applications as a production tool in the motion picture industry.

Full details can be obtained from Australian Video Engineering, 7 The Crescent, Annandale, NSW.



*Block schematic shows basic TTL-600 unit, plus associated equipment and accessories.*



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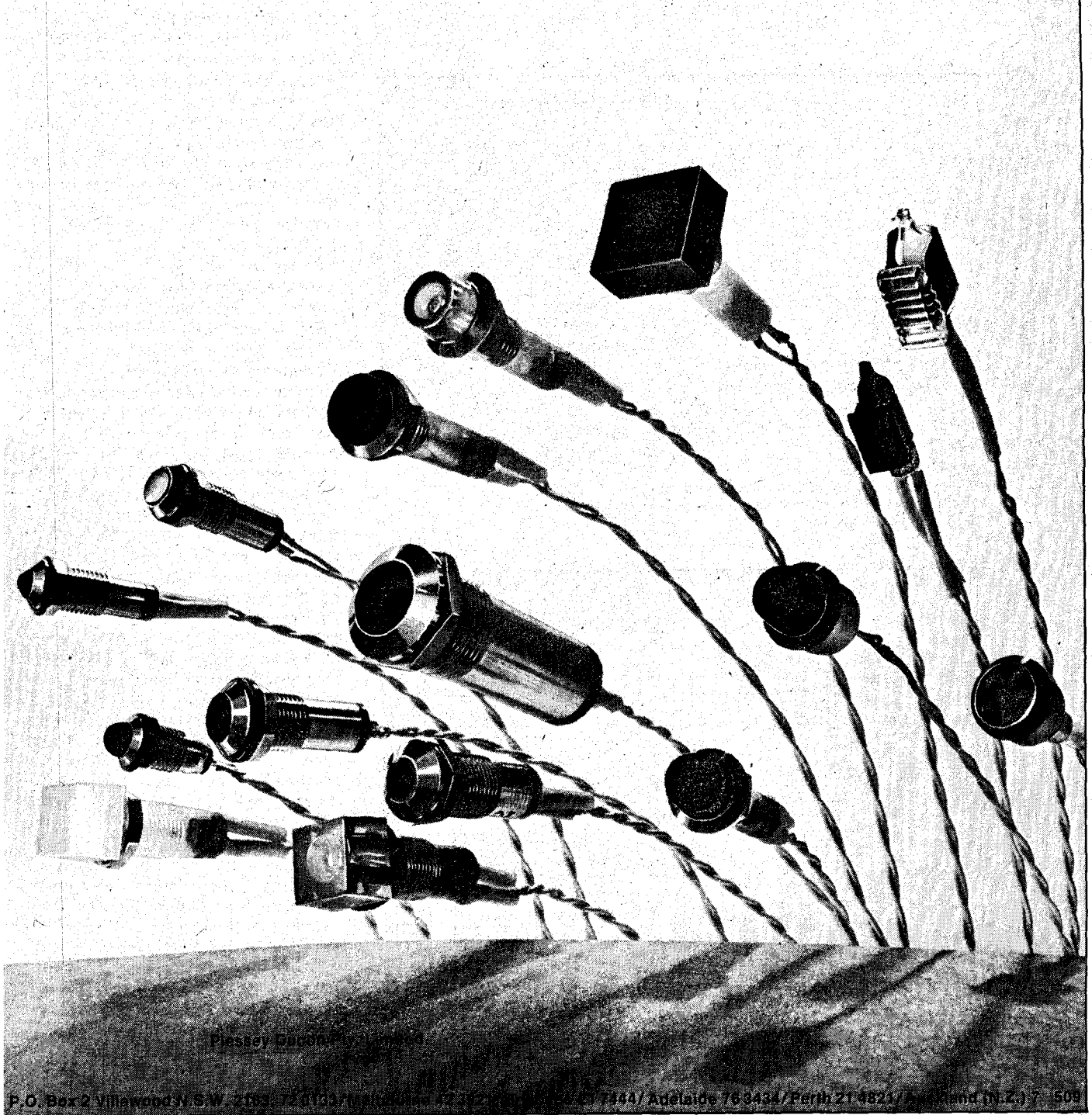
Timing may be mechanically controlled using a belt driven from the mirror shaft or by photo transistor and an oscilloscope having a calibrated time base. The apparatus is supplied

without stands, pulley and illuminant.

The large mirror and pulley may be supported by any laboratory stand and boss and accumulators should be used for driving the small motor in the mirror box.

Full details can be obtained from Philip Harris Ltd., 63 Ludgate Hill, Birmingham 3, England.

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# The Rotel Model RA

**electronics**  
TODAY  
**product test**

This competitively priced amplifier from Japan's Roland Electronic Co., has provision for two sets of individually switched speakers.

THE Rotel Model No. RA310 stereo amplifier is typical of the new breed of medium priced amplifiers being produced in Japan. Most of these amplifiers offer good performance and adequate facilities, although they may vary in appearance and switching facilities.

On the Rotel Model No. RA310 the brushed aluminium front panel is neat in appearance and well laid out. Fluted aluminium knobs are used for bass, treble balance and function selector controls.

A row of six "push on" "push off" switches is located at the bottom right hand corner of the panel and these provide the following functions, from left to right:—

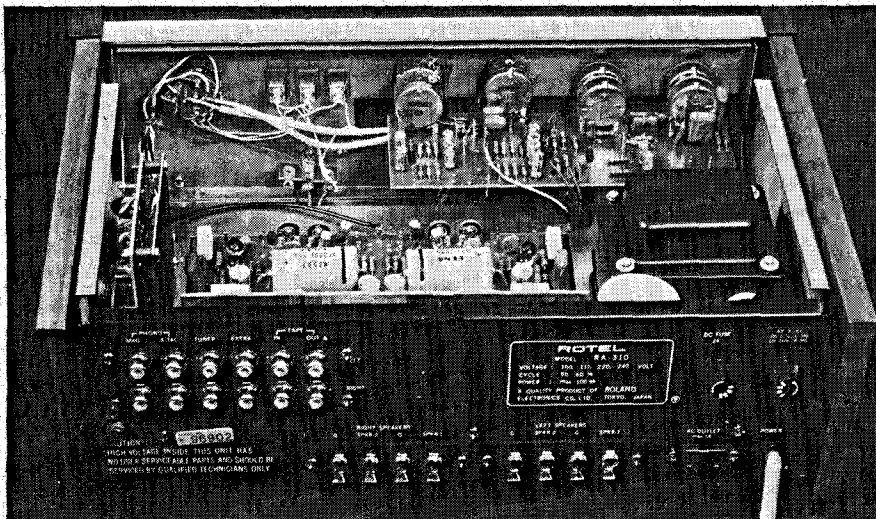
- Power on/off
- Speaker system No. 1 on/off
- Speaker system No. 2 on/off
- Stereo or mono mode selection
- Tapes monitor selector
- Loudness control on/off

To compensate for the apparent loss of bass and treble whilst listening at low levels a loudness control should provide boost for both the bass and the treble with the main boost being applied to the bass. As the graph of Equal Loudness Contours (Fig. 1) shows, the main change in the ear's relative sensitivity (or subjective loudness) is at the low frequency end of the audible spectrum, whilst the change at the higher frequency components usually masked by the background noise and for this reason, amongst others it is customary for a loudness control to apply some treble boost as well as the normal bass boost. The designers of the Rotel RA310 have not followed conventional practice in this respect and only bass boost is applied.

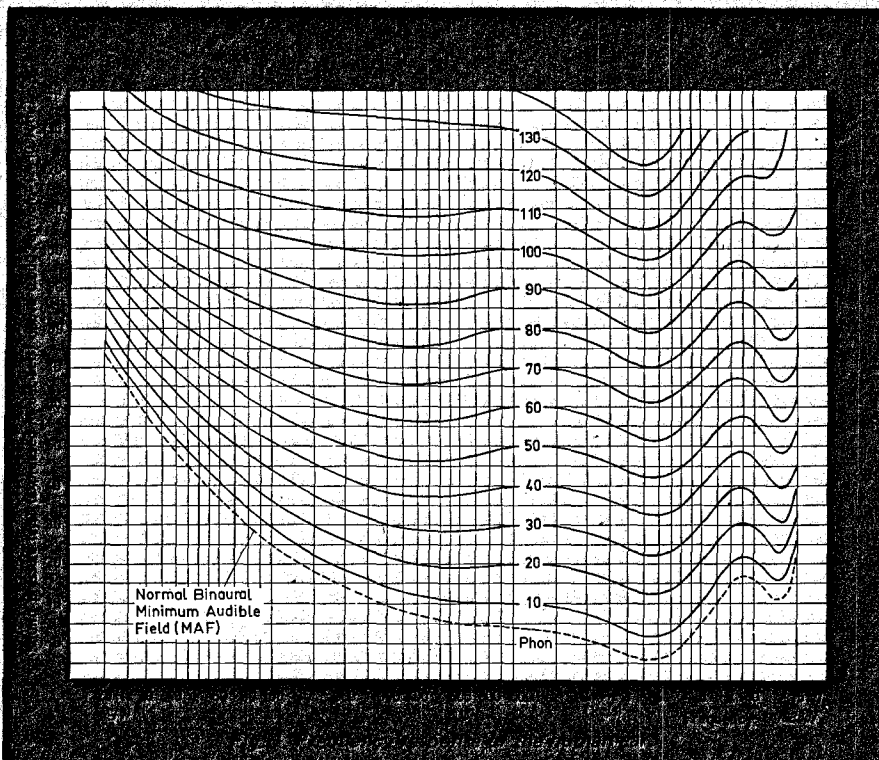
The treble and bass control do not clearly indicate either the flat response position or the degree of boost or cut provided, but familiarity would overcome this problem.

The selector knob for phono/tuner/auxiliary input is not engraved but three small bezel lights are provided and these are selectively illuminated to indicate which of the programme sources has been selected. A phone jack is provided for low impedance stereo headphones on the lower half of the front panel.

The amplifier housing has timber sides and plastic coated steel top, bottom and rear panels. The timber



Rear view of Rotel RA 310 Amplifier — note the facilities for connecting two sets of speakers.



# 310 Amplifier



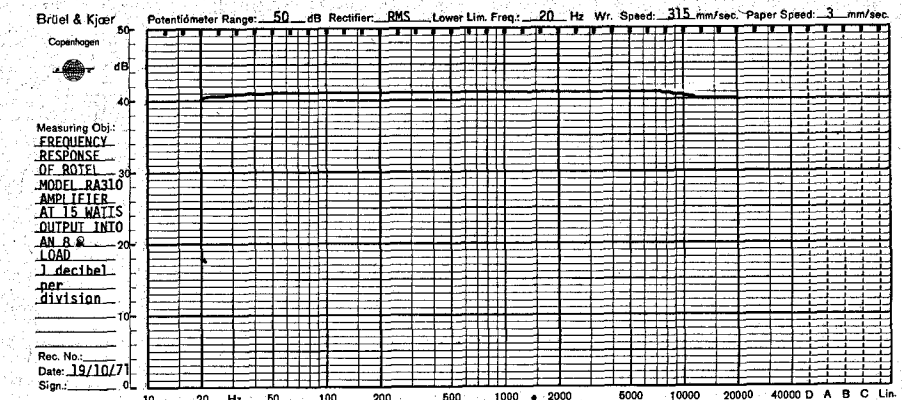
side panels frame each end of the front panel. The bottom section of the front panel forms a channel section containing the Rotel name as white letters on a black background.

The rear panel contains six pairs of RCA type coaxial sockets providing the following input output facilities:—

- Phono input — magnetic
- Phono input — crystal or ceramic
- Tuner input
- Extra input — auxiliary input
- Tape recorder — record output
- Tape recorder — monitor input

An unusual but very worthwhile feature is that two sets of 4 screwed type terminals are provided, thus allowing two sets of speakers to be connected to the amplifier. Auxiliary mains power for a turntable or tuner is provided via an American type power socket on the back panel.

Both the ac supply and the dc supply are fused and the fuses are mounted above the switched power socket at



the right-hand end of the back panel. The internal layout of the amplifier provides easy access to both sides of the two power amplifier printed circuit boards and all other components.

The circuitry is modern, using 24 silicon transistors and the output stage uses the single-ended push-pull configuration. The only protection for

the output transistors is provided by means of the fused dc supply. This is effective, but by no means foolproof.

The lower frequency response of the amplifiers is limited below 10 Hz by an RC network at the input of each power amplifier. This effectively protects the speaker system from the low frequency transients that are often produced by a record player and cartridge.

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# The Rotel Model RA 310 Amplifier

## HOW THE UNIT PERFORMED

When we measured the performance of the amplifier we found that most of the stated performance figures were equalled or exceeded. The frequency response is very good, although the sensitivity of the magnetic inputs is 3 decibels below the stated figures. The result of this is that with a low sensitivity cartridge you would not be able to develop or utilise the full power output capacity of the amplifier.

The distortion figures are higher than stated, but the performance is still more than adequate and as usual, the speakers would be the limiting factor.

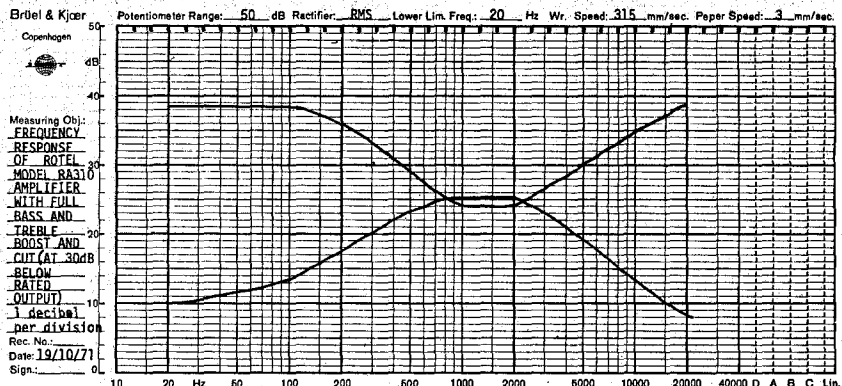
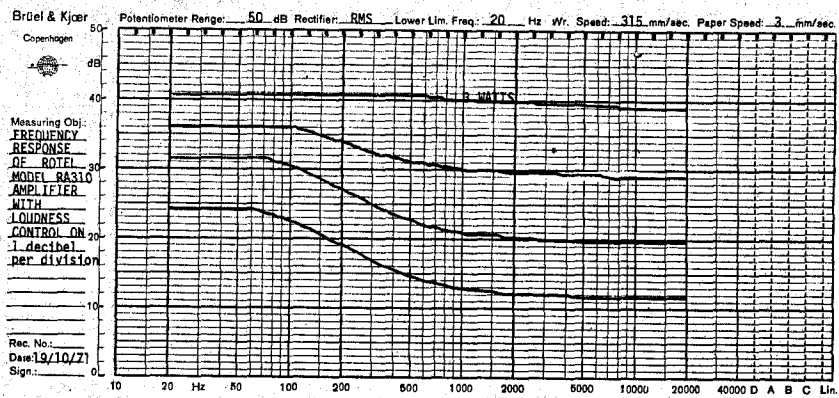
The operating manual is very brief, having a total of eight pages; however this is partly compensated for by the concise information sensibly laid out and in good English. A circuit diagram with all components types and sizes listed is included in the manual.

Under the heading of "Record Player Connections" the manual suggests that the coaxial cable between the pick up and amplifier should not exceed 10'. Using the shielded cables generally available commercially this would result in considerable loss of high frequency response, in fact, with cable lengths of the order of 10 feet the relatively high capacitance could cause as much as 10 decibels of attenuation at 10 kHz. The loudness control is adequate at the low frequency end of the spectrum (but does not provide any boost at the high frequencies). This control becomes effective below 3 watts output into an 8 ohm load.

The bass boost circuit flattens out below 100 Hz providing a margin of safety for the amplifier when driven hard. For a medium response amplifier this is probably better than the typical rising characteristics of most amplifiers. This characteristic was also evident in the loudness control contour, although its justification here is not apparent.

The facilities for driving two sets of speakers are seldom seen on an amplifier of this power rating, but are becoming more and more desirable for homes having separate living room and lounge room speaker systems.

The Rotel RA310 amplifier is a medium priced unit offering a reasonable performance and is adequate for the average home and, apart from lack of sensitivity, should meet the basic requirements of most high fidelity systems.



## MEASURED PERFORMANCE OF THE ROTEL MODEL RA310 AMPLIFIER, SERIAL NO. 96902

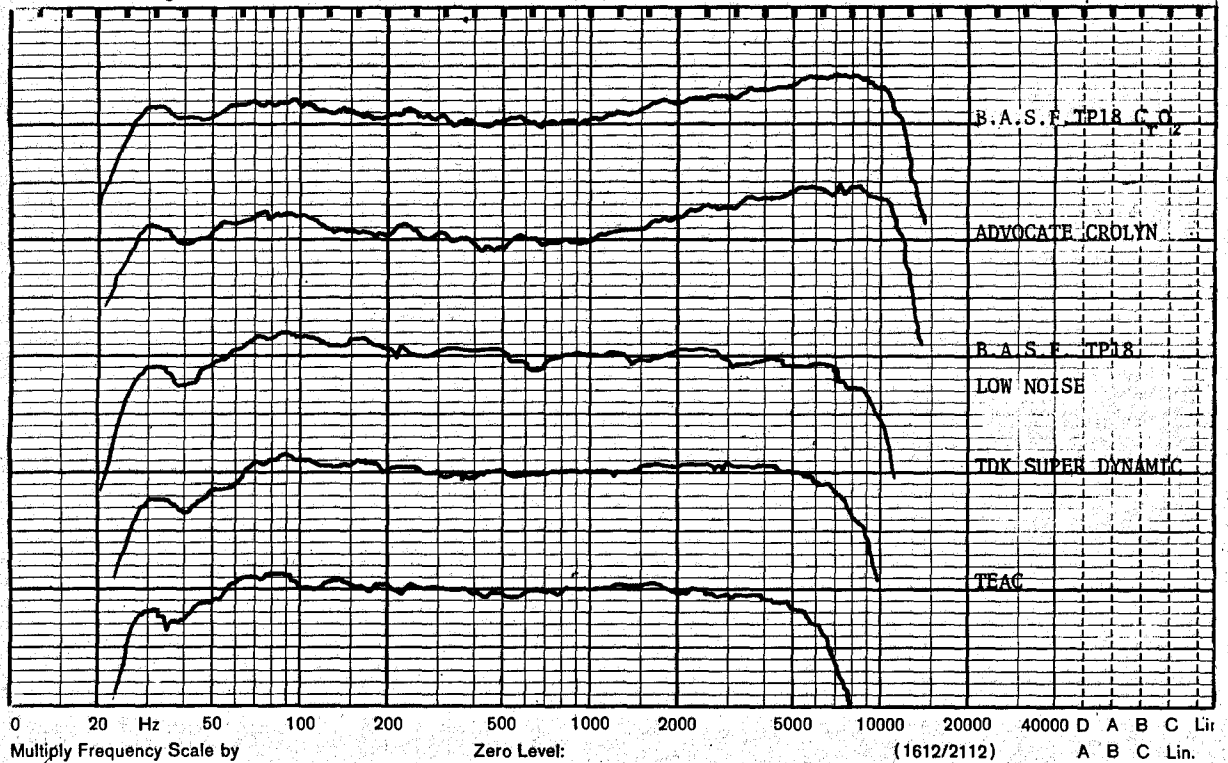
Frequency response:	-0 dB	
	20Hz to 20kHz	
	+1 dB	
Total harmonic distortion at 15 watt into 8 ohm load.		
100Hz	5%	
1 kHz	5%	
6.3 kHz	5%	
Channel separation		
Auxiliary input	33dB	
Phono magnetic input	31dB	
Signal to noise ratio		
'A' weighted at rated output	64dB (A)	
Auxiliary (extra) input	78 dB (A)	
Tape monitor input	82 dB (A)	
Bass control		
13dB boost at 100 Hz		
12dB cut at 100 Hz		
Treble control		
10dB at 10 kHz		
11dB cut at 10 kHz		
Loudness control		
13dB boost at 50 Hz		
Damping factor	32 into 8 ohm load.	
Inputs	Recommended Input	Measured Output
Phono magnetic	3mV	8W
Tuner	200mV	20.5W
Phono crystal	100mV	17.5W
Tape monitor	300mV	19.0W
Extra	200mV	20.5W
Dimensions	14" wide x 4½" high x 6¾" deep	
Weight	11 lbs.	
Price	\$129.50	

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# TAPE REVOLUTION



Latest chromium dioxide recording tapes provide dramatically improved sound — full report.

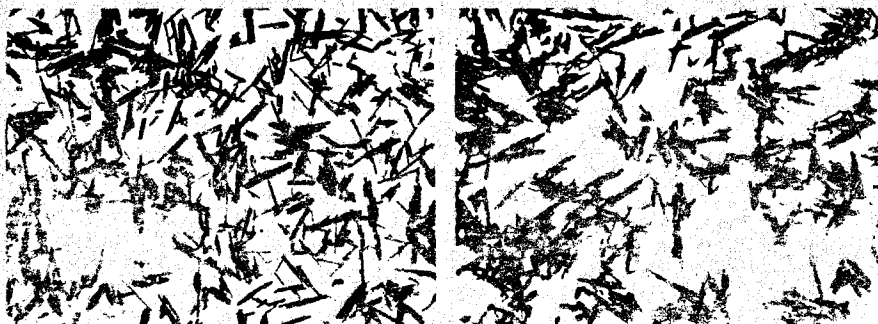


Fig. 1. Micro-photographs of (left) chromium dioxide tape, and (right) iron oxide tape.

SINCE the inception of compact cassette recorders, considerable research has been undertaken to improve their frequency response. In the early 1960s, trials were performed on chromium dioxide tapes, but the real advantages of these tapes were not evident until after 1966. This year has seen the breakthrough of chromium dioxide tapes into the compact cassette market with the Advocate and the B.A.S.F. Chromium Dioxide tapes.

Chromium dioxide tapes offer many improvements over the conventional iron oxide tapes. The main advantages for compact cassettes using chromium dioxide tapes are:

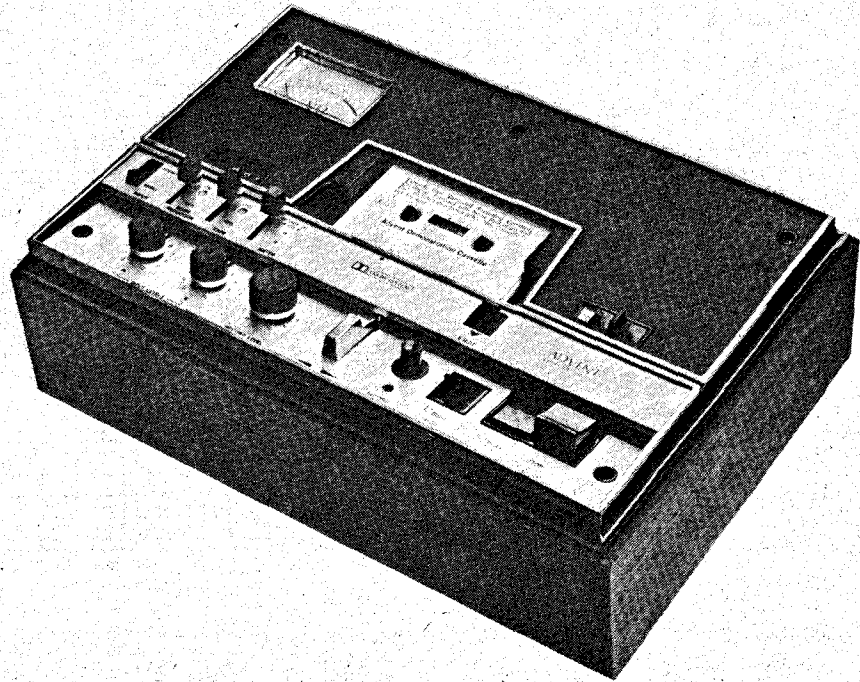
1. Improved frequency response.
2. Improved background noise at high frequencies.
3. Improved high frequency dynamic range. (Short wave sensitivity).

One major disadvantage is the higher coercivity (coercivity is, in essence — the force required to remove any recording on the tape) of the chromium dioxide tape. This necessitates considerably greater erasure capacity and higher bias levels.

One advantage of the magnetic material, chromium dioxide, is that it is relatively easy to vary the coercivity over a wide range, making it possible to choose the appropriate optimal coercivity for a certain application. Furthermore, the desired coercivity is readily maintainable during manufacture. In addition, the form of the single particles approaches more or less an ideal needle shape so that an extremely good homogeneity can be obtained, that is superior to that of conventional tapes. (Fig. 1).

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

The very high maximum output at high frequencies is of decisive importance for quality recording at very low tape speeds, (for example the compact cassette tape speed of 1 7/8 ips (4.75 cm/s).) As everybody who has tried to make a good recording on cassettes from a good master or a good FM broadcast knows, the major limitations of the compact cassette system are:— poor background noise and generally poor high frequency recording (lack of brilliance) especially with music that contains a



For optimum results, chromium dioxide tape should be used in conjunction with tape recorders — such as this Advent Model 201 — that have been specifically designed for these tapes.

predominance of high frequencies.

Chromium dioxide is a low noise oxide, which implies that at the same background noise level as obtained from modern "conventional" tapes, a significant improvement in high frequency output is available, whereas the signal to noise ratio improves because the maximum output level at lower frequencies can be better utilised. This imparts to the chromium

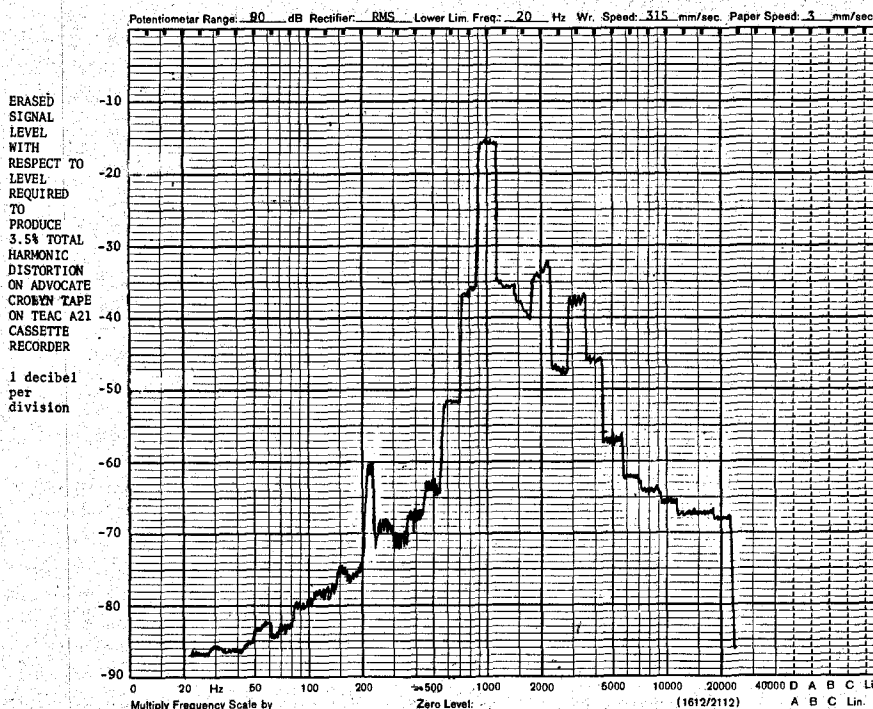
dioxide tape cassettes a superior dynamic range, and noticeable improvement to their brilliance and transparency.

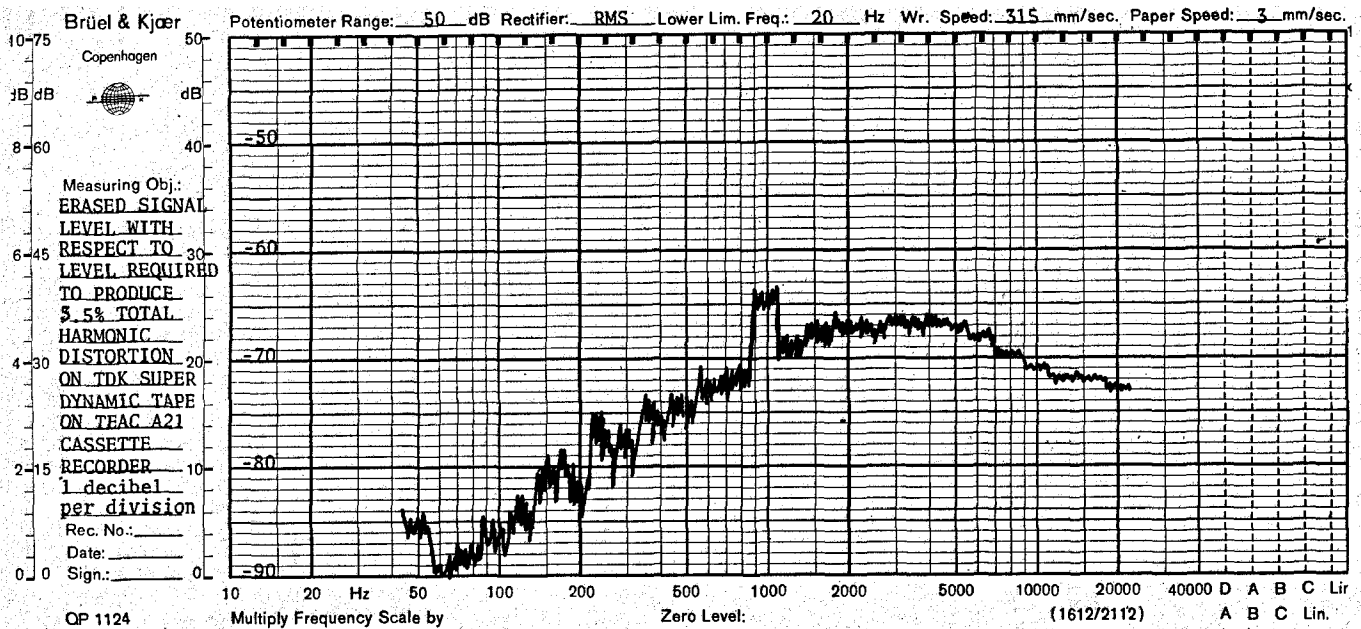
One could say that chromium dioxide tapes produce at a tape speed of 1 7/8 ips, nearly the same sound recording quality as conventional tapes on a standard tape recorder at 3 3/4 ips.

All of the factors considered so far have been based on the assumption that the replay parameters (or performance) 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 maximum output level advantages of the chromium dioxide tapes to improve the signal to noise ratio of the recorders.

Key to this is the replay frequency response time constants. If this time constant (which has been standardised internationally at 120  $\mu$ s) could be reduced to a lower value, the background noise would be reduced in a similar manner. However, this can only be done at the cost of the maximum output level curve as a function of frequency, because under such conditions at least a part of the high frequency response is lost.

Now most of the various cassette recorder manufacturers are already solving the noise problem by incorporating the DOLBY B, or Philips noise suppression systems by means of which the signal to noise ratio of cassette recording systems can be





### MANUFACTURER'S SPECIFICATION

Magnetic Properties	Typical Low Noise Tape	B.A.S.F. TP18 C <sub>02</sub>	Advocate Crolyn
Coercivity (Amps/metre)	23900	35800	39700
Retentivity (TESLAs)	0.105	0.145	0.160
Remanence Ratio	0.7	0.85	DATA NOT AVAILABLE
Remanent Flux per unit track width (nano webers/metre)		580	770

### MEASURED PERFORMANCE

Make and Model No. of Cassette	Signal to Noise Ratio Following Erasure *	Erased Signal Level	Relative Levels for 3.5% Distortion	Bias Level used for 3.5% Distortion Recording
	dB	dB		
BASF TP18 LOW NOISE	68	-44	0.0	0 - reference level
BASF TP18 C <sub>02</sub>	60	-25	-3.8	+2
ADVOCATE CROLYN	55	-16	-3.9	+2
TDK SUPER DYNAMIC	56	-63	+1.5	-2
TEAC	56	-66	+1.4	-2

\* with respect to level required at 1kHz to produce 3.5% total harmonic distortion.

**DROP OUT AND CONSISTENCY** Maximum deviation in dB over a 60 second period.

	1kHz	4kHz	8kHz
BASF TP18 LOW NOISE	0.3	0.3	0.7
BASF TP18 C <sub>02</sub>	0.3	1.0	1.4
ADVOCATE CROLYN	1.6	1.3	1.7
TDK SUPER DYNAMIC	1.0	1.5	2.0
TEAC	1.2	0.7	1.4

## TAPE REVOLUTION

improved up to approximately 9 dB. Such systems do, however, allow the advantages of chromium dioxide tapes to be fully utilised to improve the high frequency response or brilliance of the recorders.

Because of the high coercivity of chromium dioxide cassette tapes, which is higher than that of conventional cassette tapes, it is necessary to increase the HF bias current for optimum recording. For the same reason an increase in the level of the erasure signal is required and less pre-emphasis is necessary for the standardised replay time constancy used at present.

The frequency response curves shown on the level recordings have been obtained with an increase of bias level of 2 dB but with no changes in pre-emphasis (or equalisation). The erasure capacity of the recorder has to be increased by at least 40% to 50% over that required for conventional tapes to obtain adequate signal erasure. It is therefore 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.

The Advent model 201 cassette recorder reviewed in our last month's edition incorporates these modifications. Should chromium dioxide tape be used on machines optimised for conventional tapes, significant changes will be observed in the replay, record and erasure functions. The reproduction of

pre-recorded cassettes with chromium dioxide tape is simple because, during the duplicating process, it is easy to take care of the properties which can be overcome with the technical facilities found in most large tape duplicating studios.

The reproduction of these cassettes on conventional cassette recorders will give an increase in high frequency output resulting in an overemphasis of the higher end. However, on recorders with a tone control, this can easily be compensated for, so that there will be a noticeable reduction in hiss.

From a theoretical point of view the different recording properties of new chromium dioxide cassettes should cause problems during recording. However, most recorders already have such a high HF bias signal that they are generally suitable for the chromium dioxide tape. A bias setting

which gives maximum output at low frequencies with conventional tapes is generally close to the optimum bias for balanced utilisation of chromium dioxide tape.

It is for this reason that in most cases it will not be the bias setting which causes incorrect recording, but the relatively strong pre-emphasis (or equalisation) in the recording amplifier, resulting in an overemphasis of the high frequency spectrum. This, of course, can be corrected for by adjusting the tone controls as mentioned above.

The erasure of chromium dioxide tapes on conventional cassette recorders remains the only major problem. The level recordings of the erased signal levels for standard and chromium dioxide tape clearly show the magnitude of this problem. These results will vary considerably from

recorder to recorder, depending on the intensity of the erasure signal.

We conducted tests with three new conventional cassette recorders and all failed to provide sufficient erasure signal to cope with the chromium dioxide tape (the erased signal being only -15 decibels to -30 decibels down on the three machines tested.)

All three recorders exhibited a dramatic improvement in frequency response, hiss reduction (i.e. high frequency noise reduction) and last, but not least, the subjectively clearer sound that they produced.

The big future for these tapes is as base material to be used for pre-recorded tapes, for not only will the material be better with any recorder, but, in suitable Dolby-ised form, will make sufficient difference to justify the consideration of cassette machines as high fidelity devices. ●



### CASSETTE HEAD CLEANING TAPE SIZE 31

A cassette for cleaning tape heads, capstan and pinch wheel in one quick operation. Suitable for all compact cassette recorders and players.



### COMPACT TAPE HEAD CLEANING KIT SIZE J

Cuts repair costs, ensures better recording and reproduction with either reel or cassette recorders. Kit comprises, bottle of Bib Tape Head Cleaner, (non-flammable), 2 Blue Tape Head Applicator Tools, 2 White Tape Head Polisher Tools, 10 Applicator and Polisher Sticks, Cleaning Cloth, all in a plastic wallet.



### STYLUS AND TURNTABLE CLEANING KIT SIZE B

Essential for maintaining stylus and turntable free from dirt. Kit contains, special cleaning brush on free-standing base, absorbent cleaning cloth, bottle of approved non-flammable, anti-static cleaner, with full instructions.



### CASSETTE TAPE EDITING AND JOINING KIT SIZE 24

A complete kit to enable cassette tapes to be edited easily, quickly and accurately. The kit comprises, Cassette Tape Splicer (1/2"), 2 Tape Cutters, Tape Piercer, 10 Labels, Splicing Tape, 3 Tape Winders and Removers (2 spares), instruction leaflet, in handy plastic wallet.



### TAPE EDITING KIT SIZE 23

Essential for quick and accurate editing. Kit contains (1/2") Tape Splicer, 12 Tape Reel Labels, Razor Cutter, Splicing Tape, Tape Marker, and instruction leaflet, all in a plastic wallet.

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<b>7" TAPES UNBOXED NEW</b> \$2.00 each.			Please include adequate Postage according to weight and distance.		

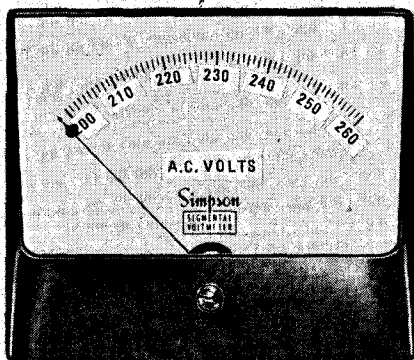
# EXPANDED SCALE VOLTMETERS

*Increased resolution and accuracy may be obtained by expanding a narrow range over the full scale.*

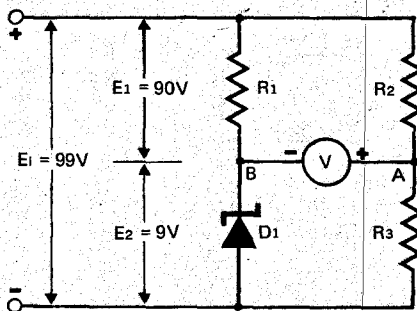
**T**HERE are numerous applications in which only a narrow segment of a voltage range must be read — and with considerable accuracy. At the same time, the large remaining portion of the range may be of no interest.

A typical case is the metering of line voltage. Let's assume that in a particular location the nominal line voltage is 230 volts ac. Assume further that it is necessary to measure this voltage accurately within 1V. Depending upon the regulation available in different locations, actual line voltage may range somewhat higher or lower than the nominal value. This regulation differential is frequently in the order of 5V though up to 10 or 15V is quite possible. So for the moment we will consider that the maximum line voltage excursion for a given location is from 220 to 250 Vac. We know that the line voltage will never dip to, say, 180V, nor will it ever climb to 270V.

If we wished to monitor such a line outlet, using a conventional meter, we would probably select a 0-300 Vac unit. Not only would the scale from 0-220 and 250-300 be wasted in the sense that the line voltage would never enter these ranges, but it would be impossible to read the actual line voltage within the required 1V. First of all, since accuracy is based on the percent of full scale reading, the usual



*Fig. 1. Accurate reading of line voltage on expanded scale is offered by electrically segmented meter.*



*Fig. 2. Basic circuit of segmented voltmeter, for a particular set of component values, A and B are in balance, and no current flows through the meter when the input is 99 Volts. Higher voltage produces a reading.*

2% meter would be inadequate. An unusual and costly 0.33% accuracy would be needed ( $0.0033 \times 300 = 1$  V approx.). Secondly, even with a 0.33% accuracy meter, the visual resolution of 1 V on a 300V scale is inconvenient and very susceptible to reading error.

The most effective way to obtain precise readings is to use a meter in which the specific range of interest has been expanded to occupy the entire scale.

## MECHANICAL SUPPRESSION vs. ELECTRICAL SEGMENTATION

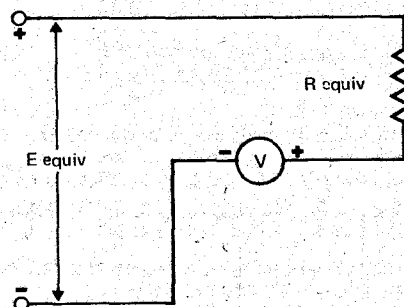
There are two ways of attaining an expanded range. The simplest approach is a mechanical one. First, a meter with a range equal to the desired span is constructed. (Span is the difference between the lowest and highest values displayed.) Then, the meter hairsprings are "wound up" so they tend to push the pointer below the normal zero mark in the scale. The "winding up" is continued until, with the desired lower current value applied, the pointer rests at the normal zero mark on the scale. Full scale obviously is the sum of this lower current value plus the original range. Naturally, a new scale is required for the revised unit.

A mechanically suppressed meter provides increased resolution but problems in movement tracking,

stability of the hairsprings under stress and other factors generally prevent an increase in accuracy rating.

An even more important limitation of mechanically suppressed meters is that it is impractical to suppress a major portion of the range. 50% is a representative limit. Beyond this amount, problems are encountered with variations in suppression torque due to temperature, drift due to exceeding stress limits on the springs and mechanical interference due to spring distortion. This limitation severely restricts the number of prospective applications since the expansion of a narrower segment than 50% is usually desired.

The most effective method for expanding a portion of a range is through electrical segmentation. Here the significant portion of the overall voltage range is expanded to occupy the full scale length. This is accomplished by nulling out any voltage below the lower limit of the desired portion. Accuracy is increased in direct ratio to the amount of suppression, assuming the associated circuitry stays accurate. This is because accuracy relates to percent of the portion of the range that is expanded, though the rating may be stated in terms of percent of centre scale value. It is possible to segment a d-c or average reading meter over a wide range (e.g., 10-100V to 99-100V).



*Fig. 3. Simplified equivalent of circuit shown in Fig. 2.  $E_{equiv}$  would be 0.091V when  $E_i$  is 100V.*

# University QUALITY METERS

10 Amp A.C.

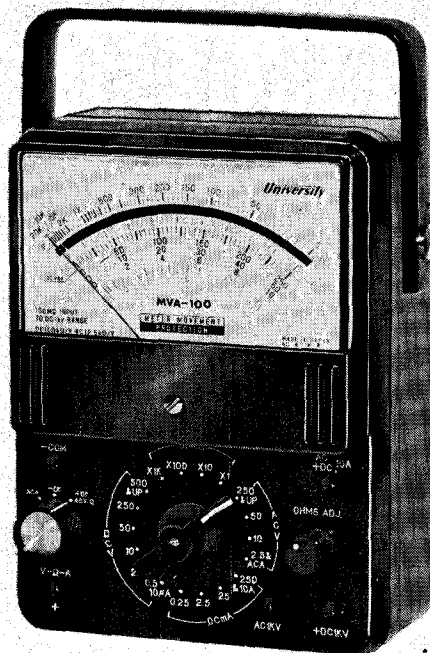
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1000V A.C.

10 Micro-Amps D.C.

100 Kohm/Volt D.C.

Overload Protection



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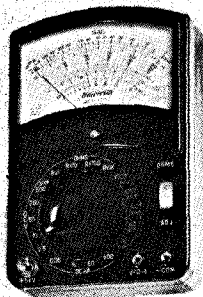
#### Specifications:

D.C.V. : 0.5-2.5-10-50-250-500-1000 (100K $\Omega$ /V)  
 A.C.V. : 2.5-10-50-250-1000 (12K $\Omega$ /V)  
 D.C.A. : 10  $\mu$ A-250  $\mu$ A-2.5 mA-25 mA-250 mA-10A  
 A.C.A. : 0-10A  
 Ohms : 20K-200K-2M-200M  
 db : -20/0/+ 62  
 Accuracy :  $\pm$  3% for D.C.  $\pm$  4% for A.C.

Battery : 4 x 1.5V + 1 x 22.5V  
 Size : 7" x 5 1/2" x 3"  
 Weight : 3 lbs.

Optional Extra: Leather Case. \$6.00 plus 15% S.T.  
 Features: Mirror scale, Diode overload protection, polarity reversing switch, multi-colour scale, spring-loaded shock resistant movement, engraved front panel, 90-day guarantee.

Also available from our quality range is the Model CT500, a well-known model which now carries the "University" brand name to ensure that the unit is backed by the spare parts and repair facilities that are offered with all "University" equipment. Price each \$14.00, plus 15% sales tax (postage 30c).



#### Specifications:

D.C.V. : 2.5-10-50-250-500-5000 (20K $\Omega$ /V)  
 A.C.V. : 10-50-250-500-1000 (10K $\Omega$ /V)  
 D.C.A. : 50  $\mu$ A-5-50-500 mA  
 Ohms : 12K-120K-1.2M-12M  
 db : -20/0/+ 62  
 Accuracy :  $\pm$  3% for D.C.  $\pm$  4% for A.C.  
 Battery : 2 x 1.5V  
 Size : 5 1/2" x 4" x 1 1/2"  
 Weight : 1 lb.

Features: Diode overload protection, multi-colour scale, spring-loaded shock resistant movement, engraved front panel, 90-day guarantee.

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## EXPANDED SCALE VOLTMETERS

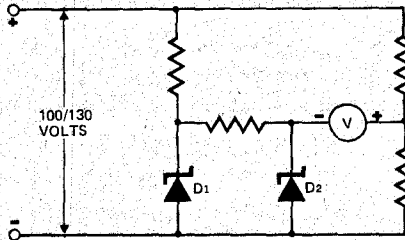


Fig. 4. For a wide voltage span, a second Zener is added to assure stability.

### D-C, AVERAGE, RMS AND P-P

Before we examine how the segmentation is accomplished, a few words on the type of sensing may be in order. The basic meter responds to d-c at the d-c level. The typical a-c voltmeter, with bridge rectifier, senses the average a-c voltage (0.637 of sine peak), though its scale may be calibrated in terms of rms. The VTVM (peak or peak-to-peak sensing) may also be calibrated in terms of rms. The true rms meter senses the effective value (0.707 of sine peak).

If all three types of meters were used to measure a particular sine wave voltage, the scale readings should be identical. However, if the waveform were non-sinusoidal, three different readings would result. This fact should be borne in mind when specifying a meter. Segmented voltmeters are available in d-c, average a-c sensing, peak sensing, peak-to-peak sensing and true rms sensing types.

### NARROW RANGE SEGMENTATION

The basic circuit of the electrically segmented voltmeter is shown in Fig. 2.

$R_1$  is a current limiting resistor to establish the nominal current through the Zener ( $D_1$ ) at the rated value at the desired centre scale value (i.e., at 99.5 volts on a 99-100 volt unit).

$R_2$  and  $R_3$  are a voltage divider with values chosen so that the voltage at point "A" equals the voltage at point "B" when the applied voltage is equal to the lowest value to be displayed on the scale. At any other input voltage, a difference in potential will exist between "A" and "B".

If we assign arbitrary values to illustrate the 99-100 volt unit, nominal value might be 12,000 ohms for  $R_1$  (Zener current = 7.5 mA), 40 k for  $R_2$  and 4 k for  $R_3$ . Assuming the Zener voltage to be exactly 9.00 volts, balance between "A" and "B" occurs when the input voltage is exactly 99.0 volts. Therefore, no current flows through the meter, and the pointer rests at the normal "zero" mark. At 100 volts input, point "A" will be more positive and current will flow through the meter from "A" to "B".

At this point, the question of meter sensitivity vs. the combination of span

and divider resistance values must be considered.

Since our bridge circuit of Fig. 2 can be simplified to an equivalent circuit of Fig. 3, we can approximate the required sensitivity by simple inspection.

At 99 volts input, the voltage at "A" in Fig. 2 is 9.00 volts. Ignoring the meter current, the voltage at "A" would rise to 9.091 volts when the input rises to 100 volts. This gives a difference ( $E_{equiv}$  in Fig. 3) of 0.091 volt between "A" and "B". If, to simplify our calculations, we assume both the meter and Zener resistance to be "0",  $R_{equiv}$  would be 40 k ( $R_2$ ). This means that the meter current would be less (since we made some impossible assumptions) than 2.275 microamps ( $E_{equiv}/R_{equiv}$ ). This sensitivity is available in few meters today and is certain to be expensive.

More meter current could be provided by reducing the values of  $R_2$  and  $R_3$ . Unfortunately, this increases the power dissipated by the resistors and, if carried to extremes, can cause a substantial rise in the internal temperature of the meter. For a given application, it becomes necessary to arrive at a compromise between meter sensitivity and wattage dissipation.

### WIDE RANGE SEGMENTATION

A relatively wide voltage span, such as 50-100 v, causes a stability problem. That is, a 50-volt swing across the input will increase Zener current, and the self-heating will affect the Zener voltage due to the temperature coefficient of the diode. This is especially critical since a 1% change in Zener voltage may result in a 10% change in meter reading.

The solution is to insert a second Zener,  $D_2$  in Fig. 4 to act as a voltage reference. Thus a small change across  $D_1$  does not affect the  $D_2$  voltage.

An extremely sensitive meter is not needed for a wide voltage span, but to keep Zener current low, a 50  $\mu$ A meter is frequently employed. Either the wide range or narrow range segmented meters can be converted to average sensing a-c meters by putting a full wave rectifier ahead of the unit.

### TRUE RMS SEGMENTATION

To obtain true rms segmentation, a thermal bridge is used with a ring demodulator as in Fig. 5. At some level of  $E_i$ , the resistance of lamp  $L_1 = R_1$  and the resistance of  $L_2 = R_2$ . At this voltage there is no output from the bridge, and consequently no output from the ring demodulator. The meter rests at the "no current" point or the lowest value of the scale span.

Bridge balance is dependent on lamp resistance. Since it is the rms or heating value of the current which

determines the resistance the rms sensing segmental voltmeter is an accurate rms measuring unit at the null point. At other points on the scale it departs from the ideal, so accuracy is generally greatest with narrow segments.

At all points other than the null, there is an ac output across points 1 and 2 of Fig. 5. The ring demodulator, which applies its output to the meter, has its magnitude determined by the amount of bridge unbalance, and its polarity determined by the relative phase of  $E_1$  and  $E_{1-2}$ . The ring demodulator avoids ambiguity of indication by comparing the phase of these signals applied to it. If a simple rectifier were used, upscale indication would result under all input conditions except zero and null.

Like a rectifier type meter, the demodulator and movement combination responds to the average value of the current applied to it, and is calibrated to the rms equivalent on a sine wave input. Therefore, inputs other than sine wave and greater than the null point value will be in error. The magnitude of the error may be closely approximately by the formula:

$$B = 100 K \frac{[0.901 - (E_{avg}/E_{eff})]}{E_{cs}}$$

where

B is error, expressed as % of centre scale value

K is deviation in volts between null and point being checked

$E_{avg}$  is average value of waveform applied to meter

$E_{eff}$  is rms value of waveform applied to meter

$E_{cs}$  is centre value of meter

Thus, the error on a 100-130 v meter used to check a 120 v square wave, assuming no error on a sine wave, would be:

$$B = 100 \times 20 \frac{[0.901 - (1/1)]}{115} = 1.72\%$$

The current actually applied to the meter would have an rms value 1.72% less than the value indicated. By comparison, an average sensing unit would have an error of 11%.

For this reason, the rms sensing segmental meter is generally recommended where constant voltage transformers, SCR circuits, d-c to a-c inverters, relaxation oscillators or pulse voltages are to be measured. ●

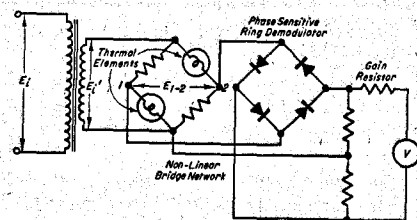
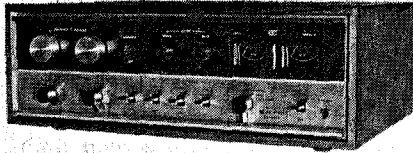


Fig. 5. Circuit of true rms reading segmental meter. Thermal bridge, consisting of lamps  $L_1$  and  $L_2$ , and  $R_1$  and  $R_2$ , has no output at the null voltage.



### SONATA MODEL 600 SOLID STATE STEREO AMPLIFIER

Output transistor protection fuse, Speaker Imp. 4-8-16 OHMS. Inputs for microphones, ceramic, crystal, magnetic cartridges. Aux. tape in. Tape out. Tuner. Stereo headphones. Tape monitoring switch. Tone def. switch. Hi. freq. scratch filter switch. 20 freq. scratch filter switch. 2 v.u. meters. Loudness control. Separate bass, treble balance and volume controls.

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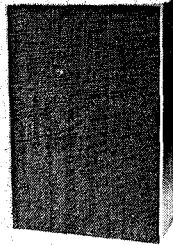
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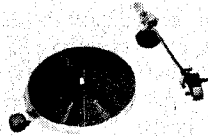


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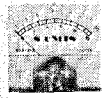
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# RADIO ASTRONOMY

(Continued from page 59)

it cannot penetrate it to any appreciable extent because the electric field causes currents to flow and appreciable power is consequently drawn from the wave.

Ionised gases will *refract* electromagnetic waves. This is due to the interaction of the electric and magnetic fields, and the free electrons in the gas, causing a reduction in the velocity of propagation of the wave. Power is absorbed from the wave by the ionised gas, the heavier the ionisation (that is, the more free electrons available), the more power is absorbed and the greater is the refractive index.

The refractive index and the absorption vary with frequency — the lower the frequency, the greater the refractive index and the greater the absorption.

Thus, the ionosphere, which surrounds the earth at a height of about 100 km to about 600 km will affect signals received from space. The effect diminishes with increasing frequency until, at about 50MHz, the effect of the ionosphere is negligible.

Similarly, ionised hydrogen, great clouds of which exist in space, absorbs electromagnetic energy. But, because of its particular characteristics, this absorption occurs at one particular frequency. This is approximately 1420 MHz. (21cm).

When observations of particular sources are made at frequencies below 50MHz, a phenomenon known as scintillation is observed. This is caused by rapid fluctuations of the ionisation density of the ionosphere causing fluctuations in the signal strength of the noise source being observed. It is analogous to the "twinking" of stars caused by fluctuations in the Earth's atmosphere.

Most of the cosmic noise radiation from space is incoherent in nature, that is it has random amplitude, phase and frequency characteristics along with random polarisation. Considerable modification to the characteristics of cosmic noise can be caused by a variety of natural circumstances. If the radiation passes through a magnetic field, it can acquire certain polarisation characteristics, particularly over a certain band of frequencies and, as explained above, neutral hydrogen can absorb radiation at approximately 1420 MHz (21cm) and an "absorption line" can be noticed in the radiation from certain sources.

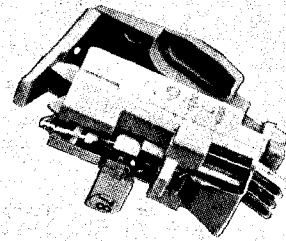
The second part of this series — which will be published next month — describes the various types of antennae — used by both amateurs and professionals for radio astronomy reception. ●

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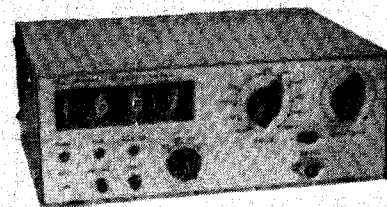
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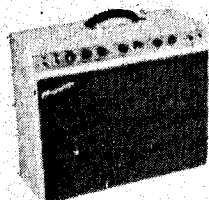


P/M 128  
JAN. 1970.



STEREO 60W + 60W R.M.S.

1968 Solid State. V.T.V.M.



BATTERY CHARGER 1A

PLAYMASTER 116 and 117  
and 125 GUITAR AMP.

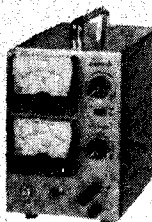
June 1967 — 40 watt  
July 1967 — 60 watt  
July 1969 — 50 watt

3-BAND SHORT-WAVE CONVERTER  
May, 1966.

LAB QUALITY

Regulated Power Supply (0-30v)  
September, 1968.

1966 R/C Bridge  
May, 1966.



OCT., 1970



PLAYMASTER 129 I/C AMP

3-BAND DOUBLE-CHANGE RECEIVER  
April, 1966.

1966 3in CRO  
May, 1966.

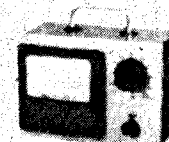


Playmaster 122  
Program Source  
August, 1968.

FOUR-CHANNEL AUDIO MIXER  
February, 1966 & 1967.

3-BAND 3-RECEIVER  
November, 1966.

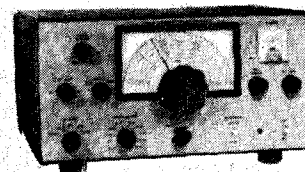
TRANSISTOR MILLIVOLT  
METER  
May, 1968.



## 1970 - COMMUNICATIONS RECEIVER - 240

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VALVES — TRANSISTORS — ZENER & POWER DIODES — SEMI-CONDUCTORS — DIACS — TRIACS — S.C.R.'S. — I/C'S. SPEAKERS — MICROPHONES — COILS — IFT'S. TRANSFORMERS — INST CASES — METALWORK. PLAYERS & CHANGERS — METERS — RELAYS — CONDENSERS — RESISTORS — BEZELS — STYLII — CARTRIDGES — RECORDING TAPE — PROBES — INSTRUMENTS — POTENTIOMETERS — CRYSTALS — FERRITE BEADS — CORES — BALUNS — TERMINALS — CO-AXIAL PLUGS & SOCKETS — MULTI CONNECTORS — PRINTED CIRCUIT BOARDS — COPPER WINDING WIRE — ETC. — ETC. —

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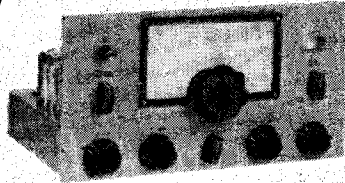
Phone 63-3596

232 FLINDERS LANE, MELBOURNE, VICTORIA 3000

AMPLIFIERS — PREAMPLIFIERS — TUNERS — CONTROL UNITS —  
GUITAR UNITS — INSTRUMENTS — INVERTERS — CONVERTERS —  
RECEIVERS — TRANSMITTERS — REGULATED POWER SUPPLY —  
TRANSISTOR AND VALVE TYPES.

Dec. 1967

OCT. 1967



SERIES 1967-ALL WAVE 3 TO 7

SEPT. 1970

IF. ALIGNMENT  
OSCILLATOR



OCT.  
1969

FULL KITS —  
OR ANY  
SINGLE PART

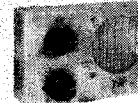


MUSICOLOR



I/C STEREO 3-3

MAY 1967



METRONOME

POPULAR KITS - TOP QUALITY - LOWEST PRICES

INSTRUMENTS C.R.O.

- 1. 5in wide range.
- 2. 1963. 3in cal.
- 3. Audio
- 4. 1966. 3 in.
- 5. 1968 — Audio
- 6. Electronic SW.
- 7. W/band.

MULTIMETERS

- 8. 20K ohm/Volt protected M/M. Probe for above.
- 9. Protected D.C. M/M.
- 10. Meterless V/meter.
- 11. A.C. Millivoltmeter
- 12. A.C. Solid State Millivoltmeter.
- 13. Solid State A.F. Millivoltmeter.
- 14. Noise Distortion Millivoltmeter.
- 15. Standard V.T.V.M.
- 16. 1966 — V.T.V.M.
- 17. 1966 — V.T.V.M.
- 18. 1966 — V.T.V.M.

BRIDGES

- 19. Standard R/C.
- 20. 1966 R/C.
- 21. 1968 R/C and Signal Injector.

TV INST.'s

- 22. Sweep and marker Generator
- 23. Dual sweep Gen.
- 24. Silicon diode sweep Gen.
- 25. Silicon diode noise Gen.
- 26. Pattern Gen.
- 27. Trans. pattern Gen.
- 28. Wild range pulse Gen.

AUDIO INST.'s

- 29. 1960 Audio Osc.
- 30. 1962 High perf. audio Gen.
- 31. Crystal locked std. Electronic tuning standard.
- 32. 1965. Solid State audio osc.
- 33. Direct reading A.F. meter
- 34. Saw wave Gen.
- 35. 1967 transistor audio Gen.
- 36. Additive frequency meter.
- 37. A.F. tone burst gen.
- 38A. 1968. Solid State A.F. Generator.

R.F. INST.'s

- 39. 6-band service oscillator.
- 39A. Trans. wave meter.
- 40. "Q" meter
- 40A. Crystal Calibrator — Solid state.

40B. Digital freq. meter.

- 40C. 1969. Dip Osc. — Solid state.
- 41. G.D.O. wide range.
- 42. G.D.O. adaptor.
- 43. Trans. service osc.
- 44. Simple signal injector.
- 45. Transistorised signal tracer.
- 46. Transistorised osc.
- 47. Basic test osc.
- 48. Transistor test.
- 48A. IF. Align Osc.

MISCELLANEOUS INST., KITS

- 49. 1960. Trans. Tester.
- 50. 1968. Transistor est. set.
- 51. Valve and Transistor tester.
- 52. Electronic Stethoscope.
- 53. Moisture alarm.
- 54. Electronic Pistol range.
- 55. Transistor Geiger Counter.
- 56. Light beam alarm.
- 57. Burglar alarm.
- 58. Flasher unit.
- 59. Transistor alarm.
- 60. Electronic switch.
- 61. Photo Timer.
- 62. Direct reading Impedance meter.
- 63. Electronic anemometer.
- 64. S.W.R. indicator.
- 65. Simple proximity alarm unit.
- 66. Metal Locator.
- 67. Electronic metronome.
- 68. Bongo Drums.
- 68A. Keyless organ.
- 68B. Theremin.
- 68C. Laser unit.
- 68D. Color organ.
- 68E. Stereo Headphone Adaptor.

BATTERY CHARGERS

- 69. Universal unit.
- 70. 1 amp unit.

REGULATED POWER SUPPLIES

- 71. Transistor, 9v.
- 72. Transistor, fully protected supply.
- 73. 1966 H.T. unit.
- 74. 1968 lab. type. 0-30v supply.
- 74A. Simple pwr. supply

VOLTAGE-CURRENT CONTROL UNITS

- 75. Vari-watt unit.
- 76. Vari-tach. motor speed control.
- 77. 2KW auto-light

78. dimmer, 4KW auto, light dimmer.

- 79. Model train control unit.
- 79A. Vari Light Dimmer.
- 80. Model train control unit with simulated inertia.
- 81. Above-hi-power.
- 82. No. 81 with simulated inertia.

TACHOMETER UNITS

- 83. 6 or 12v Std.
- 84. 6 or 12v Mullard.
- 85. 6 or 12v with dwell angle.
- 86. Tachometer and dwell angle unit for service stations.

TRANSISTOR IGNITION

- 87. Co-Fo. 6 or 12v.
- 88. Hi-Fire 6 or 12v (transformer).
- 88A. C.D.I. unit.
- 88B. Electronic ignition.

POWER CONVERTERS

- 89. D.C.-D.C. 60w.
- 90. D.C.-D.C. 40w.
- 91. D.C.-D.C. 40w. 12v—input.
- 92. D.C.-D.C. 70w. 12v—input.
- 93. D.C.-D.C. 100w. 12v—input.
- 94. D.C.-D.C. 140w. 24v—input.
- 95. D.C.-D.C. 225w 24v — input G.

HIGH-FIDELITY AMPLIFIERS MONO UNITS

- 96. Hi-Fi 3
- 97. Mullard 3.3.
- 98. Mullard 5-10.
- 99. Mullard 5-10. transistor.
- 100. Transistor 20w.
- 101. Transistor 60w.

STEREO UNITS

- 102. Mullard 2-2.
- 103. Mullard (v) 3-3.
- 104. Mullard (t) 5-5.
- 105. Mullard (t) 5-5.
- 106. Mullard (v) 10-10.
- 107. Mullard (t) 10-10.
- 108. Philips Twin 10.
- 111. Hi-Fi 60 Plus 60. P/M 128.
- 112. Playmaster 2-2.
- 113. Playmaster 3 plus 3.
- 114. Playmaster unit 3.
- 115. Playmaster unit 4.
- 116. Playmaster 10 plus 10.
- 117. Playmaster 101.
- 118. Playmaster (t) 105.
- 119. Playmaster (t) 113.
- 120. Playmaster (t) 115.
- 121. Playmaster (v) 118.

P.A. UNITS

- 122. 10 watt std.
- 122A. Mullard 20w Solid state.
- 122B. Mullard 40w, Solid state.
- 123. 25 watt std.
- 124. 35 watt std.
- 125. 30 watt (t).
- 126. 100 watt std.
- 127. Stereo P.A.

GUITAR UNITS

- 128. 10 watt std.
- 129. 25 watt std.
- 130. 35 watt std.
- 131. 50 watt std.
- 132. 70 watt (t).
- 133. Playmaster 102.
- 134. Playmaster 103.
- 135. Playmaster 40w. 116.
- 136. Playmaster 60w 117.
- 137. Guitar fuzz box.
- 138. Guitar Waa-Waa.
- 139. Reverb unit.
- 140. Guitar preamp.
- 140A. Guitar 50w Solid State P/M 125.

STEREOGRAMS

- 141. Playmaster 105.
- 142. Playmaster 106.
- 143. Playmaster 107.
- 143A. Playmaster 124.

CONTROL UNITS

- 144. Playmaster No. 9.
- 145. Playmaster No. 10.
- 146. Playmaster No. 104.
- 147. Playmaster No. 112.
- 148. Playmaster No. 120.
- 149. Mullard 2v.
- 150. Mullard 3v.
- 151. Philips Miniwatt.
- 152. P/M 127.

PREAMP UNITS

- 153. Transistor — Mono.
- 154. Transistor — Stereo.
- 155. Transistor — Silicon mono.
- 156. Transistor dyn. mic. mono.
- 157. Above-Stereo. Playmaster 115 F.E.T. Stereo.
- 158. Playmaster 115 mag.
- 159. Sound projector.

MIXER UNITS

- 162. Trans. 4 ch. (1966).
- 163. Trans — 4 ch. (1967).
- 164. Valve — 4 ch.

TUNER UNITS

- 165. Playmaster u/style.
- 166. Playmaster No. 11.
- 167. Playmaster No. 114.
- 168. Playmaster No. 122.
- 169. Playmaster No. 123.
- 170. Philips Miniwatt.
- 180. Trans — Long range.

TAPE UNITS

- 181. Trans. Preamp.
- 182. Playmaster 110 (M)
- 182. Playmaster 110 (S)
- 183. Power Unit 110.
- 184. Adaptor 110.
- 185. Playmaster 119. Adaptor.
- 186. Transistor V.O.X.
- 187. Tape Actuated relay.
- 188. Mullard Trans Tape Amp.

RECEIVERS

- 189. Fremodyne 4. 1970.
- 190. Fremodyne 4. R.F. Sect. only.
- 191. Synchrodyne Communications RX.
- 192. Detailnet RX.
- 193. 3 Band Double Change S/het RX.
- 194. Explorer VHF Transistor RX.
- 195. Interceptor 5 Semi-Comm. RX.
- 197. 1967 All-Wave 2.
- 198. 1967 All-Wave 3.
- 199. 1967 All-Wave 5.
- 200. 1967 All-Wave 6.
- 201. 1967 All-Wave 7.
- 202. Transporta 7.
- 203. Transistor 8

CONTROL UNITS

- 204. 3 Band 2V RX.
- 205. 3 Band 3V RX.
- 206. All Wave 1970 I/C2.
- 207. Versatile Mantel Set.
- 208. All-Wave Transistor 3.
- 209. A.B.C.
- 210. 1968 F.E.T.
- 210A. I/C TRF RX.
- 210B. R.F. Preamp.
- 210C. "Q" Multiplier.
- 210D. 1970 Communica-

TRANSISTORS

- 211. 144 MHz 50w. Linear Final.
- 212. 144 MHz 20w.
- 213. 144 MHz 20w. 3.
- 214. 144 MHz 18w.
- 215. 144 MHz S.S.B.
- 216. 3 Band A.M.
- 217. Basic 3 Band.
- 218. 5 Band S.S.B.
- 219. 1967 S.S.B.

CONVERTERS

- 220. 50 MHz.
- 221. 144 MHz. 1970.
- 222. 50 and 144 MHz Crystal Locked.
- 223. 1965 S/W.
- 224. 1965 S/W 2 Band
- 225. 1966 3 Band
- 226. Basic S/W.

V.F.O. UNITS

- 227. Remote Unit.
- 228. 7. 8 and 9 H.F. and V.H.F.
- 229. All transistor.

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232 FLINDERS LANE, MELBOURNE, VICTORIA. 3000.

# THE CONTRIBUTIONS OF EDSSEL MURPHY TO THE UNDERSTANDING OF THE BEHAVIOUR OF INANIMATE OBJECTS

## I. INTRODUCTION

IT HAS LONG BEEN the consideration of the author that the contributions of Edsel Murphy, specifically his general and special laws delineating the behaviour of inanimate objects, have not been fully appreciated. It is deemed that this is, in large part, due to the inherent simplicity of the law itself.

It is the intent of the author to show, by references drawn from the literature, that the law of Murphy has produced numerous corollaries. It is hoped that by noting these examples, the reader may obtain a greater appreciation of Edsel Murphy, his law, and its ramifications in engineering and science.

As is well known to those versed in the state-of-the-art, Murphy's Law states that "If anything can go wrong, it will". Or, to state it in more exact mathematical form:

$$1 + 1 \rightarrow 2 \quad (1)$$

where  $\rightarrow$  is the mathematical symbol for hardly ever.

Some authorities have held that Murphy's Law was first expounded by H. Cohen when he stated that "If anything can go wrong, it will during the demonstration". However, Cohen has made it clear that the broader scope of Murphy's general law obviously takes precedence.

To show the all-pervasive nature of Murphy's work, the author offers a small sample of the application of the law in electronics engineering.

## II. GENERAL ENGINEERING

II.1 A patent application will be preceded by one week by a similar application made by an independent worker.

II.2 The more innocuous a design change appears, the further its influence will extend.

II.3 All warranty and guarantee clauses become void upon payment of invoice.

II.4 The necessity of making a major design change increases as the fabrication of the system approaches completion.

II.5 Firmness of delivery dates is inversely proportional to the tightness of the schedule.

II.6 Dimensions will always be expressed in the least usable term. Velocity for example, will be expressed in furlongs per fortnight.

II.7 An important Instruction Manual or Operating Manual will have been discarded by the Receiving Department.

II.8 Suggestions made by the Value Analysis group will increase costs and reduce capabilities.

II.9 Original drawings will be mangled by the copying machine.

## III. MATHEMATICS

III.1 In any given miscalculation, the fault will never be placed if more than one person is involved.

III.2 Any error that can creep in, will. It will be in the direction that will do the most damage to the calculation.

III.3 All constants are variables.

III.4 In any given computation, the figure that is most obviously correct will be the source of error.

III.5 A decimal will always be misplaced.

III.6 In a complex calculation, one factor from the numerator will always move into the denominator.

## IV. PROTOTYPING AND PRODUCTION

IV.1 Any wire cut to length will be too short.

IV.2 Tolerances will accumulate unidirectionally toward maximum difficulty of assembly.

IV.3 Identical units tested under identical conditions will not be identical in the field.

IV.4 The availability of a component is inversely proportional to the need for that component.

IV.5 If a project requires n components, there will be n-1 units in stock.

IV.6 If a particular resistance is needed, that value will not be available. Further, it cannot be developed with any available series or parallel combination.

IV.7 A dropped tool will land where it can do the most damage. (Also known as the law of selective gravitation.)

IV.8 A device selected at random from a group having 99% reliability, will be a member of the 1% group.

IV.9 When one connects a 3-phase line, the phase sequence will be wrong.

The man who developed one of the most profound concepts of the twentieth century is practically unknown to most engineers. He is a victim of his own law. Destined to a secure place in the engineering hall of fame, something went wrong.

His real contribution lay not merely in the discovery of the law but more in its universality and in its impact. The law itself, though inherently simple, has formed a foundation on which future generations will build.

In fact, the law first came to him in all its simplicity when his bride-to-be informed him of the impending birth of an heir to the family fortunes.

This hitherto unpublished photograph of Edsel Murphy was taken just after he had heard his fiancée's news.



Consideration is given to the effects of the contribution of Edsel Murphy to the discipline of electronics engineering. His law is stated in both general and special form. Examples are presented to corroborate the author's thesis that the law is universally applicable.

- IV.10 A motor will rotate in the wrong direction.
- IV.11 The probability of a dimension being omitted from a plan or drawing is directly proportional to its importance.
- IV.12 Interchangeable parts won't.
- IV.13 Probability of failure of a component, assembly, sub-system or system is inversely proportional to ease of repair or replacement.
- IV.14 If a prototype functions perfectly, subsequent production units will malfunction.
- IV.15 Components that must not and cannot be assembled improperly will be.
- IV.16 A dc meter will be used on an overly sensitive range and will be wired in backwards.
- IV.17 The most delicate component will drop.
- IV.18 Graphic recorders will deposit more ink on humans than on paper.
- IV.19 If a circuit cannot fail, it will.
- IV.20 A fail-safe circuit will destroy others.
- IV.21 An instantaneous power-supply crowbar circuit will operate too late.
- IV.22 A transistor protected by a fast-acting fuse will protect the fuse by blowing first.
- IV.23 A self-starting oscillator won't.
- IV.24 A crystal oscillator will oscillate at the wrong frequency — if it oscillates.
- IV.25 A pnp transistor will be an npn.
- IV.26 A zero-temperature-coefficient capacitor used in a critical circuit will have a TC of  $-750$  ppm/°C.
- IV.27 A failure will not appear till a unit has passed final inspection.
- IV.28 A purchased component or instrument will meet its specs long enough, and only long enough, to pass incoming inspection.
- IV.29 If an obviously defective component is replaced in an instrument with an intermittent fault, the fault will reappear after the instrument is returned to service.
- IV.30 After the last of 16 mounting screws has been removed from an access cover, it will be discovered that the wrong access cover has been removed.
- IV.31 After an access cover has been secured by 16 hold-down screws, it will be discovered that the gasket has been omitted.
- IV.32 After an instrument has been fully assembled, extra components will be found on the bench.
- IV.33 Hermetic seals will leak.

## V. SPECIFYING

- V.1 Specified environmental conditions will always be exceeded.
- V.2 Any safety factor set as a result of practical experience will be exceeded.
- V.3 Manufacturers' spec sheets will be incorrect by a factor of 0.5 or 2.0, depending on which multiplier gives the most optimistic value. For salesmen's claims, these factors will be 0.1 or 10.0.
- V.4 In an instrument or device characterized by a number of plus-or-minus errors, the total error will be the sum of all errors adding in the same direction.
- V.5 In any given price estimate, cost of equipment will exceed estimate by a factor of 3.
- V.6 In specifications, Murphy's Law supersedes Ohm's. ●

## UNITED TRADE SALES P/L

280 LONSDALE STREET, MELBOURNE, 3000

PHONE 663-3815 (Opposite Myers)

**COMPUTER RACKS** — 28½" x 28½" x 71". Square Tube 1½" 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 2½" 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.

# EQUIPMENT NEWS

## 50MHz FREQUENCY COUNTER



Wayne Kerr has released first details of their flexible counter, model FC50. It has a six-digit readout with automatic location of the decimal point, but the effective resolution can be increased, in some instances up to eleven digits, by under-ranging. The ranges are 0.1Hz to 50MHz and 1 microsecond to  $10^5$  seconds, with a count facility to 999,999.

Start and Stop can be manual or electrical (or a mixture of the two) and facilities are provided for inhibit, gating, storage and varying the up-dating rate. Clock signals are

available for external use and there is an option of BCD outputs from all six number tubes.

The display can be switched to show a non-blink series of completed counts or the run as it proceeds. Acceptable input levels range from 20mV (rms) to 100V and provision is made for correctly terminating 50 or 75-ohm lines.

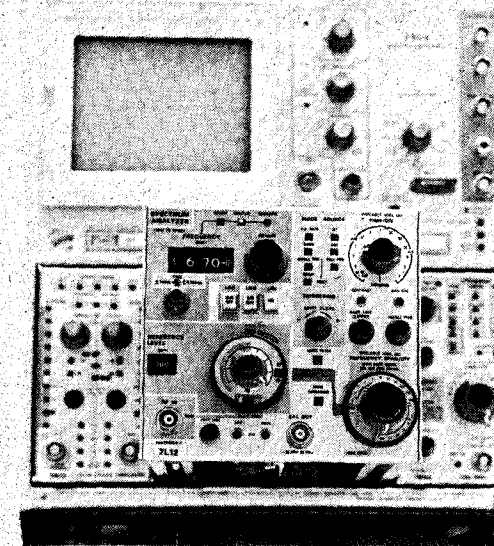
Full details from Wayne Kerr Ltd., Roebuck Road, Chessington, Surrey, England.

intensity. A total of up to 128 independent analogue (variable intensity) and "on/off" ("black/white") variables can be continuously presented as a function of time on a single record. This can give an overall picture of the present and past status of; production plant operation, city traffic, automatic processing measurements, experiment progress, hospital patients, environmental conditions, power station operation and many other multi-parameter systems. The record is continuously available and deviations from past performances are immediately obvious allowing rapid, effective analysis and decision making.

Units are already in use in New Zealand and the U.S.A. Interface equipment for a large range of applications is available or can be designed by ANAC.

Full details from ANAC (Australia) Pty. Limited, P.O. Box 102, Sutherland, N.S.W. 2232.

## WIDE RANGE SPECTRUM ANALYZER

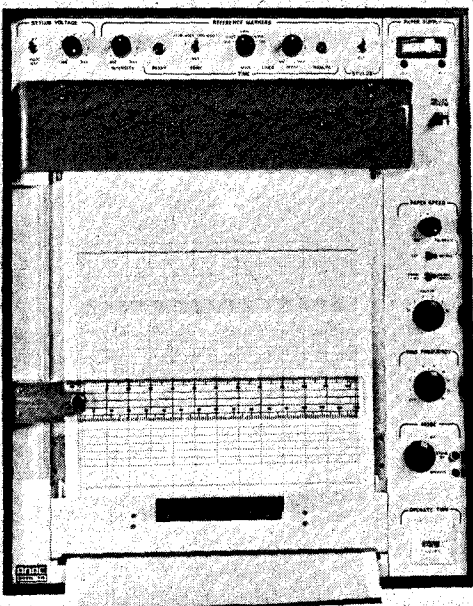


Tektronix Australia Pty. Limited have announced the 7L12 - a plug-in, swept front-end analyzer with absolute amplitude and frequency calibration, 70 dB dynamic range and less than 70 dB intermodulation distortion. Internal spurs, except zero hertz, are claimed to be less than twice noise. Resolution shape factor is four to one, 6 to 60 dB down.

The 7L12 plugs into all eight 7000-Series Oscilloscopes.

Automatic computation of full screen reference level and maximum distortion free input power, a frequency marker on the maximum 1.8 GHz frequency span display, front panel and CRT readout of display

## MULTI-CHANNEL CHART RECORDER



The Model 910 Multi-stylus Recorder, manufactured by ANAC Limited, has 128 styli mounted in a writing head which oscillates transversely across electro-sensitive chart paper with a small variable amplitude normally set equal to the styli separation.

Information can be recorded across the full 10-inch writing width with excellent uniformity and without gaps. Each stylus can present eight channels of information and the total number of channels is effectively  $8 \times 128$ , or 1024, giving the equivalent of 1:1024 resolution for precision intensity, x-y, or alpha-numeric displays.

Paper speeds are continuously variable from 16cm/min down to  $\frac{1}{2}$ cm/hr. Reliable, continuous, un-attended operation is possible for as long as 90 days. Remote control facilities allow start/stop, variable speed operation controlled from other devices or a computer.

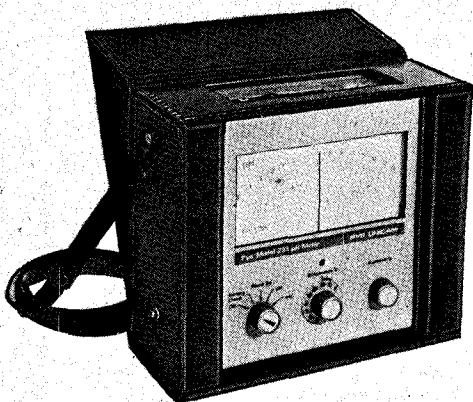
With analogue-to-pulse width or analogue-to-pulse rate conversion, variables such as voltage, current, temperature, pressure, humidity, weight, thickness, conductivity, concentration or optical absorption can be presented as intensity variations. Variables already in terms of a rate, such as radio-activity, heart-beat, or traffic flow, can be directly converted to



parameters are some of the ease-of-use features unique to the 7L12.

Full details from Tektronix Australia Pty. Ltd., 80 Waterloo Road, North Ryde, NSW 2113.

## PORTABLE pH METER



A new pH meter from Pye is designed to provide precise pH measurements on site. Stability and accuracy are claimed to be equivalent to any general purpose mains operated laboratory pH meter. An operational life between battery changes of more than 2,000 hours is achieved by the use of two readily available dry cells.

The number of controls have been kept to a minimum — the function control acts as a selector for pH standby, mV and as on/off and battery check switch. A single knob serves as asymmetry and millivolt zero control. No zero control is required for the pH scale and in the standby position the meter indicates the electrode asymmetry potential rather than the instrument's electronic zero. Parallax errors are reduced by the use of a knife-edge pointer and backing mirror. The makers state that the bold and well defined calibration on a 120mm scale enable accurate readings to be taken under adverse conditions.

Full details from the Scientific and Industrial Equipment Division, Philips Pty. Ltd., 200 Goulburn Street, Sydney, 2000.

## INPUT SELECTORS

Two new input selectors developed by Harrison Ltd., in England allow up to four parallel binary inputs to be fed into a logic system.

A typical application for the modules might be in taking the outputs from four digitisers and passing them all into one decoder, so saving the need for four separate decoders.

One module, 723, is capable of multiplexing from 12-bit words and the other, 725, from 20-bit words. Word selection can be by means of a front

push-button control or by remote control via a rear panel socket for automatic multiplexing.

Both modules accept TTL inputs and provide outputs at TTL levels. The multiplex control signals are binary coded on two select lines. All inputs are TTL fan-in of one, while the outputs are capable of driving a fan-out load of ten.

The modules are for 5.5 inch high racks and are 10.5 inches deep and 2.1 inches wide. They require a power supply of only 5V. All external connections are made via rear panel sockets.

Full details from Racal Electronics Pty. Ltd., 47 Talavera Road, N. Ryde, N.S.W. 2113.

## TELEGRAPH AND DATA CIRCUIT TESTING EQUIPMENT

Recent additions to the range of Plessey telecommunications testing equipment now available in Australia from Plessey Telecommunications include the latest telegraph signal generator and telegraph distortion measurement set.

Comprehensive maintenance and servicing facilities for these units are provided by Plessey Telecommunications, the largest division of the Plessey Pacific group and a major supplier of telecommunications equipment to the Australian Post Office.

The TSG 40 signal generator has several built-in test messages in both 5 and 8 level codes plus a series of selection keys to allow individual characters to be generated. It can provide continuous or pulse release output.

Serial output is via an isolated electronic relay capable of handling 6 to 100 volts polar operation or 6 to 200 volts neutral operation. An internal signalling voltage supply is also provided.

A parallel output facility is available at logic level.

The TDMS 80 telegraph distortion measuring set has a 10 x 6 cm cathode ray tube raster display with x 5 expansion for easy reading, enabling an operator to read distortion down to less than one per cent.

Input is electronic, isolated from chassis, fully protected, and capable of polar and neutral, shunt and series monitoring.

The unit will read 7-13 units code in 1 unit increments.

Full details from Plessey Telecommunications Pty. Ltd., Industrial Electronics Division, Meadowbank, N.S.W., 2114.

## MINIATURE SOLDERING IRON

A new concept in soldering iron design is announced by "Antex" of U.K. The element of their model CCN irons is totally enclosed in a ceramic (aluminium oxide) shaft, which is claimed to be comparable in strength to the stainless steel shaft of other models. Apart from the greatly improved reliability of this construction, the manufacturers say that the insulation is so

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instrument cases . . .  
engraved & printed panels

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Any kind of metalwork  
such as

switchboards

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Laboratory Power  
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# NEW PRODUCT

SOLID STATE 2 metre A. M. Receiver Kit 9 FETs, 5 Transistors, 5 Diodes, Double Conversion, Noise Limiter, Audio Amplifier, Electronic Tuning, Fibre Glass Printed Circuit Board.

SPECIFICATIONS: Frequency 144 MHz to 145 MHz. Sensitivity .3uV for 6dB S/N at 50 ohm. Audio Output 1 Watt into 8 ohm.

OUR CHRISTMAS OFFER FOR COMPL. KIT \$42.

NEW STOCK OF INTEGRATED CIRCUITS AND TRANSISTORS.

		Transistors	
SN 7490N	\$2.60	BC 107/108	\$0.70
SN 7441AN	\$2.85	BC 109	\$0.75
SN 7475N	\$2.45	2N3645	\$1.20
SN 7400N	\$0.85	2N3642	\$1.20
SN 7410N	\$0.85	2N3568	\$1.20
SN 7472N	\$1.45	2N3055	\$1.50
Other types of I.C.		2N3819	\$0.80
available. Prices		TIS 88	\$1.00
on request.			

Light emitting Diodes \$1.20

SPECIAL 2 WATT CARBON RESISTORS MIXED VALUES \$1.00 PER 100.

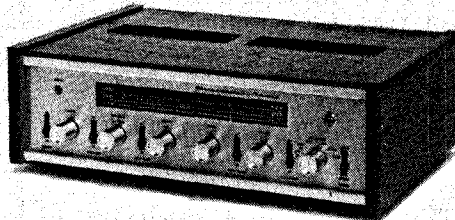
COLLINS MECHANICAL FILTERS 455 kHz. 6 kHz BANDWIDTH \$15.00.

WAYNE COMMUNICATION ELECTRONICS  
757 GLENFERRIE RD, HAWTHORN 3122, PHONE 81-2818.

## NEW ALL-TRANSISTOR STEREO AMPLIFIERS WITH IN-BUILT A.M. TUNER ULTIMATE IN DESIGN—LONG DEPENDABILITY

using all silicon transistors 40 WATTS — RMS

**SPECIFICATIONS:**  
20 watts per channel R.M.S. Total output 40 watts R.M.S.  
**FREQUENCY RESPONSE:**  
From 20 cycles to 20,000±1db.  
**HARMONIC DISTORTION:**  
Less than 1 per cent at rated output.  
**HUM AND NOISE:**  
Aux. 70db. Mag. 50db.  
**INPUT SENSITIVITY:**  
Mag. 3mv. Aux. 200mv.  
**SPEAKER IMPEDANCE:** 8 ohms.  
**EQUALISED:** Mag. RIAA.  
**TOE CONTROLS:**  
Bass, 50 c/s ± 12db. Treble 10 kc/s 12db.  
**LOUDNESS CONTROL:**  
50 c/s 10db.  
**SCRATCH FILTER:**  
(High filter) at 10 kc/s 9db.  
**RUMBLE FILTER:**  
(Low filter) at 50 c/s 5db.  
**PROVISION FOR TAPE RECORDER:**  
Record or play-back with din plug connection.  
**PROVISION FOR HEAD PHONES:**  
With headphone/speaker switch on front panel.  
**DIMENSIONS:**  
16 1/2 in. x 5 1/2 in. x 11 in. deep.  
**TUNER:**  
This unit can be supplied with either valve or transistor tuner with a coverage of 530 to 1,600 K.C. Calibrated dial available for all States.  
**THE CIRCUIT INCORPORATES** regulated power supply with transistor switching protection for output transistors, 26 silicon transistors plus 5 diodes are used.



**\$134.00** Plus Freight  
(cabinet extra)

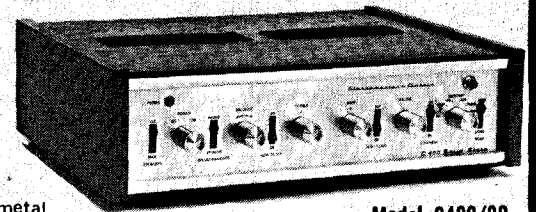
Model C300/20/T

**\$108.00**

Plus Freight (cabinet extra)

AMPLIFIER ONLY. Specifications as above but with the added feature of front panel switch which allows selection of two speaker systems.

Cabinets for above in teak or walnut with metal trim, \$10 extra.



Model C400/20

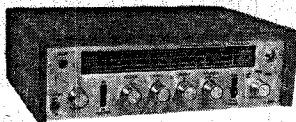
### THE NEW MAGNAVOX 8-30 SPEAKER SYSTEM

COMPLETE SYSTEM: (1.6 cubic ft.) IN WALNUT OR TEAK VENEER, OILED FINISH. (Regret no. mail orders for complete system). — \$60.00.

SPEAKER KIT: (Less cabinet). COMPRISING 1 8/30 SPEAKER, 2 3TC TWEETERS, 1 3" TUBE, 1-4 or 2 mfd. CONDENSER, INNERBOND AND SPEAKER SILK. AVAILABLE IN 8 OR 15 OHMS. \$29.50. Postage \$1.50 extra.

### NEW 6 WATT STEREO AMPLIFIER WITH A.M. TUNER

A high quality Stereo Amplifier incorporating the new Plessey SL403D I.C. Audio Amplifiers with separate bass and treble controls. Inbuilt high gain A.M. tuner with Ferrite aerial. Coverage 530 to 1600 HZ. Calibrated dial available for all states. Timber cabinet in Teak or Walnut.



MODEL C500/T

**\$79.50**

Post & Packing  
N.S.W. \$1.75  
Interstate \$2.75

#### SPECIFICATIONS OF AMPLIFIER

PROTECTION S.C.R. Short Circuit Protection  
FREQUENCY RESPONSE Within 2db from 20Hz to 100KHz  
DISTORTION Less than 1.5 percent at 1KHz  
TONE CONTROLS Bass control, 15db boost or cut at 50Hz, Treble 14db boost or cut at 10Hz.  
SIGNAL TO NOISE RATIO —62db with respect to 3 watts to 8 ohms loads.

Above amplifier/tuner supplied with 2 Magnavox 8 WR. Mk V Speakers, two 8TC Tweeters, 2 4MFD Condensers and Garrard SRP22. Record Player with sunatone ceramic pick up \$130.00 Freight extra.

## CLASSIC RADIO

245 PARRAMATTA ROAD,  
HABERFIELD, N.S.W. PHONE 798 7145

# EQUIPMENT NEWS

high that the complete iron passes a test of 4000 volts ac.

Another advantage of the very high insulation of the CCN models is that the leakage current is negligible, enabling operators to solder live transistors without the slightest risk of damage.

The Model CCN is a precision miniature soldering iron 7" long and weighing 1 oz. Elements are rated at 220-230 and 230-240 volts 15 watts.

For very high speed soldering on production lines a special bit has been

designed to bring the element even closer to the tip of the bit. The extremely fast recovery time with the help of these bits enables an operator to solder at the speed of the most expensive of temperature controlled irons.

To ensure long and care-free life these bits have been coated with iron, nickel and chromium.

Full details from Technical & Scientific Equipment Company Proprietary Limited, G.P.O. Box 1726P, Melbourne, Vic. 3001.

## POWER SUPPLY MODULES

telemetering, scientific and industrial control and other fields.

Features include, outputs from 3.5 Volts to 50 Volts, current rating to 2 Amps, 'crowbar' overvoltage protection, auto recovery overload, dual output with tracking.

The dual supplies incorporate a unique feature in that both Master and Slave regulators will collapse symmetrically if either regulator is overloaded; this ensures complete protection to the load.

The modules are of printed circuit board construction, designed to be compatible with widely accepted racking systems. Chassis mounting connector types are also available for general use.

Full details from Scientific Electronics Pty. Limited, P.O. Box 61, Blackburn, Vic. 3130.

A range of high performance low-cost stabilized Power Supply Modules have been designed for use in instrumentation,

## LOW COST FREQUENCY SYNTHESIZERS

Two new signal sources with a frequency range of 0.01 Hz to 13 MHz have spectral purity not usually associated with frequency synthesizers. Calibrated level control with 0.01 dB resolution, flatness of  $\pm 0.05$  dB, and full programmability are among features available.

By combining the desirable characteristics of frequency synthesizers with those of oscillators, Hewlett-Packard now has two new low-cost, signal sources of laboratory quality. The lower cost unit is the Model 3320A Frequency Synthesizer, and the higher cost model is the 3320B, with calibrated level output. Options provide flexibility to meet many present and future signal source requirements.

Both the Models 3320A/B cover the frequency range from 0.01 Hz to 13 MHz in seven frequency ranges. Two low ranges, 100 Hz and 10 Hz are optional. Frequency resolution is 1 part in  $10^5$  across the full frequency range. Using a standard crystal reference, the instrument's drift is claimed to be less than  $\pm 10$  parts in  $10^6$  per year, and can be  $10^8$  per day with an optional reference crystal oven.

Accuracy of frequency setting, with the vernier out, is claimed to be  $\pm 0.001\%$  of setting. With the crystal vernier in, the accuracy is  $\pm 0.01\%$  of range. Both instruments have a low harmonic content of greater than 60 dB down to 40 dB down,

depending on frequency setting. Spurious content is greater than 60 dB down.

The Model 3320A has an output of 1 volt rms maximum into 50 ohms (+13 dBm) with a continuous +13 dBm to 0 dBm amplitude vernier. In applications where precise control of amplitude is needed or where it is necessary to digitally control the output amplitude, the Model 3320B is used. It has a four-digit leveling loop with 0.01 dB level resolution of a calibrated output from +26.99 dBm to -69.99 dBm (-73.00 dBm under remote control). This is a maximum of 0.5 watts of output power (5 volts rms into 50 ohms or 10 volts rms into an open circuit).

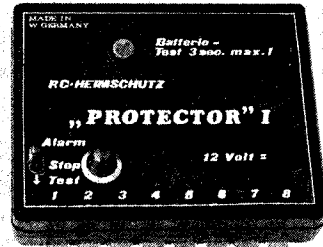
Precise output amplitude is maintained by automatically leveling the Model 3320B to  $\pm 0.05$  dB from 10 Hz to 13 MHz range. Frequency response of the Model 3320A is  $\pm 2$  dB over the entire range.

Auxiliary outputs of 1 MHz and a 20 MHz offset signal (20 to 33 MHz) are on the rear panels of both instruments.

Both synthesizers are programmable. Digital remote control is an option. The Model 3320A with option 003 allows parallel BCD remote control of frequency. All front panel controls can be digitally programmed except the power switch, the last frequency vernier digit and the output level control.

Two remote control options are available

## INTRUDER ALARMS



SIZE: 3 1/4" x 3" x 1 1/2"

### FULLY TRANSISTORISED EASY TO INSTALL

PROTECTION SYSTEMS WITH:—

- DELAYED ALARM
- AUTOMATIC CUT-OFF (after 1 1/2 mins., eliminates neighbourhood nuisance)
- NO EXTERNAL KEY SWITCH NEEDED
- INBUILT BATTERY TESTER
- INSTANT CIRCUIT CHECK
- 12 MONTH GUARANTEE

— SPECIFICATIONS —  
Volts 12 DC ● Standby Current 150uA  
● One set batteries lasts up to one year ● Switch current up to 8 amp.

HOME ALARM \$35.00  
CAR ALARM \$25.00

ACCESSORIES  
MINI SIREN \$9.50  
PLYWOOD CABINET  
FOR ALARM & BATTERY \$12.00  
REED RELAY + MAGNET \$1.25  
MAIL ORDERS ACCEPTED C.O.D.

### PROTECTOR ALARM SYSTEMS

SHOP 9, CHARD ROAD, BROOKVALE,  
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N.S.W., 2100. PHONE: 93 7292.

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5" twin cone 10 watt tweeter 8/ohms only 4000/16000 C/S — \$3.50, P.P. 30c; 6" twin cone 5 watt 55/15000 C/S 8/16/ohm V.C. — \$5.75, P.P. 30c; 8" twin cone 8 watt 50/15000 C/S 8/16/ohm V.C. — \$7.75, P.P. 40c; 10" twin cone coaxial 30/20,000 C/S 20W (horn tweeter) — \$28.50, P.P. 40c; 8" twin cone coaxial 40/20,000 C/S 25 Watt (horn tweeter) — \$23.50, P.P. 40c; 12" guitar type E.G. 35-5.5 K/C 15 watts rms 15/ohm K.C. — \$17.50, P.P. 50c; 12" guitar type imported 20 watts rms 8/ohm V.C. — \$22.50, P.P. 50c; 15" guitar type imported 30 watts rms 8/ohm V.C. — \$30.00, P.P. 70c; 2 1/2" horn type tweeter 5000/20,000 C/S 20 watt — \$5.50.

### ELECTRONIC KITS

ABSOLUTELY SAFE, BATTERY OPERATED, NO SOLDERING

28.207 Crystal radio kit, easy 1 hour construction — \$4.50, P.P. 40c; 28.214 2 transistor radio kit, tunes AM band, inc. solar battery — \$7.95, P.P. 40c; 28.241 AM tuner/amplifier kit, 2 separate chassis, easy to assemble — \$12.50, P.P. 40c; 28.242 2 set telephone telegraph kit, build your own 2-way communication system — \$12.50, P.P. 50c; 10/1 Electronic project kit, 10 easy to assemble projects — \$9.50, P.P. 40c; 20/1 1/C integrated circuit, builds radio's oscillators etc., amplifiers — \$11.95, P.P. 40c; 50/1 Project kit, 50 projects inc. 15 solar energy projects — \$19.95, P.P. 50c; 150/1 150 project kit in wooden case, inc. meters, radio's loudspeakers, ideal gift — \$32.50, P.P. 50c.

### SINCLAIR

Sinclair IC10 integrated amplifier, \$14.90; Sinclair 230 20 watt amplifier module, \$14.90; Sinclair 250 40 watt amplifier module, \$18.75; Sinclair active filter unit, \$26.50; Sinclair P25 power supply unit 30V 1.5 amps, \$17.75; Sinclair P28 power supply unit, \$27.00; Sinclair P28 power supply unit, \$23.75; Stereo 60 control unit and pre-amplifier, \$34.00.

### REPLACEMENT RADIO SPEAKERS

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.

**MODEL C-1000 POCKET MULTIMETER**, 1000 ohms/per Volt. AC Volts: 0-10/50/250/1000 (1000 opv). DC Volts: 0-10/50/250/1000 (1000 opv). DC Current: 0-100mA. Resistance: 0-150K ohms (3K centre), 2 colour scale. Range Selector Switch. Dimens.: 3 1/2 x 2 1/4 x 1 in. — \$6.75 post free.

**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/DPV). DC/Amps: (0.06 mA / 60 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 3/4. — \$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 3/4 in. — \$34.50, P.P. 40.

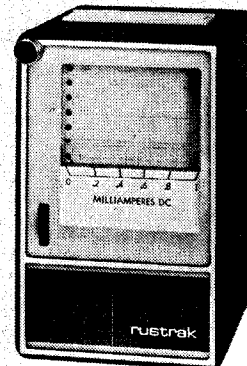
**1 WATT TRANSCEIVER, 13 TRANSISTOR, 3 CHANNEL** and Call System. Specifications: Circuit: 13 Transistors, 1 Diode, 1 Thermistor. Range: Up to 10 miles (depending on terrain, etc.). Frequency: 27.240 MHz (PMG approved) Freq. Stability: Plus or minus 0.005%. Transmitter: Crystal controlled, 1 watt. Receiver: Superheterodyne, Crystal controlled. Antenna: 13 Section Telescopic. Power Source: 8 UM3 1.5 volt pen batts. Size 8 1/4 in. x 3 3/4 in. x 1 3/4 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!



# THE rustrak PRIVATE EYE

Rustrak Miniature Recorders 63' chart roll — one month's supply at 1" per hour. Portable or for panel mounting as a system component. Accuracy  $\pm 2\%$  of full scale. Only 5 3/8" high, 3 3/8" wide, 4 1/4" deep. Weighs 3 1/2 lbs. Combine any two functions on one chart in our new Dual 300 Series. Quick, easy chart review and re-wind. Sliding access window. Rugged die-cast aluminium case in epoxy suede-like charcoal gray finish.

63' chart roll — one month's supply at 1" per hour. Portable or for panel mounting as a system component. Accuracy  $\pm 2\%$  of full scale. Only 5 3/8" high, 3 3/8" wide, 4 1/4" deep. Weighs 3 1/2 lbs. Combine any two functions on one chart in our new Dual 300 Series.



Model 288

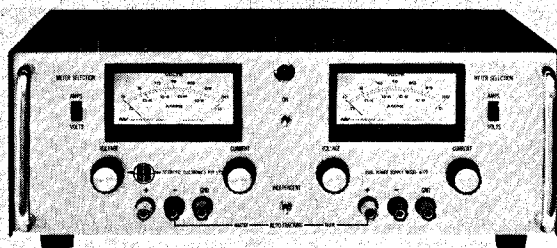
TECNICO ELECTRONICS



53 Carrington Road, Marrickville, N.S.W. 2204. Tel. 55 0411  
2 High Street, Northcote, Vic. 3070. Tel. 489 9322  
211 Flinders Street, S.A. 5000. Tel. 23 3979  
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TE5932

## VARIABLE POWER SUPPLIES



- Single and Dual Outputs
- Output Voltages to 60 Volts
- Output Current to 2 Amps
- Excellent Line and Load Regulation
- 0° to 60°C Operating Temperature
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- Constant Voltage/Current Limit
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## SCIENTIFIC ELECTRONICS PTY. LIMITED

42 Barry Street, Bayswater,  
Vic. 3153. Phone:

Melbourne 729-3170; Brisbane 47-4311;  
Adelaide 77-1325; Perth 21-6146

# EQUIPMENT NEWS



for the Model 3320B. All front panel controls except the power switch and the last vernier digit are programmable. Both options control both frequency and amplitude. Option 004 is parallel BCD remote control. Option 005 is a unique, bit-parallel/word-serial ASCII programming option. With option 005, up to 10 different Model 3320B synthesizers can be controlled. Each can have a unique address and all can be controlled from the same computer I/O card, marked card programmer or any other device having ASCII codes. Each 3320B responds only to commands that follow its address. Kits are available for interfacing the Model 3320B to Hewlett-Packard 2100 Series computers.

Programming of the Model 3320B is made easy with a new marked card programmer. Called the Hewlett-Packard Model 3260A, the card reader works with the Model 3320B with option 005, ASCII programming, installed. It detects pencil marks or punched holes on hand-fed cards and gives a digital output corresponding to the presence of marks in the eight columns. The Model 3260A has its own power supply and card drive motor. A 32 word card is read in 1.5 seconds, and each test is performed as the card instructs.

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

## BATTERIES FOR APOLLO 15

Plessey Ducon announce that Eagle-Picher electrical power systems were used during the Apollo 15 moon landing.

The lunar roving vehicle (LRV), which carried the astronauts and their scientific equipment over the moon's surface during their highly successful explorations, was driven by four independent electric motors. Power for these motors was supplied by

specialty designed silver-zinc 36-volt batteries from Eagle-Picher.

Compactness in proportion to their output is an outstanding feature of these batteries which measure approximately 10" x 10" x 8" and weigh less than 60 lb. each. Two of them are able to provide about 9,000 watt-hours of energy.

Resulting from 15 years of development, the silver-zinc electrochemical system offers one of the best watt-hours per pound ratios among standard battery systems.

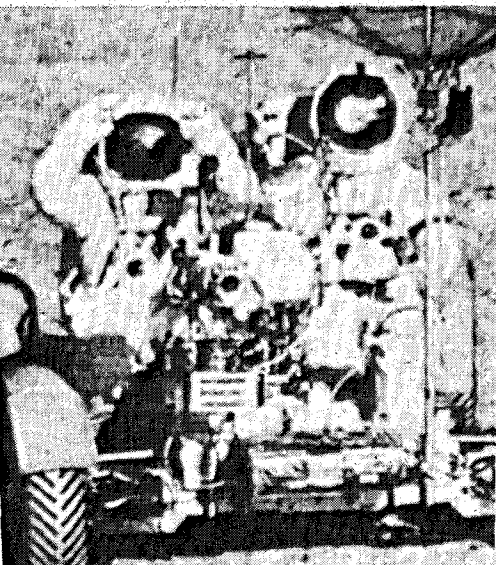
The LRV drive batteries were housed in precision-built containers specially fabricated from sheet magnesium.

During the trip to the moon and on the moon itself, they had to withstand extremes of environmental factors such as temperature, vibration and pressure.

Eagle-Picher batteries also furnished power for other mechanical and electronics equipment carried on the LRV, as well as the batteries carried to the various Saturn rocket stages, and the lunar, command and service modules totalling approximately 30 separate battery systems.

Eagle-Picher has been the principal supplier of batteries in the Apollo, Gemini and Mercury manned space programmes. The unmanned Surveyor also featured Eagle-Picher batteries.

Further information on these batteries may be obtained from Plessey Ducon, P.O. Box 2, Villawood, N.S.W. 2163.



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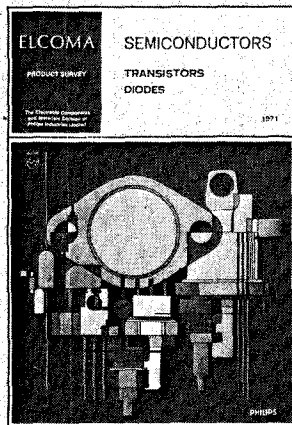
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# COMPONENT NEWS

## SEMICONDUCTOR BROCHURE



A new 50 page brochure 'Semiconductors: Transistors - Diodes' has been produced by the Elcoma Division of Philips Industries.

The brochures are available free of charge from the Elcoma Office in each state.

Applications for the brochure should be accompanied by a stamped addressed envelope (24c stamp), and should bear the endorsement 'T/P' in the top left-hand corner. The envelope size should be not less than 9" x 12 3/4".

Elcoma Division, Philips Industries Limited, 252 Sturt St., Sth Melbourne, Vic. 3205. 54-56 Cordelia St., Sth Brisbane, Qld. 4101. 11-13 West Terrace, Adelaide, S.A. 5000. 672 Murray St., Perth, W.A. 6000. 2A Pierce St., Moonah, Tas. 7009. 95 York St., Sydney, N.S.W. 2000.

## ENCAPSULATED REGULATORS

Very high dissipation is achieved in a new British range of encapsulated series regulators for stabilised power supply systems by the provision of an isolated metal heat transfer surface in one face of each module.

Encapsulated by a special process, the regulators enable single or multi-rail stabilised power supplies to be designed and constructed in minutes, and are virtually indestructible, say the makers, Roband Ltd.

The units operate from a single un-stabilised dc rail or from a battery, give well stabilised outputs up to 55V or 20A, and have full over-current protection. Output voltage and protection levels are preset externally by a fixed resistor, or can be remotely programmed.

Though the units fit a standard heat sink extrusion, they can also be mounted on any convenient metal surface using the two fixing holes provided. This enables them to be mounted as near the load as possible, optimizing performances and minimising cross-talk between rails.

A typical 2A unit, which measures 1.9 in. by 1.2 in. by 0.9 in. gives a stabilised rail set anywhere between 6V and 24V with maximum internal dissipation of 25W.

Connections can be by socket, minimising service downtime. Since identical modules can be used for a wide range of supplies, spares holdings can be kept to a minimum.

Full details from Amalgamated Wireless (A'asia) Ltd., 47 York Street, Sydney, N.S.W. 2000.

## POT HAS DIGITAL READOUT

Bourns, Inc., has introduced a potentiometer with built-in digital readout.

The dial with 1/8-inch high white numerals on black background reads from 0 to 999 with an accuracy of  $\pm 0.5$  per cent between electrical output and dial reading. Resistance tolerance is  $\pm 5.0$  per cent.

Minimum potentiometer end resistance is 1 ohm or 0.1 per cent of total resistance, whichever is larger. The new 7/8-inch diameter pot can be specified with total resistance from 100 to 250,000 ohms in 12 selections of maximum resistance.

Operations of the potentiometer is continuous. The dial has vernier readings allowing an estimate of less than a full change between numerals.

Full details from W.G. Booth Pty. Ltd., P.O. Box 131, Richmond, Vic. 3121.

## TINY REED SWITCH

NS Electronics announce the release of FR Electronics' new TRA 200 reed switch which combines high performance in rating and sensitivity with extremely small physical dimensions. It can handle up to 250mA, switch a maximum of 3W and has a glass diameter of only 1.78mm. Available in selected bands in the range of sensitivities 15 to 50 A.T., this switch is ideal for reed relays utilizing the TO116 dual-in-line package.

Full details from NS Electronics, Cnr. Stud Road & Mountain Highway, Gay'swater, Vic. 3153.

## MULTI-PURPOSE PROGRAMMABLE OP-AMP

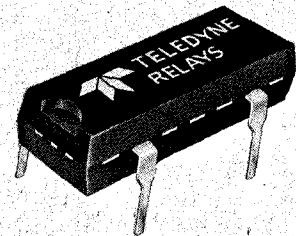
A new Programmable Operational Amplifier from Fairchild is constructed on a single silicon chip using the Fairchild Planar epitaxial process. High input impedance, low supply currents, and low input noise over a wide range of operating supply voltages coupled with programmable electrical characteristics result in an extremely versatile amplifier for use in high

accuracy, low power consumption analogue applications. Input voltage and current noise, power consumption and input current can be optimized by a single resistor or current source that sets the chip quiescent current for nano-watt power consumption or for characteristics similar to the  $\mu A741$ . Internal frequency compensation, absence of latch up, high slew rate and short circuit current protection assure ease of use in long time integrators, active filters and sample and hold circuits.

The new  $\mu A776$  operational amplifier has a wide range of acceptable supply voltages from  $\pm 1.2$  to  $\pm 18$  volts and it is pin compatible with the popular  $\mu A741$ . A unique feature of the  $\mu A776$  is the dependance of the gain, bandwidth, slew rate, and quiescent power dissipation on the master bias current setting.

Full details from Fairchild Australia Pty. Ltd., 420 Mt. Dandenong Rd., Croydon, Vic. 3136.

## SERENDIPITY



Teledyne Relays announces the introduction of the Model 640-1 SerenDIP\*. The SerenDIP is a fully isolated bipolar output, solid state relay, housed in a TO-116 dual in-line package. It is a SPST device which is capable of bounceless switching up to 0.1 Amp @ 50V ac or dc, and at switching rates up to 100 kHz. The unit is totally TTL compatible and replaces DIP reed relays (on a pin-for-pin basis in most cases), and FET analogue switches.

The SerenDIP is a fully solid state device and is rated at a maximum operating speed of 100,000/sec.

Beyond the above listed advantages, the SerenDIP also lends itself to automatic insertion by reason of its DIP package, and is priced about 50% lower than FET analogue switches.

The SerenDIP relay is a new concept in circuit switching devices. Its size, specifications and bipolar output, combined with the fact that it is totally solid state, make it unique.

(Presumably the name SerenDIP is a diminutive of Serendipity - which is the gift of finding valuable things in unexpected places by sheer luck - Ed.)

Full details from Austronic Engineering Laboratories Pty. Ltd., 452 Victoria St., Brunswick, Vic. 3056.

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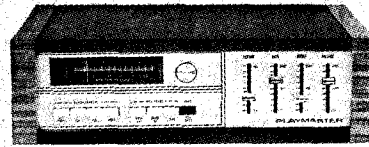
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See Review in E.T. Aug.

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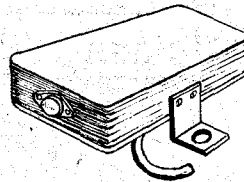
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# AUDIO NEWS



**LOUIS A. CHALLIS**  
B.E. M.I.E. (AUST.)  
M.A.C.E.(AUST.)

*Consulting Acoustical and Vibration Engineer; Graduate of University of Sydney, Lecturer in Acoustics at University of Sydney and University of N.S.W.; a member of the Executive of Acoustics Committee of Standards Association, and a number of other committees, including Hearing Conservation, Community Noise, Instrumentation, Aircraft Noise, and Chairman of working group, producing Vehicle Noise Standards.*

*Since graduation has been involved in underwater acoustics, telecommunications, electronic design, and has been principal of Louis A. Challis & Associates for the past 6 years.*

## ELECTRONICS TODAY PRODUCT REVIEWS

Since the inception of ELECTRONICS TODAY, our audio product reviews have been produced by Louis A Challis & Associates.

The results have been so satisfactory that an agreement has now been signed appointing Louis A Challis & Associates as acoustical consultants to this magazine.

Louis A Challis & Associates are one of the best known firms of consulting engineers in Australia.

Their laboratory is N.A.T.A. registered for the measurement of acoustical and vibration phenomena, and for the calibration of measuring equipment. They have developed large numbers of new products for environmental control, air conditioning, and industrial noise control.

The facilities currently available in their laboratory enable the broadest range of precision measurements to be made of acoustical and electro-acoustic phenomena. These facilities are used in ELECTRONICS TODAY's product reviews to provide more 'in-depth' information hi-fi and professional equipment than currently available from any other source.



**MURRAY G. WOOD B.Sc.**  
M.E.

*Consulting Acoustical and Vibration Engineer and Associate Graduate of Universities of N.S.W. and Newcastle; lecturer in acoustics at University of Sydney; the author of a number of papers, he has led a number of extensive research and development projects for the analysis of physical phenomena, using advanced instrumentation and computer analysis.*



**GEOFFREY L. SHUTTLEWOOD**

*Acoustical consultant with many years experience in the design of products for 'conditioning' the acoustical environment. He has had extensive design experience in all facets of architectural and Electro Acoustic design and, as a result of many years of conducting laboratory tests is a very discerning critic.*



**DENIS W. CALEY Grad. A.**  
Cert. E.A.

*Acoustical Consultant with five years experience in the fields of electronics, electro-acoustics, acoustics and vibration. He has worked extensively in the fields of consulting and design and is currently involved in a number of major projects involving development of new and advanced electro-acoustic systems.*

## de MORGAN ORGAN

A digital musical computer, fabricated from 22 MOS/LSI circuits and containing the equivalent of 48,000 transistors, has been developed jointly by North American Rockwell and the Allen Organ Company.

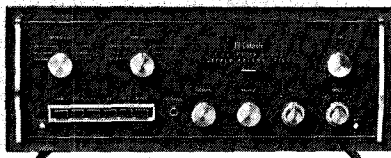
The instrument operates by converting sound waveshapes into digital signals which are then stored in the instrument's memory banks until recalled by touching the appropriate organ key.

The brain of the organ is a digital computer which adds, subtracts, and multiplies musical sounds expressed as binary numbers.

The keyboard is connected to a microelectronic computer consisting of the 22 chips mounted on a single 11" by 18" printed circuit board. The organ can be externally programmed to produce an infinite variety of sounds, including those of any other type of instrument. The standard model is on sale in the USA at prices ranging from \$5000 to \$14000.

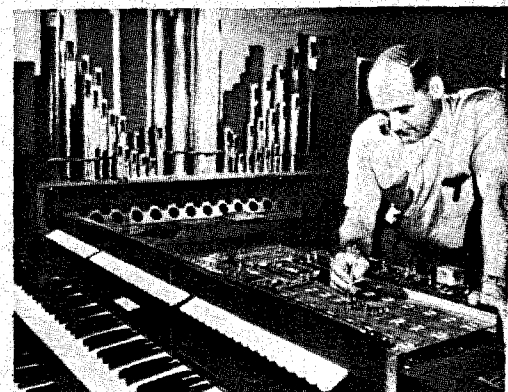
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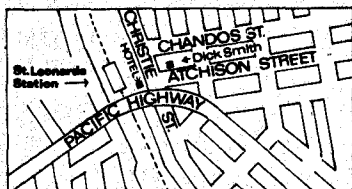
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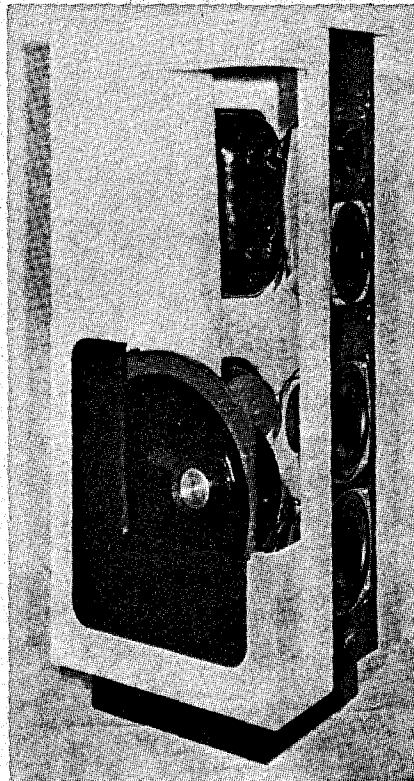
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**AUDIO NEWS**

**DOLBY DODGING**

Dynamic noise suppression devices are occupying the attention of audio designers around the world, particularly in Japan and in the USA, most of them trying to find circuits that will perform as well as Dolby's system without infringing his patents. JVC Nivico have done a lot of work on their ANRS technique (Automatic Noise Reduction System) which functions by boosting the low level input signals above about 500 Hz to be recorded to a controlled extent, dependent upon their frequencies, with the lower band passing straight through the chain unaltered. On replay, the system is reversed, but all intrusive noises in the recording process are significantly reduced.

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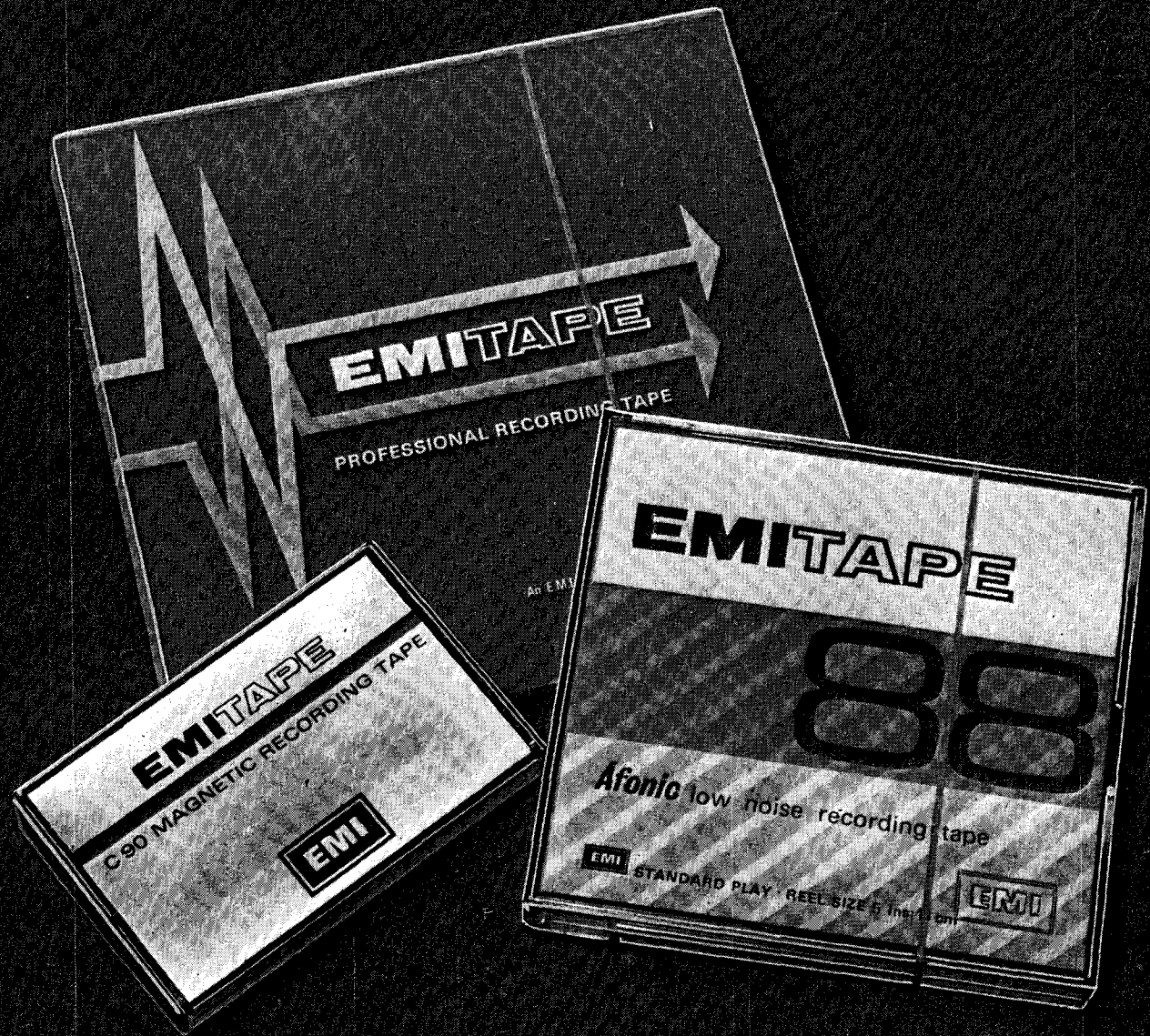
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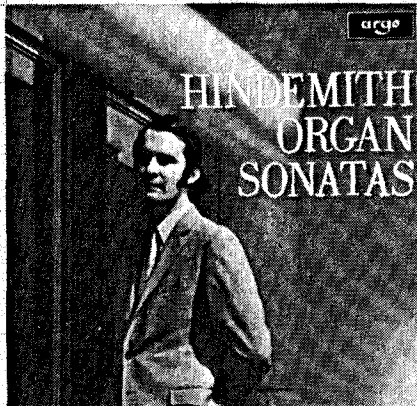
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# RECORDINGS... CLASSICAL

REVIEWERS: John Clare,  
Christopher Wagstaff, John Araneta.



**HINDEMITH — ORGAN SONATAS**  
Simon Preston (organ) ARGO  
ZRG-663.

Three Organ Sonatas belong to Hindemith's "central period" — a time when he was particularly concerned to provide "Contemporary" music to amateur performers as well as writing for less common instruments (cor anglais, bassoon, tuba, etc.) The Sonatas are incredibly different from one another (especially as to tempo) yet all are true miniature masterpieces.

The First Sonata is the most elaborate (and certainly the most demanding) of the three, yet this is the work which Preston performs with most conviction. The other two (especially the Second) sound on the whole as if only demonstrating Hindemith's harmony and counterpoint, and nothing else. This might well be the case but I am afraid I prefer more immediacy of feeling than what Preston gives. Nonetheless mood changes from movement to movement are often very effective and the Sonatas are performed with fine (though sometimes relentless) precision. Accurate and "clean cut" phrasing often brings about a strong rhythmic drive — the third movement of the Third Sonata jolts along at a more than lively pace above the chorals theme "So wunsch ich ihr". The First Sonata, on the other hand, is given an inspiring performance. Tempi are well thought out and Preston's gentle use of rubato is often delicious — note the tremendous verve with which the free fantasia is played and also the firm control over pauses and the approaches to them.

The organ used, (St. John the Evangelist, Islington, London) sounds greatly influenced by the neo-classical style but with nevertheless more than a few hints of the English romantic instrument. It more

than adequately supplies the needs of the Sonatas. Preston seems well at ease with the instrument and his many changes of registration (mostly suitable) are carried out cleanly and efficiently. He is always willing to bring out a point of imitation here and there and the chorals themes of the Third Sonata are distinct and colourful. ("So wunsch ich ihr" is heard on the Pedal 8' trumpet) Crescendos and diminuendos (of which there is an ample supply in the Third Sonata) are effectively controlled and climaxes, notably the quick build up to full organ in the first movement of the Third Sonata, are impressive.

In all then, a distinctive rendering of the Three Sonatas — yet one should be hesitant on going past Rogg's performance on ORYX. — CMW.

**PROKOFIEV — The Love for Three Oranges Suite, Portraits from The Gambler, Cantata 'Seven, They are Seven', Gennady Rozhdestvensky, Moscow Radio Symphony Orchestra & Chorus HMV ASD-2669.**

When several fine versions of the *Love for Three Oranges Suite* are currently available, it seems to make little sense for HMV to couple it here with two unusual works not to be had elsewhere. Was this done so as to document a Russian performance of the Suite? It seems more likely that HMV does not consider this record to be particularly saleable without the Suite. I also find it strange that a more unusual coupling may be had elsewhere overseas. Be that as it may, this performance of the Suite is neither worse nor as fine as some of those available and the recording is not particularly brilliant anyhow. More important, this reading lacks a humorous and sardonic approach so important to this score.

Prokofiev's *Gambler* may be among the composer's most uneven works but the orchestral suite culled from some of the opera's music can be very moving indeed. The Suite consists of five movements, four depicting the main characters of the opera, and a final section, *The Denouement*, consisting of music from the operas two entr'actes. The programme notes on the album of this record give brief descriptions of the four main characters of the opera. I do not find each movement of this suite to be psychologically revealing of these different personalities in the opera. I prefer to listen to this work as a typical orchestral suite and very typical Prokofiev it is. Rozhdestvensky is in his element here although I would have preferred more bite in the performance. Or this may be due to the rather ordinary recording.

The Cantata *Seven, They are Seven* supposedly ranks among the Russian composer's more original and important works. Personally, I find Prokofiev's

attempts to outdo Stravinsky's *Rite* usually contrived and this work is no exception. Stunning this Cantata may well be, and the performance seems good enough, but once again I feel the engineers have hardly done this work justice. It is more than likely the performances on this disc stem from not so recent Russian tapes. But it is nevertheless good to have two unusual Prokofiev works available even if I do personally feel they don't rank with the composer's best. — J.A.A.

**J.S. Bach — Suite in G minor for Lute, BWV 995**  
**Buxtehude — Lute Suite in C minor**  
**Pachelbel — Lute Suite in F sharp minor**  
**Walter Gerwig (lute) Three Centuries of Music 3c 302.**

The label *Three Centuries of Musick* (sic!), a division of Oryx and recorded in cooperation with Barenreiter seem like Oryx to be concentrating on less readily available material. Performances are generally very competent and in quite a few instances standards of performance and recording are very high indeed. This recording of baroque lute music is one such instance.

All three works on this record have been available before, but on the guitar, an instrument considerably easier to negotiate than the lute.

For those used to hearing Bach's Fifth cello Suite (BWV 1011) on that passionate sounding modern string instrument, it always seems quite a shock to hear the work's character, as it were completely changed to something cool, detached and yet even more subtly intellectualized. And yet the same Suite when played on the viola da gamba reveals none of that hot quality one tends to associate with the work, so that the lute (or guitar) probably approximates as to sound character what Bach had in mind, while revealing even more the contrapuntal qualities of the work which neither viola da gamba nor cello can deliver. Indeed it would seem Bach wrote the present Suite for the lute first. Personally I cannot admit to preferring lute version to the cello (or viola da gamba). Both make for very fascinating listening and both are undoubtedly tributes to the inventiveness and flexibility of Bach's craft. Gerwig remains one of the very few virtuosi on the baroque lute and his performance here can hardly be bettered.

The Buxtehude and Pachelbel pieces here are originally for the keyboard. They are, of course, not in the same class as the Bach Suite but they are delightful and beautifully played.

Very fine recording and pressing. Quite a bargain at four dollars. — J.A.A.

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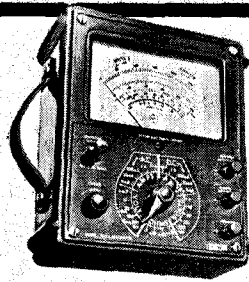


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# CLASSICAL

**HOVHANESS — And God Created Great Whales.**

**Sibelius — 3 movements from The Tempest**

**Weill — Mack the Knife**

**Skalkottas — 3 Greek Dances**

**Glinka — Jota Aragonesa.**

**Andre Kostelanetz and orchestra  
CBS SBR-235433.**

The main feature of this album, Hovhaness' *And God Created Great Whales* utilizes real whale songs amid string vibrational passages and (for those who know this often powerful but uneven composer's music) all too typical oriental banalities. Kostelanetz is no stranger to Hovhaness' music, having commissioned and first performed several pieces including the present work, and delivers a powerful performance. This is obviously a piece of no great consequence but it is also effective and fun. It is also a work which cannot survive much replaying, there are even embarrassing moments, especially its rather contrived conclusion, but one can at least admit to its excitement. The most striking sections of this work are hardly due to Hovhaness' efforts: those real whale songs, not just rare but even haunting, evoke depths and a timeval situation when whales were not more plentiful but unusual enough to be a subject of fable.

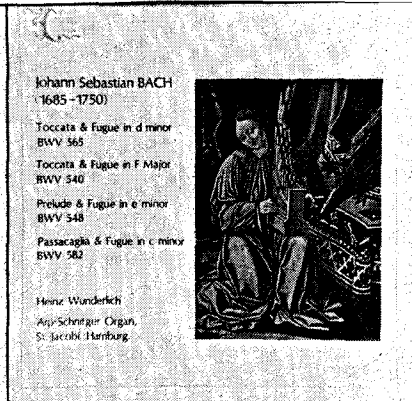
But it is not so much whales which give this album current importance. It is surely a shame that no current recording of the complete *Tempest* music by Sibelius is readily available. Sibelius' *Tempest* contains some of the composer's happiest inspirations and the general level of the music is high enough to rank the score among the half dozen or so masterpieces of incidental music. Kostelanetz gives us three sections (The Mermaids, Miranda, Caliban's Song) in regrettably terrible renditions — sluggish, inaccurate readings, surprising in view of the at least competent playing of everything else in this album.

I almost thought the Skalkottas Greek dances, of which three are recorded here, to be hardly new to records but oddly enough only one ancient and none too good recording of twelve dances is presently available on the American *Fantasy* label. Kostelanetz here, in the Weill *Mack the Knife* (featuring the original orchestration) and in the Glinka *Jota Aragonesa* is effective enough without being particularly brilliant.

CBS and Kostelanetz are to be commended for their recording here of unusual repertoire. Recording is clear, and especially powerful in the Hovhaness. Pressing on my copy is quite acceptable. — J.A.A.

**J.S. BACH, ORGAN WORKS. Toccata and Fugue in D minor (BWV 565); Toccata and Fugue in F major (BWV 540); Prelude and Fugue in E minor (BWV 548); Passacaglia and Fugue in C minor (BWV 582); Heinz Wunderlich at the Arp Schnitger Organ of St. Jacobi, Hamburg. Three Centuries of Music. 3C 304.**

Here is a splendid opportunity to hear an organ dating back to 1512 and rebuilt by the greatest organ builder of the High Baroque (and probably the most important builder of all times), Arp Schnitger. It was



this instrument for which J. S. Bach coveted the post of organist (and was refused!) Remarkably the organ remains in almost its original condition despite two world wars. Wunderlich has chosen works to display adequately the resources of the instrument and at the same time gives good, clear and, in many respects, unusual interpretations of them. Perhaps the E minor Prelude and Fugue comes off best. Wunderlich is careful and consistent over phrasing throughout, though I did find the phrasing of the Fugue opening unusual (use of staccato). The only real criticism (this also applies to the other works) is Wunderlich's frequent use of reed stops, especially if there is a return to the Hauptwerk, as this obscures the lines of counterpoint.

The Passacaglia and Fugue is given a thoughtful interpretation but perhaps the subject is a little slow — there must always be a sense of progression forward in this work. There are a few slight irregularities of time and some of the manual changes are too severe.

A fairly good rendering of the well-known Toccata and Fugue in D minor (how difficult it is to break for precisely the right duration on the rests in the Toccata's opening). Wunderlich is extreme with time changes — perhaps a little too extreme for my liking, but the echo effects in the Fugue are treated delightfully — note the "tinkle" of the high rank cymbal mixture.

The F major Toccata is perhaps the most difficult of all Bach's organ works — not because of technical difficulties, but because interest is so quickly lost (due to its many repetitive sections) if the work is not played with complete conviction. Unfortunately there is a lack of conviction here. The opening canonic manual sections and the pedal solos (with a distinctly unusual phrasing of the opening six note semiquaver figure) are fine but from then on the work becomes tedious — aggravated by the use of reed stops. The double Fugue is a remarkable piece of contrapuntal writing somewhat similar in form to the well-known "St. Anne" Fugue and it is evident that Wunderlich realises its significant features (such as the appearance of the first and second subjects in the final section). Perhaps, however, he does overemphasise these features — the treatment of the two subjects is done with too much contrast. Ornaments are clear but some are unusually interpreted — he begins the trill on the lower note and has no turn. The use of manual reeds from the start of the final section is here also distracting.

There is a noticeable degree of record distortion in the F major Fugue, especially with the final appearance of the subject — unfortunate because elsewhere the sound is particularly clear. The disc comes with an informative note by Wunderlich on the history of the instrument as well as its specifications. — C.M.W.

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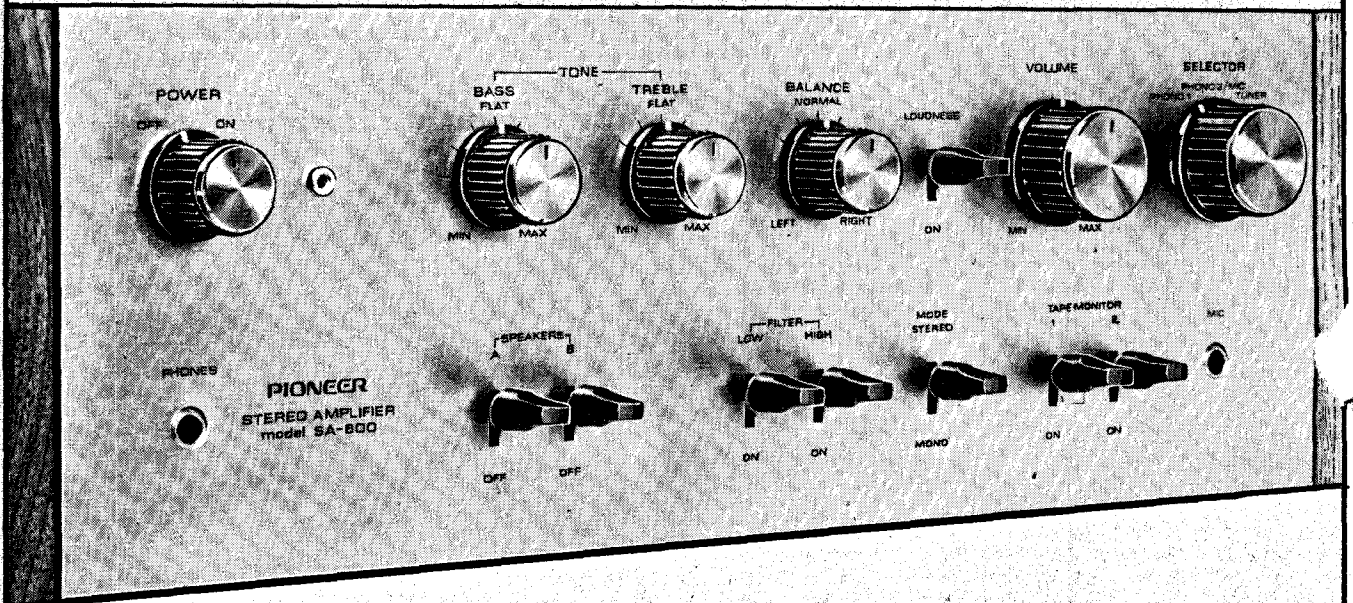
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# RECORDINGS... JAZZ

REVIEWER: John Clare.

**DON BURROWS** — *Just The Beginning, Cherry Pie*, stereo CPS 1009. *Passing The Bach, Whenever, Facade, So Long Samba, Morning, 6th Variation, The Set Up, Just The Beginning, Recuerdos* etc. Don Burrows, Ed Gaston, George Golla, Laurie Bennett, Alan Turnbull.

John Sangster's recording for *Cherry Pie* was much quieter stuff than he is likely to play in a live performance (it was a sound track, after all) but this recording is a pretty fair representation of The Burrows group as they play at the Wentworth Hotel in Sydney. It's not really very wild stuff either, though most tracks have a brief peak of excitement, most often provided by Burrows' flute.

This is music for relaxing with; yes, even talking over: you find yourself stopping every so often to concentrate on something particularly brilliant, then resuming your conversation. If this is background music — and that is the criticism most often levelled at Burrows — it is possibly the most lyrical, inventive and musically background music ever recorded.

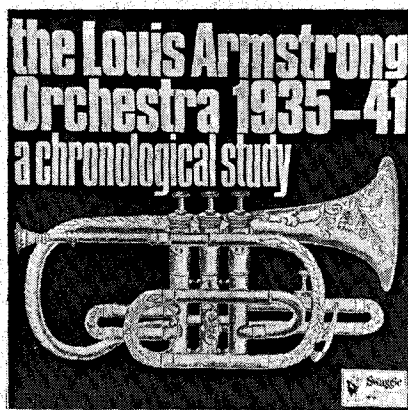
A word or two should be said for *Cherry Pie*. They have come out of the blue and produced two recordings of the highest quality ever made in this country. A bit of dirt had got onto my copy, and that produced the only appreciable surface noise. All the instruments have been recorded with such fidelity that it is very easy indeed to imagine that you are sitting right in front of the band at the Wentworth Supper Club.

Care too has gone into the packaging. Though I don't think that the outside cover is a complete artistic success, there is an excellent booklet inside in which steel engravings of old Sydney face stark, tone-dropped plates of Sydney today. — J.C.

**LOUIS ARMSTRONG** — *Louis Armstrong and his Orchestra, Volume One Mono Swaggie 701*. *I'm In The Mood For Love, You Are My Lucky Star, La Cucharacha, Got A Bran' New Suit, I've Got My Fingers Crossed, Old Man Mose, I'm Shooting High, Falling In Love With You, Red Sails In The Sunset, Solitude, I Hope Gabriel Likes My Music, The Music Goes Round And Round, Rhythm Saved The World*.

From 1933 to 1935 Louis Armstrong toured Europe.

He returned exhausted to confront a new musical craze: swing; and to find that he was no longer necessarily the man the American public thought of as being synonymous with the trumpet; further, it was clear that he would have to make his



mark as more than just an improviser of genius and a great original virtuoso if he were to avoid drifting into obscurity. After a brief period of inactivity, in which it was rumoured that he had died or had given up music, he took over the Luis Russell band and began to establish himself as a vocalist and entertainer as well as an instrumentalist, and to concentrate on popular songs rather than blues and jazz classics.

Understandably, this stage of Armstrong's career is remembered less vividly than other periods. For those interested in what Armstrong did from 1935 to 1941, Swaggie have issued four volumes of performances arranged in chronological order. My personal opinion is that all jazz fans, or students of popular music for that matter, should have at least one of these albums. I've listened to them all the way through — having heard only isolated tracks before, such as *Swing That Music* — and I think that some of the later tracks have more jazz interest. At deadline, however, I'd only had had time to give this first volume a thorough hearing.

Armstrong's trumpet is sweeter and more restrained on these tracks than we are used to hearing it; often he does not use his great unfurling vibrato on high notes, but hits them quite delicately after the manner of Bunny Berigan; but his solos are all compact and strong, all good jazz. Even on rather pedestrian material such as *I'm In The Mood For Love* or *You Are My Lucky Star*, he creates variations which are compulsive listening.

The playing of the orchestra at this stage is more interesting in terms of pop history than of jazz feeling, of which I must confess I can detect precious little, despite the presence of Pops Foster and Paul Barbarin. Then, they are not trying to play jazz. They are playing in the popular style of the time, which is a curious mixture. In ensemble passages they got a corny rub-a-dub rhythm, which was a compromise between the highly contrasting methods employed by the brass, which is ridiculously

clipped and perky, and the saxes which moo and slurp in a manner which leans towards Guy Lombardo.

None of this is unpleasant. It is fascinating, and as it was popular, obviously it has an appeal, it is easy to listen to — like Buddy Holly — but I am afraid that I cannot sustain interest for terribly long. I turn off after a while and wait for Louis to come in.

*I'm Shooting High* presents an amazing contrast between the relaxed, floating trumpet and the hokey, clipped band. *Red Sails In The Sunset*, not even Louis can redeem. I really can't tell whether they are all out of tune here, or whether it is just their exaggerated intonation. As on a couple of other tracks, it seems to have recorded a fraction slow, though how this could be, I have no idea.

On *Shoe Shine Boy*, Louis comes as close as he can to playing schmaltz on his trumpet, yet the same solo has passages of compact strength, with the odd phrase which seems to foreshadow Clifford Brown. *In My Solitude* is taken at rather too breezy a lope, yet here again there is some quite magnificent trumpet.

The vocals, too, display Louis' amazing sense of time, but they are more tied down than the trumpet by the material. I enjoyed his scating on *La Cucharacha* more than anything else.

The sound is generally very clear, and remarkably free from surface noise, but I cannot get the bass and drums up enough for my tastes. Very pleasant listening with a few inspired moments. — J.C.

**JOSEPH JARMAN** — *Art Ensemble Of Chicago, Phase One. Stereo America AM 6116*. "Ohnedaruth, Lebert Aaly (Dedication to Albert Ayler). Lester Bowie, Flugel horn; trumpet, steer horns; Joseph Jarman, Soprano, alto, tenor, clarinet, flute, oboe, marimba etc; Roscoe Mitchell, soprano, alto, bass-sax, cymbals, gongs etc; Malachi Favors, bass, fender bass, percussion; Don Moye, drums, bells etc.

There is a lot of new jazz available presently and some of it is very good, but I would say that this was the very best of it.

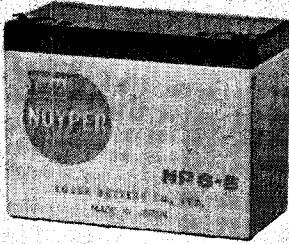
Far from being dead, jazz is in one of its most vital periods. The regions opened up by Ornette Coleman are now being cultivated by a richly various new population. In fact, it is not unlike the Thirties when so many gifted players who had absorbed the Armstrong influence began forging their own styles. Many will take umbrage at this comparison, and I would have done so myself two or three

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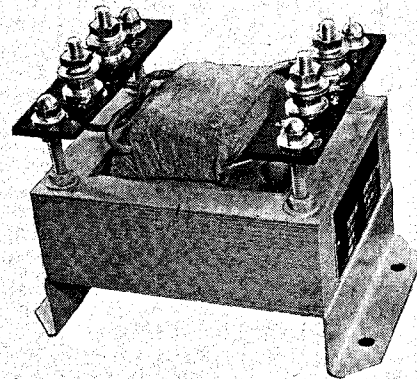
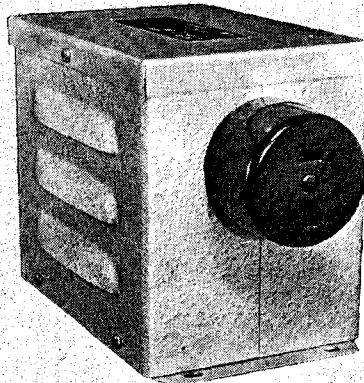
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# JAZZ



years ago, but I find it hard now to hear this music with my uncomprehending ears of yore. Why couldn't I hear it then?

I remember my trumpet teacher saying, back in the Fifties, "What can they do after THIS?" He was referring, of course, to bop and the music that followed it. This record is part of the answer. To many it must still seem as weird, far out and unrelated to jazz as once did bop, when in fact this music presents amongst other things a return to voice-like instrumental sounds and the communal group feeling of early jazz.

Each has been written about 'free jazz' I can't think of many recordings to which the term could be accurately applied; certainly not this one. Once you become used to the music, an undisciplined solo will sound just as undisciplined in this context as it would in the context of any other kind of jazz. You cannot 'just play any note at all!' There is, however, an attempt to get back to a more intuitive feeling of what note can or cannot be played at a given time, of playing naturally what 'feels right' rather than referring to memorised scales related to a particular chord. At the same time, these are men with considerably musical knowledge, and this knowledge cannot and should not be suppressed.

It is significant that this recording seems at first to be divided into straight jazz blowing on side one — after a bit of atmospheric play with cymbals and gong — and a more self-conscious approach with some superficial resemblances to serial music on side two. This is a little misleading though, for these musicians are probably more consciously influenced by Eastern music — in which there are some parallels with the methods rather than the sounds and feelings of serial music — than by the European experimental tradition.

For much of 'Lebert Aaly', on side two, figures which are unresolved in the more conventional sense come and go over a slow, barely felt pulse, to the accompaniment of a tinkling and softly clattering thicket of percussion. As you get into it, the music seems less studied; it is difficult to tell what is written, what improvised; and you begin to perceive it more as natural sounds, occasional cries, conversation; as a kind of brooding distillation of jazz. Towards the end a tonal centre asserts itself more obviously — the feeling here is not so far removed from Gil Evans — and jazz rhythms begin to run across the calm surface.

There are many fascinating sounds and

combinations of sounds here. Take note of Lester Bowie playing trumpet and flugel horn simultaneously: the more immediate trumpet seems to stop and start as unpredictably as possible to shake off the flugel horn which shadows every move. There is a wealth of invention here, and it is good music on any terms.

Ohnedaruth on side one begins with the aforementioned atmospheric, but there soon emerges a powerhouse jazz theme, twelve bars in straight ahead four-four but with distinct Eastern overtones, not unlike something Charlie Munroe might have written.

Jarman solos first on tenor. His probing ominous introductory phrases dig into that area between the beats, and thrusts everything forward with brute power. The solo gradually increases in complexity and abandon until Jarman is often blowing so hard that his notes split into two and sometimes three separate sounds. He uses these splitting harmonic strands as emotional colouration. Sometimes the effect is like that of a fraying steel cable. Two things to remember. One, he is not just blowing haywire. You can feel the theme run through again and again behind the solo, and the solo has a form of its own apart from its relation to the theme (this relation becomes more tenuous, admittedly, toward the end of the solo). Two, one's first reaction is to reject a more forceful expression of elemental energy and feeling than one is used to. If one were not in the mood for, or one was not used to the playing of, say, Roy Eldridge, a barrier would be set up and it would all be heard at a remove as harsh and rather repellant noise. Play this when you are in the mood, and go with it! Then judge for yourself.

The rhythm section of Moye and Favors is one of the best I've heard, and this is even more apparent to me during Bowie's trumpet solo. Personally, I felt that Bowie began to run out of ideas towards a few well timed blasts to keep the whole thing on the boil. The first half of Bowie's solo is extremely exciting. It is hard to say whether he has been listening to Miles, or Miles has picked up the odd thing from him. It's probably a bit of both. His sound is much brassier than Miles' — sometimes he gets about the hardest brassiest sound I've ever heard — but he is using space and dynamics in much the same way.

Mitchell's alto solo develops through three stages: a cool fragmented sequence at the beginning, then an exhaustive workout on a single basic melodic idea, then a sudden eruption into continuous multi-noted patterns in a dark rough, most un-altolike sound. The side ends with a reprise of the flaring introduction to the theme, and it's all still as alive, or very nearly, as it was at the beginning, which is saying something about a flat-out blow through three quarters of a side of an LP.

Recording balance is excellent, though the quality of sound is a little shallow. In this regard, it should be pointed out that these 'America' recordings are cheaper than the average LP.

I should add that there is another recording on 'America' by the Art Ensemble, on which they seem to be drunk. This is the one to hear. A recording to get hold of as soon as possible. If your dealer does not have it, it can be obtained through Carinia Records in Sydney. — J.C.

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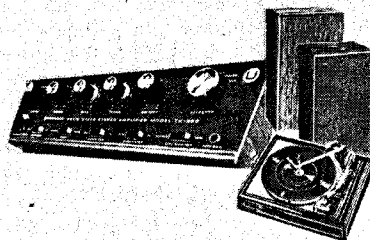
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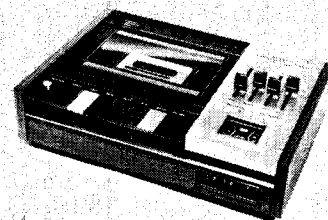
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MS327

Murray Jennings talks  
with one of Australia's  
leading ladies of song . . .



# MARIAN HENDERSON- *firelit lady*

ONLY INSANITY would normally have urged me out of the house on such a night. Sydney September rain, dropping from low cloud like cats and dogs. The thunderheads above it all building for the big finale, their one grand blow for freedom.

It was the kind of night when to stay at home meant all directions of thought, action, motion, etc., would

have to be decided by the electricity. Either some fool with less than 1/16th of an inch on his front tyres would pulverise a pole and put out the lights, or the static in the air would vibrate the images on the telly, and Bill Peach's voice would contort grotesquely.

The kind of night when my record-player gives me Vice Squad frequencies in the middle of a tormented trumpet solo.

I decided to go out. And I found such warmth as to shame the devil.

The silver-yellow rain across my eyelashes in the streetlamp's spreadeagled claw obliterated the street number sequence. But a gum tree, a white wall enclosing a sort of courtyard, some wrought iron, a deep green creeper up a side wall, sandstock brick cut back to post-colonial magic; these things told me I'd probably found Marian Henderson's house. I don't know why, I still thought of her somehow, as Antique Annie, the heroine of the opening song on her record album, "CAMEO". As someone sort of passively opposed to the "Edgecliff ladies" who are driven up to Antique Annie's Magic Lantern Show in Bentleys, trying not to frown as they "touch and tease and toy and spoil her show . . ."

With something like awe, I was confronted by a mini-skirted Marian and we mumbled hesitant hullo and half-smiles flashed briefly in the misery of the outside. I was shown into the womb of the house, a dining room with a big red fire in the chimney, slapping its licks of light about the walls like wet steamy towels at a sauna bath.

A hint or two of the Antique Annie in her tastes — the rejuvenated furniture, the rustic warmth of the home she'd made for herself. And the work she'd put in — restoring an old terrace house is not easy at the best of times with unlimited finance and assistance — but it's the work of one woman determined to make a home. About that point I decided to forget Antique Annie altogether, except as a song. Because there really isn't anything about Marian Henderson that you could truthfully call antique. She's young, and her ideas come out with maturity but with the colour and conviction of a kind of practical idealist, if the latter is possible. I don't know if Marian would be the kind of person to compromise too much.

There were, she told me, six cats upstairs. Did I know anyone who wanted a kitten? An enormous dog lay like a tiny puppy, curled near the fire. We had to ask him to move while I plugged in my recorder at the point behind his back. Part alsation, part great dane, part labrador, his gentle ways found him a home only a week before.

One can't point to Marian Henderson and see a folk singer.

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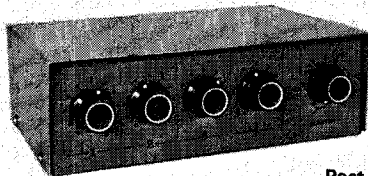
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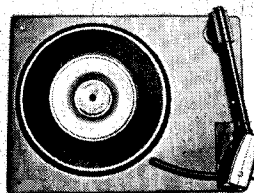


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## MARIAN HENDERSON- firelit lady

**MARIAN:** I hope not. If I were a folk singer in the traditional sense of that term, then I'd probably be wandering around with my guitar slung across my back, and with no fixed abode. In Australia the folk singers we have now are probably mostly the older people who used to go shearing and bullock driving and so forth. A more accurate definition for me might be singer of folk songs. But then, if I could sing opera, I'd sing that, too.

**M.J.:** Did you have any training?

**MARIAN:** No, I didn't, much to my regret. Every time I have a cold, I find it very difficult to sing. I'm told that if you're well trained, you could be dying of pneumonia and you should still get those notes.

**M.J.:** Where did you get that version of "Country Girl" for your album? I never knew it was a traditional song. I knew it only as "I'm just a Country Boy" from 1963.

**MARIAN:** I probably heard Peggy Seeger singing it. And if you read through her books and others you probably find a verse or two here and there that you add to it — this is what so-called folk singers do. For example, there are twenty-six versions of "Barbara Allen" in Kentucky alone . . .

(And that broke me up along with the ice.)

**MARIAN:** And Wilfred Thomas, I think, recorded about fifty people singing their own particular versions, in Ireland, and not one of them was like another . . .

(We talked about my hero, Ben Hall, and "The Streets of Forbes", another song from "Cameo". And what every happened to that film someone was supposed to be making about him? My wife, never one to accept blindly the romantic concept, had asked a few nights before, "But whose gold did Hall steal?" I'd had to say, for the sake of my illogical worship of Hall the Robin Hood, rather than Hall the robbin' hood, "Oh, the banks' money; definitely the banks' money." Then she said, "But where did the gold come from?" I replied that it came from the miners. "There you are," she said triumphantly. "So much for your hero. He robbed from the miners." I had to object. "No, once they put their gold into the bank the money value was still there, no matter how much the bank lost in robberies." My wife gave me a very funny look. It said volumes about shifty allegiances and flimsy moral justifications.)

**MARIAN:** I was preparing an album with Tully backing me. I allowed myself to become very excited at the prospect — a thing I don't do very

often. What I didn't realise was that Tully had changed a great deal — the influence of Meher Baba being responsible. This is okay by me, but I felt that somehow it wasn't going to work, so I dropped the idea, not willingly . . . but I didn't want more confusion with my name or anyone else's being put before a world market for all to hear. I still sing "White Horses", written by Colin Campbell, one of the songs that was to have been on the album; it is a sensitive song that pays homage to Meher Baba. Because of my love of the sea and how those "ten million eyes" need desperately to believe in someone or something, I sing it with as much sincerity as I believe Colin wrote it. Incidentally, "Cameo" was vocally cut in six straight hours.

**M.J.:** I find that hard to believe, because I think "Cameo" is a beautiful album, really.

(But I do believe it. I know, I know, I know what happens. I know of so many others too. Recording studio casualties. Studios cost lots of money. Time costs money. Money's the name of the game, folks! Hurry along there, please!)

**MARIAN:** If and when I make another album in this country, I'm going to start planning it until I know it's ready and that the musicians are ready, and everyone else, too. This is so that every song has the right instruments, overtones, the right everything. And I also have to learn a lot about studio work before I'm going to feel happy about making another recording. When you publish something, obviously the first thing you should be aware of is the criticism . . .

**M.J.:** Not all of it is valid, of course, but you have to draw from it.

**MARIAN:** Yes. But, I don't think I was ready to make an LP then. I had promised that I would, and with an option on another LP, which is still to pick up . . .

**M.J.:** It surprises me that you weren't too happy with your "Cameo" LP. You had some beautiful musicians there . . .

**MARIAN:** Some very good musicians. But to me there was so much that could have been lifted out of there . . . but I'll know better next time.

(Marian had with her on "Cameo", Doug Ashdown and John Jackson on guitars, and the bassist, Ed Gaston. Ashdown and Jackson work together beautifully, as you will know if you've ever seen them at PACT Folk nights and concerts. Doug Ashdown and Jimmy Stewart wrote "Antique Annie's Magic Lantern Show" especially for her, and with Laurie Lewis, John Jackson, and Marian herself, arranged the traditional

numbers of the album, such as "Lady of Carlisle", "Streets of Forbes", and "Convict Maid". Perhaps one of the reasons for her doubts is that Laurie Lewis, a thoroughly professional music man, had not worked with or for her before. Perhaps Marian's meticulous approach suffered in the studio where often the pace is frenetic. Perhaps).

**M.J.:** It seems to me that there isn't as much violence or aggression in songs today as there was up to The Stones' "Street Fighting Man". Dylan wrote a lot of fairly aggressive songs that were decidedly anti-women, round his middle era. Do you have any feeling about this?

**MARIAN:** I think violence is being written about in a different form. The middle verse of a song I've been thrashing over today, "Suzanne", by Leonard Cohen — he's talking about Jesus and the way he was put down by humanity. Then there's "Jesus Christ, Superstar" . . . those two songs are specifically about religion, but I think the writers think now that they are going to reach a wider audience than straight protest songs will, by using a soft sell. To sell a "commercial product", anti-violence. There's another point too — the generation gap. The song by Cat Stevens "Father and Son" — that's not a violent song, but it could have been. It's just that the songs are gentler now.

The violent songs though, are still around, for those who have ears to hear them and know where they've being sung. There are lots of kids down at PACT every Friday and Saturday night, who write their own songs. And there are still hard edged songs, but more and more I think it's a softer approach coming in.

We've had "Hare Krishna" coming from the Beatles, and now James Taylor and Cat Stevens, gently setting down reality as they know it. And then on the other hand the good old rock is coming back. At the Festival at Fairlight, I'm not sure if it was Whistler's Mother or Pirana — one of those two groups — started playing old Presley and Billy Haley numbers. And that was the first time all day I'd seen any kids get up and move. But when things like "You ain't Nothin' But a Hound Dog" rang out, off they went.

That's what first kicked me off on music. I started playing piano in a rock'n'roll band. Down in Melbourne. And I think that's where I sang my first song publicly, apart from school concerts.

**M.J.:** What was it?

**MARIAN:** I believe it was one of Fats Domino's, or Gene Vincent's or Little Richard's, or maybe it was a Bill Haley — and from there it progressed to the "Would you sing at our Saturday night Town Hall Dance?" kind of thing, so I started doing that,

## MARIAN HENDERSON- firelit lady

singing standards. Cole Porter, Gershwin, Rodgers, Hart, and Hammerstein. You see, I have very catholic tastes too. And I mean it when I say I'd love to sing opera. I love some of the classical songs so much, but I can't sing them, just listen to them, really. I've got a strange sort of ambition, and that is, one day to play a cello or a harp with a group ... a chamber music orchestra.

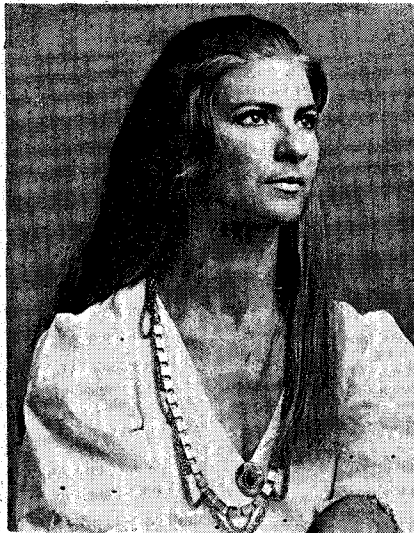
It's a beautiful feeling when you're a musician, working with other people. You get a kind of love affair with other musicians that you will never ever encounter just with members of the opposite sex — that kind of 'affair', I mean. It's... an anticipation, a thoughtful, unselfish... all the beautiful things you can think of. You know precisely what the next guy's going to do. Rather than upstage him you join him.

**M.J.:** It's something that I've always envied musicians for — the rapport they share. In a band or in an orchestra, there may well be fights, but there is often a very deep sharing that is evident to those outside, too.

(I sounded off about all the great trad groups I discovered when I was following bands around Perth from dance to dance, as a teenager. I started a record collection and bought Muggsy Spanier, Lu Watters, Fats Waller, Humphrey Lyttelton, Graeme Bell...)

**MARIAN:** Funny you should mention Graeme Bell... around about ten years ago I was singing with a small jazz group — two guitarists and a bass player — and someone asked me to sing on Graeme Bell's television show — 'Just Jazz' — and I was all set to get up and do a sort of "Stormy Weather" song. But about the same time I'd met some people who played acoustic guitars and banjos and sang folk songs. So when I mentioned that I'd learned to play a few chords and things, Graeme Bell suggested that I do a song I'd heard Odetta sing... a negro work song...

(On the "Cameo" LP there's a song called "Bald Mountain" and if you've heard it before somewhere, it was probably on an early Odetta album or on telly, or somewhere vague in your memory like that. With due respect to Odetta and respect to Marian's reservations about her own LP, you must listen to Marian's version, backed so beautifully by John Jackson and Doug Ashdown and company. Not long ago I saw Marian sing at the Clutha Campaign Benefit Concert out at the University of New South Wales. Marian, Ronne Arnold, Barry



Humphries, Bernard King, Barrie Ingham, and many other people of top calibre gave their services for the concert free for the cause of fighting coal dust and ugliness. Out onto the stage floated a tall, statuesque figure clad in a full-length dress, yellow I think was the basic colour, and she lifted a guitar and sang. She sang softly at first, in the familiar husk, and then broadened into a full-throated delivery of "Bald Headed Woman", inducing the audience to clap on the beat. That's on the OFF beat, not on the ON. Well they caught on that night, somehow. Some of them. Australian audiences and their ludicrous lack of feeling for when to put their hands together... but the thing was that Marian had the audience of 1200-odd singing their lungs out on a song that I hadn't heard in years, since I last played an old Belafonte album I've got, of work songs. It's a fun song as it turns out... and there was the final rouser, "Amen".)

**MARIAN:** ... And around then the folk boom started. I think the first folk song I was conscious of hearing was Burl Ives doing "Click Go the Shears". (And I think M.H. was then the only female folk singer in Sydney.) There were a couple other girls who sang and played guitars but I was the only one with any professional experience, and the chance to perform in public.

And then Ray Price hopped onto the folk bandwagon and said "How about making some records?" So we did. They were put out through PIX, on 45s. That brought about tours, television, radio, and later "The Restless Years", produced by Jimmy Upshaw. From that show came the record, written and mostly produced by Peter O'Shaughnessy who played the lead in the television version. That record was accompanied by a very beautiful book. Have you seen it?

**M.J.:** I can't remember.

**MARIAN:** It's the sort of thing they give away as Dux of the School prizes, you know? But apart from that it was widely acclaimed early Australian history, and it's very good.

**M.J.:** What other records have you made?

**MARIAN:** The others have been with other people. "Folk Songs on Campus", and one that followed "The Restless years", called "Old Botany Bay". I think I've learned more about Australian history from singing folk songs than I ever did from school books. So it's rather neat that they're introducing Australian folk songs into the curricula now. People like Alex Hood are taking the songs around to the schools through the Arts Council and the Education Department.

**M.J.:** Is there anything else you'd like to be doing apart from singing and playing music?

**MARIAN:** I have a way with my hands and a way with children. I'd love to work with children. I'm not trained as a teacher, but I can make most things — junk sculpture, clay, metal sculpture, and... I'm a people kind of person. I'd like to live where it's not polluted, where it's quiet where I could potter in the garden and keep animals, but I'd have to be doing something with people.

I don't try to put myself on show when I'm not singing. But I can still attempt to get away from it all into the Blue Mountains, walk into the butcher shop at Wentworth Falls and have the lady behind the counter ask me for my autograph. I like to be an identity, but I like to be inconspicuous. When I'm not singing I like to feel that I can relax and dress according to what I'm doing with my day. But I would never sing in old gear. An audience deserves to have you dress for them. The least you can do is behave professionally when you're on the stage.

**M.J.:** If you were making another album soon, what ideas would you start with?

**MARIAN:** If you can imagine a world...

(She picked up a pencil and drew a near-perfect circle on some paper.)

... with windows all over it...

(She drew in little windows)

... and each window representing a group of people, a country, with their different cultures, folklore and beliefs old and new, then that's the kind of feeling I'd like to get onto a record. You'd bring in all the elements in that concept. Love, hate, anger, fear and solitude... In a concept like that, you'd have to go deep. I'd like to see the Australian public getting out and supporting local artists who are just as

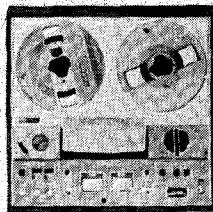
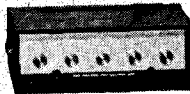
(Continued on page 118)

# HI-FI NEWS From ARROW ELECTRONICS

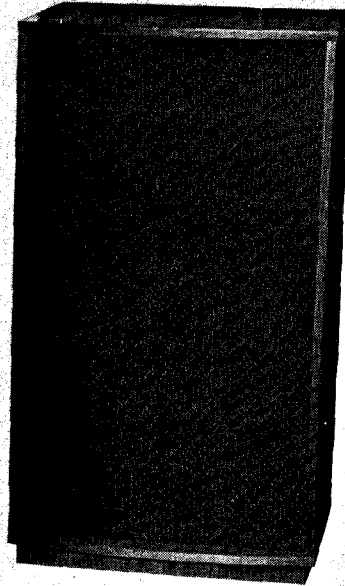


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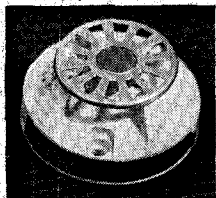
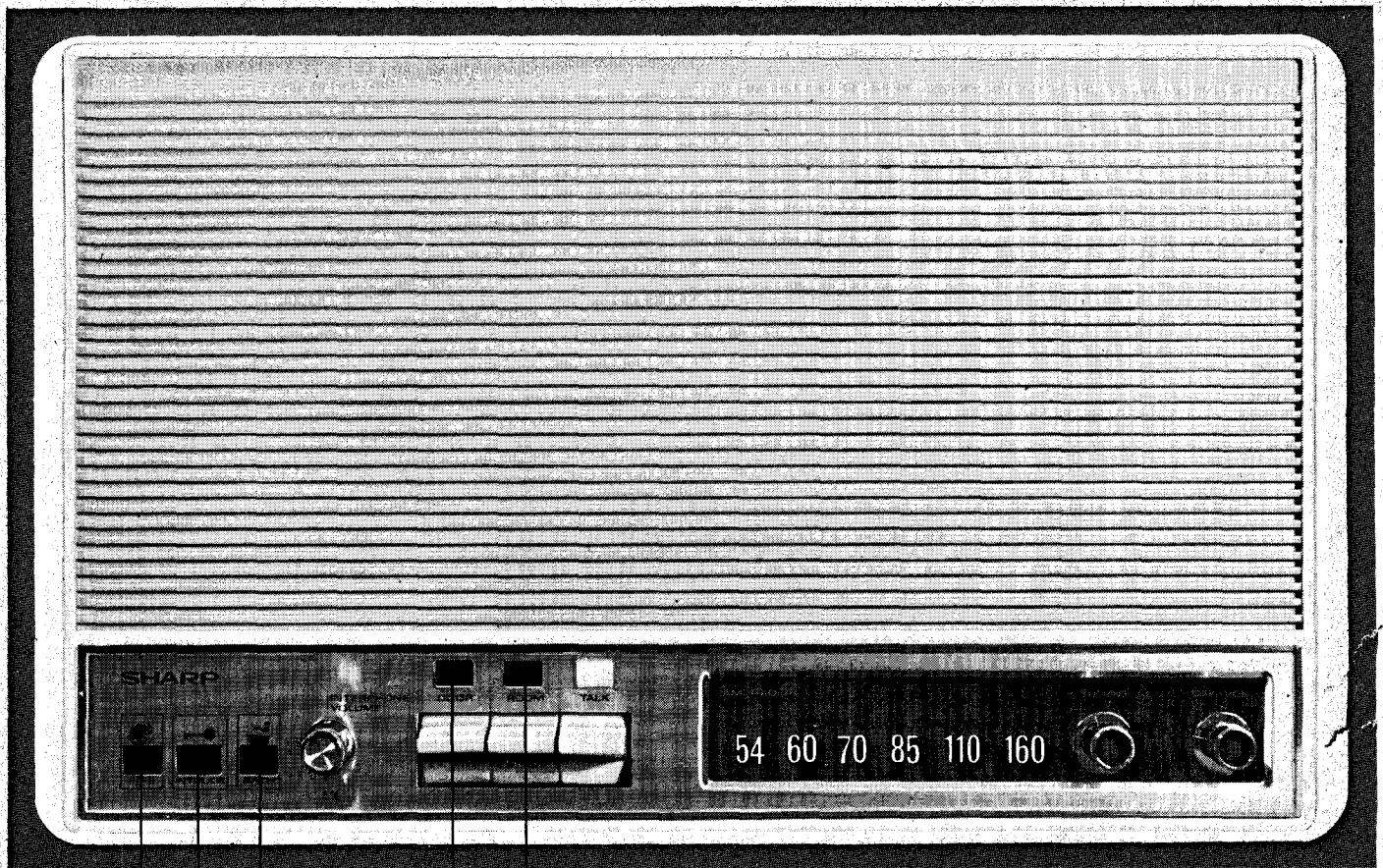


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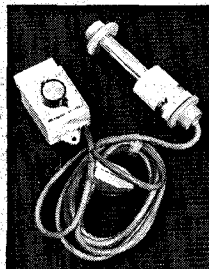


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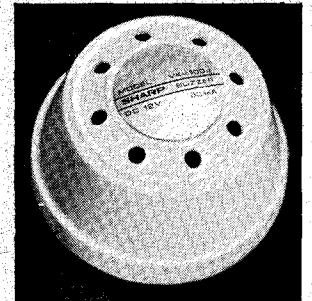
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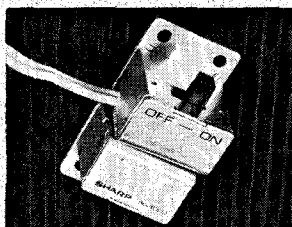
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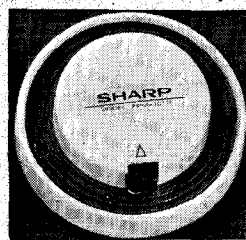
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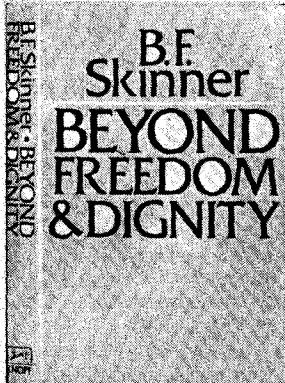
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# BOOK REVIEWS

REVIEWERS: Brian Chapman  
Jan Vernon, Roger Harrison  
Collyn Rivers.



**BEYOND FREEDOM AND DIGNITY**, B.F. Skinner, published by Alfred A. Knopf, New York, 1971. Hard cover 232 pages. Available (in December) from Modern Books and Plans, Sydney.

To solve the problems that face us in the world today we need to make vast changes in human behaviour, and to do this we need a technology of behaviour.

This is the opinion of Burrhus Frederic Skinner, Professor of Psychology at Harvard University, who states his views in his new book 'Beyond Freedom and Dignity'.

Considered the most influential of living American psychologists, Skinner is a leader in 'behaviouralistic' psychology. The Skinner method of controlling behaviour is known as operant conditioning; 'contingencies of reinforcement' are set up, being circumstances under which a particular bit of desired behaviour is 'reinforced' (rewarded) to make sure it will be repeated. (In a typical laboratory experiment a hungry rat is placed in a box equipped with a lever. While moving around the box the rat eventually touches the lever and a pellet of food is automatically ejected into the box. Soon the rat learns to press the lever whenever he wants food).

Skinner's book will probably outrage people who feel that he is planning to treat society like a laboratory experiment, but Skinner's purpose in his work is not to show that behaviour *can* be controlled in this manner. He is saying that our behaviour actually *does* come about through the rewards we have received for previous behaviour; therefore it is time we thought about the situation and planned our culture accordingly.

At present, human behaviour is commonly attributed to indwelling states of mind, agents and feelings. Skinner rejects these traditional explanations of behaviour in favour of explanations to be sought in an individual's genetic endowment and personal history.

Scientific analysis of behaviour, says Skinner, shows that we react in a given way because similar actions in our past have had particular consequence — we are not free to choose a path in life — our behaviour is a result of genetic endowment and environmental influence. But our present society assumes a person is free to choose right from wrong and condemns a person who chooses the wrong path. Skinner says we should accept the fact that we are controlled by our environment; stop trying to persuade people to be better but concentrate on the design of better environments: better people will then follow.

But, Skinner says, we must plan our culture carefully for behaviour is shaped and maintained by its consequences. We must consider the behaviour we want in our society and learn how to obtain this behaviour.

The use of science in designing a culture is commonly opposed. People fear they will be controlled, that there will be uniformity or regimentation. But if we are designing a culture then it is up to us to design it well so that we have the interchange between control and counter-control which is essential to the evolution of a culture.

A scientific view of man offers exciting possibilities, says Skinner, we have not yet seen what man can make of man. — J.V.

**TRANSISTOR EQUIVALENTS** — European, American, Japanese. Published by de Muiderking, N.V. Holland. 166 pages, plastic cover, pocket sized. Price \$3.00 plus 30 cents postage, Technical Books and Magazines Pty. Ltd., 289 Swanston St., Melbourne, Vic., or Modern Books and Plans, 21 Bathurst St., Sydney, 2000.

Unlike valves, it is virtually impossible to speak of transistor types that are equivalent to one another, or that are direct replacements in every type of circuit.

Any list of transistor equivalents must therefore have technical limitations. This fact is completely acknowledged by de Muiderking N.V., the Dutch publishers of 'Transistor Equivalents' a pocket sized, plastic covered listing of over 5000 different types of transistor.

But despite its limitations this is a most valuable little book. Each entry shows the type of transistor (germanium or silicon, npn or pnp), the country of origin, up to three European 'equivalents', one or two American 'equivalents' and where relevant, a Japanese 'equivalent'.

As the forward points out, the 'equivalents' listed may have minor mechanical or electrical differences, and it is advisable to check all critical parameters against the manufacturer's data. — C.R.

**RELIABLE ELECTRONIC ASSEMBLY PRODUCTION** by C. E. Jowett. First published 1970 by TAB books. 185 pages, 8½" x 5½" hard covers. Australian price \$16.20, available from Modern Books & Plans and other booksellers.

The revolution in electronics spanning the past twenty years or more has seen a proliferation of new devices and techniques, the application of which considerably changed the world in which we live.

Apart from the immediately apparent advantages of reduced power consumption and miniaturisation, there is another advantage associated with semiconductor components without which the ever-increasing complexity of modern equipment would not be possible. This most important factor is reliability. To exemplify this, let us consider a piece of equipment using say, 1000 valves, and let us assume that a valve had an average life of 2000 hours. Then neglecting the other components in the equipment we could expect that after an initial fairly short trouble free period, it would be quite likely that we could have one valve failure every two hours, a totally unacceptable situation. Such a piece of equipment could not be expected to operate for more than 1000 hours without requiring a major overhaul.

Thus the introduction of semi-conductors, with their almost unlimited life, has allowed the complexity of equipment to be increased enormously whilst still maintaining practical MTBFs (mean time between failures).

However, as equipment complexity is further increased other reliability factors become of significance. The reliability of resistors and capacitors and soldered joints, etc., now becomes a limiting factor and this has been perhaps the major factor in the introduction of integrated circuits. In integrated circuits the design philosophy is generally to produce a system with as few resistors and capacitors as possible and to eliminate soldered joints. The integrated circuits still have to be interfaced with other components, printed circuit boards, etc., and the complexity and methods of interfacing are still limiting factors.

Methods must be employed which improve the reliability of printed circuit boards and connections to acceptable levels and the development of such methods has become a science. Materials used, plating and soldering techniques, protective coatings, potting compounds and assembly methods must be carefully and thoroughly studied to obtain a reliable product.

Design engineers are now becoming aware that it is not sufficient to know merely how to create a specific electronic device in terms

# 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.

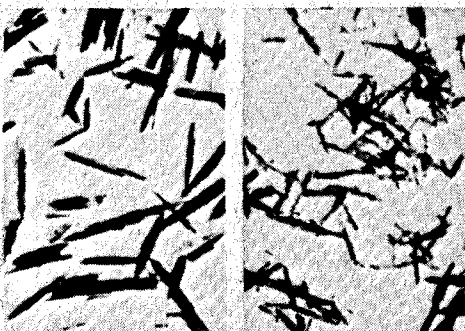
**'SD' SUPER DYNAMIC CASSETTE TAPE** The tape that turned the Cassette into a High Fidelity Medium.

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.

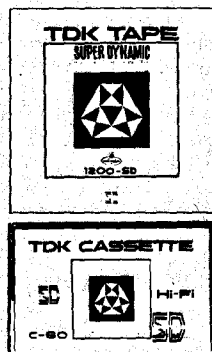
The surface of SD tapes is almost mirror smooth, which combined with special binders and lubricants has all but eliminated head wear. The tape offers the following features:

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.

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Phone 357-2444.

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Super Dynamic tape.

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of the circuit requirements alone. He must also be familiar with the properties of materials and reliability factors. Today the engineer is presented with a vast selection of materials, chemical and physical processes to choose from, for the fabrications of electronic equipment, and knowledge of the advantages and disadvantages of various methods is essential.

The present book is intended to convey an up-to-date knowledge of reasons for use, advantages and disadvantages of current techniques, materials and chemical compounds. It fills a vital need, presenting in one volume all the necessary ancillary information that has hitherto been largely a matter of trial and mostly error. I personally have been conscious of a lack of knowledge in these areas and welcome this book as a valued addition to my standard references.

Although the material is primarily aimed at production engineering in electronics manufacturing companies, it would be of advantage to anyone engaged in building electronic equipment whether he be electronic engineer or home experimenter.

It is a pity that the book is relatively expensive; this will perhaps restrict its sale somewhat.

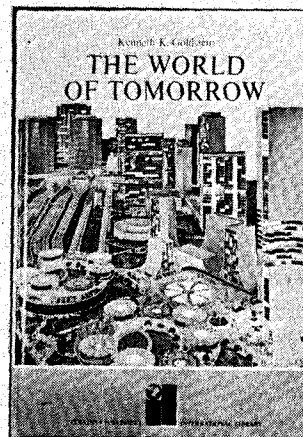
Subject matter is divided into a glossary of terms, introduction, and the following sections:

Section 1: Insulation - Encapsulation and Sealants.

Section 2: Soldering - Cleaning and Plating - Multilayer Circuit Boards - Integrated Circuits - Plated Through-Hole Connections - Resistance Welded Joints.

Section 3: Assembly - Cleaning - Repairing - Terminations Protective Coatings - High Voltage Systems - Inspection.

The treatment is thorough, a good index is provided, and the book is a worthwhile acquisition to any electronic design or production engineer. Home builders would certainly find the book of value but may be deterred by the price. - B.C.



**The World of Tomorrow**, Kenneth K. Goldstein, published by Collins, London. Price \$3.95. 128 pages, hard cover. Available from Modern Books and Plans, Sydney and all good booksellers.

Starting from the latest developments in today's technology this book attempts to forecast the way in which mankind will live in a century from now.

The author describes the way in which laser beams may well revolutionise telecommunications, how complete manufacturing enterprises will be under computer control, the manner in which underwater colonies will be developed. How bio-engineering will solve many of today's most serious medical problems.

Apart from its forecasts of the ways in which science will be used in the years to come, the book describes the latest state of knowledge in very many areas of science and technology.

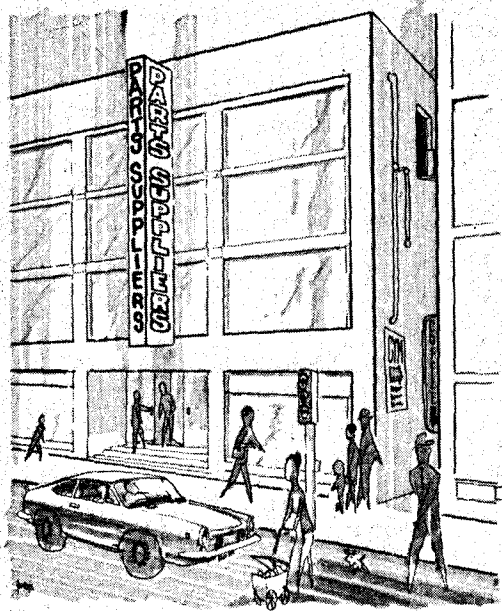
The book appears to be aimed at the 11 to 16 years old - but there is much to interest readers outside this age group. My 10-years-old daughter says: "It's a book which many children who are curious about the future would like to read sometime. It gives a very good idea of the future days to come. There are some difficult chapters which most children under 12 may not understand especially one called 'the plugged in society'".

This book would make an excellent Christmas present for the scientifically-minded child - no doubt many children would have to wait for their parents to finish reading it first - for some of it is as fascinating as the better types of science fiction. - J.V.



# 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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**INSTROL:** 91a York Street, Sydney, Telephone 29-4258.  
**KITSETS AUSTRALIA:** Suite 2, 21 Oakes Avenue, Ooe Why, Telephone 982-5571.  
**NATIONAL RADIO SUPPLIES:** 332 Parramatta Road, Stanmore, Telephone 56-7398.  
**PRE-PAK ELECTRONICS:** 718 Parramatta Road, Croydon, Telephone 797-6144.  
**RADIO DESPATCH SERVICE:** 869 George Street, Sydney, Telephone 211-0191.

**DICK SMITH:** 10 Atchison Street, St. Leonards, Telephone 43-1414.

### VICTORIA

**E.D. & E.:** 232 Flinders Lane, Melbourne, Victoria, Telephone 63-3596.  
**J.H. MAGRATH & CO.:** 208 Little Lonsdale Street, Melbourne, Victoria, Telephone 663-3731.  
**S.T.A. ELECTRONICS:** 392 Centre Road, Bentleigh, Victoria, Telephone: 97-4832.

### SOUTH AUSTRALIA

**GERARD & GOODMAN:** 192-196 Rundle Street, Adelaide, Telephone 23-2222.

(Continued from page 112)

good as, if not better than, the overseas artists we import... it's good that Australians see them, of course, but when will Australians start heading the bill more often, instead of supporting it?

**M.J.:** What songs have you written, yourself?

**MARIAN:** Only one thing I sing in public. "Of Moon and Mice"; it's about the very first visual image I remember, then various events that changed my life in large large heaps, then finally something I'd like to do when I'm an old lady.

**M.J.:** What female vocalist do you like most of all?

**MARIAN:** Laura Nyro is one of my favourite singers and writers. Aretha Franklin I love... and Wendy Saddington.

(Now if I were Wendy Saddington, I'd consider that a compliment. I wondered if Wendy's ever listened to Marian's singing. There's an enormous difference between their two styles and the kinds of repertoire they have, but both are Australian, and both are firelit — inside and out.)

Perhaps we should believe implicit in reincarnation. How else does a bitch know that the outside world is a bitch? Why else would a baby delay the proceedings? Induced births. Then out into it, and wham! Birth trauma. I can understand how that child feels. Coming out of that warm room, with fresh, hot, black coffee in my belly and knowing that in a moment Marian would open the front door and outside was...

Suddenly came the Grand Finale for the night. The house lit with flashes of blue lightning accompanied by ear-splitting noise. The big blow for freedom, thunder to induce the most difficult birth. And with that I was off, my SONY recorder banging at my knee as I struggled to get the key in the car door, rain crashing straight down in the same silver-yellow under the streetlamp.

Only insanity — mad dogs falling from the sky, not to speak of cats, and maybe an Englishman in retreat from the midday sun — would bring me, a sunnyside-up from Perth, with a passion for pretty ladies of warmth and talent, a husk in the voice, and a strong feeling for people... hell! It wasn't an interview at all! Talking to Marian Henderson had been the best possible way to forget the bitch called rain.

### DISCOGRAPHY

Unfortunately, the PIX 46s Marian did with Ray Price some years ago, are no longer available.  
"The Restless Years"  
"Old Botany Bay"  
"Cameo" MCA Stereo MAP/S 2122  
"Four Floors Down" RCA Camden Stereo OCMS/175

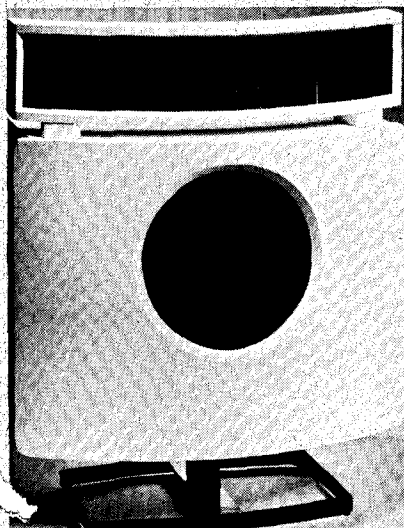
# Now! The Ecological Speaker!

No sound pollution from B. & W. 70's. The revolutionary

Electrostatic Monitor Now on demonstration at

## Convoy Technocentre of Sound

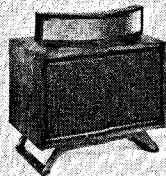
Where you hear and buy the world's top equipment.



### What the critics say about B. & W. 70's.

"...approaching the ideal everyone is seeking - perfection", writes Mr. John Gilbert in the Gramophone, London.

"I was really astounded... a major breakthrough in Speaker design... the new models don't sound like loudspeakers at all. They sound like the real thing," says distinguished English Music critic John Freestone.



The Continental (above) shown in the latest decor White with Black Trim. Also available in Walnut, Mayfair version left in teak or walnut.

The B. & W. 70's are also available in kit form, and cabinet can be made to special designs or built in. Technocentre experts advise on technical requirements.

J.B.L., U.S.A. Hear the L.100 Century speakers. See the Aquarius range of omni-directional speakers - surround yourself with superlative sound.

PEERLESS OF DENMARK. A superb 12" 3 way in Teak or Walnut only \$220. pr. astounding value. Cameo 2 way \$100. pr. best value.

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PIONEER, Japan. Best value for money in Amplifiers, Turntables, Speakers, 15 months Guarantee.

PHILIPS INTERNATIONAL HI-FI, HOLLAND. Europe's top Hi-Fi Equipment manufactured to din standards. A full range of this equipment on demonstration.

TEAC CENTRE FOR AUSTRALIA. A complete range of new TEAC semi-professional equipment on demonstration, fabulous AS100 Amplifier, reminiscent of valves. The Model 1230 Deck and the fully professional 7010 and 3300. Also professional quality TEAC Hi-Fi Cassette Deck from \$183. The superb model A350 with Dolby and bias switch only \$318.

### TECHNOCENTRE SERVICE DIVISION.

We set up your tape recorder or deck for the correct bias to give you optimum from the tape you use. It will be like a new machine when set up for TDK-SD Tape. All repairs and service for Hi-Fi equipment.

FREE CUSTOMER PARKING

# Convoy Technocentre

Now at corner of Plunkett & Maclean Sts., Woolloomooloo, Sydney, 357-2444 (past Astor Motel).

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BOX 1683 P - MELBOURNE, 3001.

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1120	.63 "
1121	.63 "
8110	2.55 "
8111	2.55 "
SE1001	.31 "
1002	.52 "
1010	.57 "
4001	.44 "
4002	.51 "
4010	.58 "
7001	2.76 "
2N3053	1.53 "
3055	1.26 "
3568	.63 "
3569	.67 "
3638	.56 "
3638A	.71 "
3640	.93 "
3641	.57 "
3642	.77 "
3643	.71 "
3644	.77 "
3645	.96 "
3646	.69 "
3693	.31 "
EM404	.22 "
2N2101	2.78 "
2N2647	3.15 "
2N2926	2.25 "
2N3716	5.30 "
2N3790	11.25 "
2SD150	1.50 "
2SF28	5.60 "
BD139	3.67 "
BD140	3.90 "
FLV100	3.30 "
MPF104 (Fet)	1.10 "
SC146 D	3.70 "
2N3054	1.80 "
MPF102 (Fet)	1.00 "
FuL709 (I.C.)	1.75 "
FuL723 (I.C.)	3.95 "
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SPECIAL QUOTES FOR 100 LOTS.

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# This symbol world's finest

## Only Philips use it. For these reasons.

Superior quality Hi-Fi International stereo systems are specifically designed to exceed the demanding specifications of the internationally recognised standard of High Fidelity Reproduction (DIN45500), together with Philips own high standard of perfection born of vigorous research and development in electronics.

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Philips design, develop and manufacture—and only fully qualified dealers handle Philips hi-fi systems. So, when you see the Hi-Fi International symbol on Philips stereo hi-fi systems, you'll know why Philips earned the right to use it.

# PHILIPS

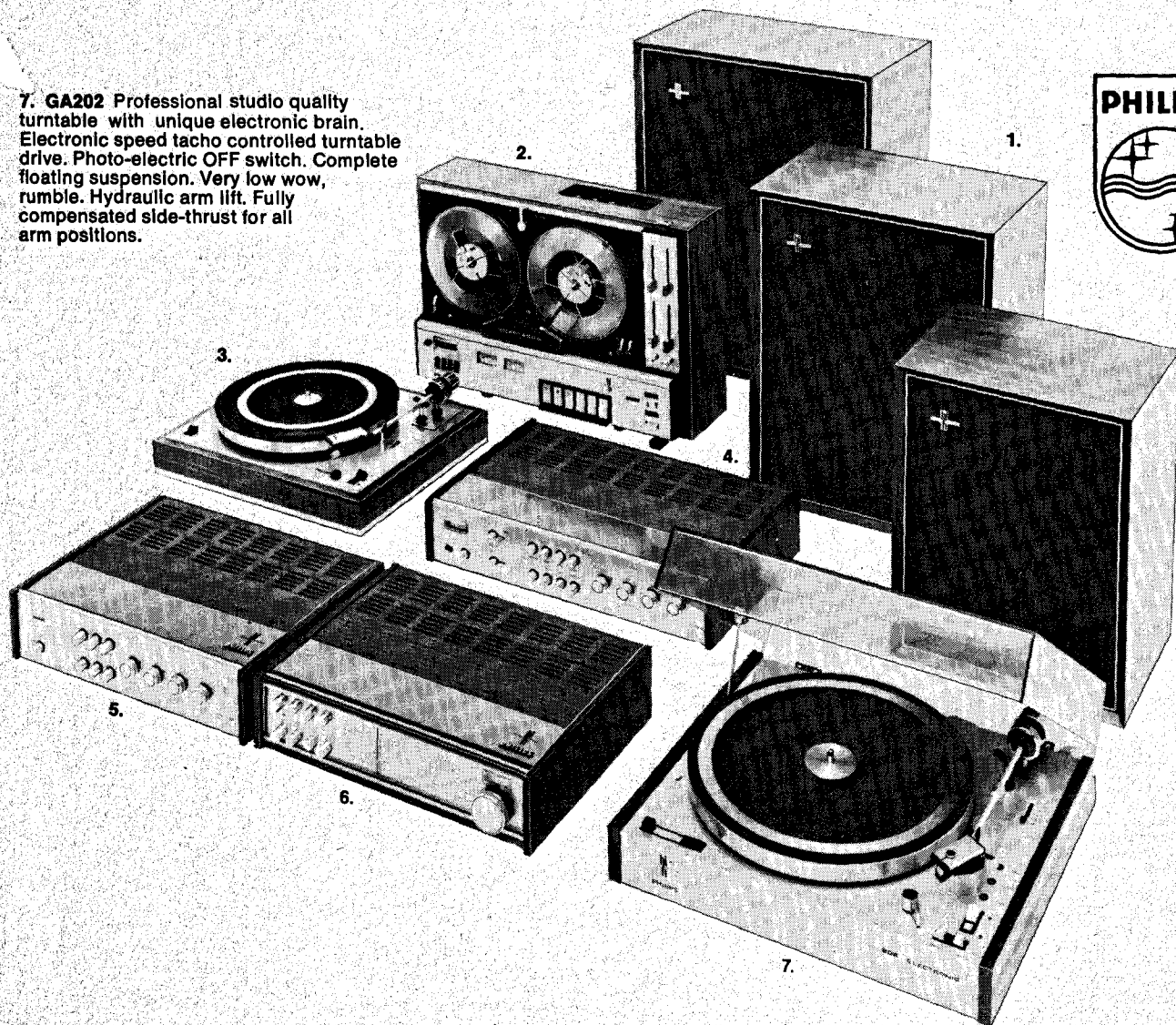
- 1. RH493/496/497/499** Ranging from 15 litre speaker enclosures. 20w R.M.S. with 8" woofer and 1" tweeter; to 74 litre volume/40w R.M.S. fitted with 12" woofer, 4 x 5" mid range, 4 x 1" tweeter. All 8 ohm V.C.
- 2. N4500** 4 track 3 head stereo tape deck. Mixing, du-play, multi-play and echo facilities. Mono/stereo and parallel playback. Before and off-tape monitoring. Sep channel mike controls. Electronic tape position selector. 7½, 3¾, 1½ speeds. High S/N ratio. High stability tape transport. Fast wind/rewind.
- 3. GA308** Hi-Fi turntable unit with tubular tone arm, precise, stylus force adjustment and hydraulic lift. 2 speed, belt drive, slow running synchronous motor. Side thrust compensation. Floating suspension.
- 4. RH591** High powered all silicon transistor stereo amplifier 2 x 20w R.M.S. cont. Frequency response ± 0.5 db 20-20,000 Hz. S/N 90 db. T.H.D. 0.15% (2 x 15 w). Rumble and two stage scratch filters. 2 position contour. All-Input selector.
- 5. RH590** Solid State Stereo Amplifier. Music Power 2 x 15w; 2 x 10w R.M.S. Freq Resp 20-20,000 Hz ± 1.5 db. S/N 80 db. Rumble and scratch filters. Mono/stereo switch. Auto contour control. Separate volume, balance, treble, bass. All-Input selector.
- 6. RH691** Super sensitive tuner. AM/FM Stereo. Switchable AFC. Switchable A.M. band-width. 3 international shortwave bands.

AVAILABLE AT: **N.S.W.**—Allied Music Systems, 210 Clarence Street, SYDNEY. Autel Systems Pty. Ltd., 20 Pittwater Road, GLADESVILLE. Convoy International Pty. Ltd., Cnr. Plunkett & MacLean Streets, WOOLLOOMOOLOO. Magnetic Sound Industries, 387 George Street, SYDNEY; 20 Macquarie Street, PARRAMATTA. Photo Hi-Fi, 367 Pitt Street, SYDNEY. Sheldons of Bondi, 157 Curlew Street, BONDI. W. Waters & Sons, Cnr. Crown & Station Streets, WOLLONGONG. Vista Dist. Pty. Ltd., 78 Roberts Street, WICKHAM (NEWCASTLE). Len Buckley Music Store, 120 Prince Street, GRAFTON. **A.C.T.**—J. B. Young Ltd., Giles Street, KINGSTON. **SOUTH AUSTRALIA**—Radio Rentals Ltd., 77 Rundle Street, ADELAIDE. Challenge Recording Co., 6 Gays Arcade, ADELAIDE. **QUEENSLAND**—Myer Queen Street Store, Queen Street, BRISBANE, and INDOOROOPILLY SHOPPINGTOWN. Packard Bell Pty. Ltd., Queen Street, CITY, and 302 Wickham Street, FORTITUDE VALLEY. Tel Air Sales Pty. Ltd., George Street, CITY, and

INDOOROOPILLY SHOPPINGTOWN. McKinney Radio & Electrical Pty. Ltd., 501-3 Ruthven Street, TOOWOOMBA. Mills Electrical Service & TV Centre, Gondon Street, GLADSTONE. Keers Radio Service, Adelaide Street, MARYBOROUGH. Malvern Star Stores Pty. Ltd., East Street, ROCKHAMPTON. Woolworths 'Big W,' 344 Flinders Street, TOWNSVILLE. Chandlers Pty. Ltd., Lake Street, CAIRNS. **WESTERN AUSTRALIA**—Albert's TV & Hi-Fi Centre Pty. Ltd., 282 Hay Street, EAST PERTH. A. D. Urquhart Pty. Ltd., 65 Market Street, FREMANTLE. Vox Adeon Nicholsons Pty. Ltd., 683 Hay Street, PERTH. Musgroves Limited, 223 Murray Street, PERTH; 280 York Street, ALBANY; Marine Terrace, GERALDTON; 193 Hannan Street, KALGOORLIE; 130 Victoria Street, BUNBURY. **VICTORIA**—Philips Industries Limited, Philips House, 252-262 Sturt Street, STH. MELBOURNE. **TASMANIA**—Philips Industries Limited, 2A Pierce St., MOONAH.

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7. GA202 Professional studio quality turntable with unique electronic brain. Electronic speed tacho controlled turntable drive. Photo-electric OFF switch. Complete floating suspension. Very low wow, rumble. Hydraulic arm lift. Fully compensated side-thrust for all arm positions.



## YOUNG BUT KEEN

I am thirteen and interested in electronics but find your book a little hard to understand as I am only just starting. Do you bring out a book for beginners? — R.J.H., Doveton, Vic.

● No, but we are currently designing a thoroughly practical course for beginners — of all ages. This will commence shortly in **ELECTRONICS TODAY**.

## OBTAINING BACK COPIES

I enjoy reading your new magazine and have so far purchased the July and August issues. Could you please tell me how to obtain the April, May and June issues? — S.H., Maylands, W.A.

● All back copies can be obtained from our subscription dept at 18 Bathurst St., Sydney, 2000. The price of 60 cents each includes postage and packing.

## OMEGA

As a conservationist — I was very disturbed to read in your last issue that the OMEGA installation may be installed in a Tasmanian National Park. However your report quoted the site as the Sinclair National Park, surely this should have read 'St. Clair'? — L.G. Melbourne.

● Our correspondent is correct.

## CLEARANCE SALE

### ELECTRONIC EQUIPMENT AND COMPONENTS

Receivers, transceivers ex-Army & Citizens Band transmitters, test equipment, oscilloscopes, sig. generators, multimeters, chassis racks, panels, computer parts & boards, power transformers up to 6.6KV, valves, transistors, potentiometers, etc., speakers, amplifiers, cables — hook/up & coaxial 50 & 70 ohm, multicore up to 50 core. Panel meters, AVO meters, valve testers and all types of electronic components.

7,000 sq. ft. of electronic gear, plenty of parking come and inspect. Open 10-5 p.m. weekdays, 9.30-12 Saturday. Wanted to buy receivers, transceivers, electronic equipment & components. Top prices paid.

### SPECIAL THIS MONTH

No. 62 transceivers Army type 1.6 to 10M/C 12 Volt operation price **\$39.50**. 50 ohm coaxial cable 1/2" diam. new price **45c** yd.

### HAM RADIO (DISPOSAL BRANCH)

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## MORE THEORY

Your 'Practical Guide To ----' series is excellent, but would it not be possible to include more basic theory? — R.H. St. Ives, NSW.

● See below.

## JUST RIGHT

As an electronics technician may I say how much I appreciate your so aptly named 'Practical Guide to Triacs' and other articles in this series. The articles tell me just what I want to know, no more and no less. In particular I appreciate the way that you slice out all irrelevant theory and mathematics.

What is the engineering background of your staff? — PD. Bankstown, NSW.

● All members of Electronics Today's editorial and projects staff have a background in industrial electronics. The editor is ex-GM Research, our engineering manager has spent many years designing data logging systems, digital instruments etc.

## CAPACITOR DISCHARGE IGNITION

I would like to make a capacitor discharge ignition system for my 1970 Holden V8. Do you intend to publish a CDI circuit in the near future? — W.R. Atherton, Qld.

● Not for some time. It is essential to use a capacitor specifically intended for CDI use and such capacitors are not generally available in Australia at the present time.

The problem is that the capacitor in a CDI system is discharged through what is virtually a dead short, and standard capacitors will not withstand this treatment for any length of time.

We have tested several commercially built CDI systems that were supplied with standard capacitors and all failed in less than a few months.

Frankly, there is very little to be gained by fitting a CDI system to an average production engine that is in good condition. Starting may be a little easier in very cold conditions but you are unlikely to gain anything more.

We will continue to look into this one, but we have no intention of publishing a CDI project unless the resulting unit is at least as reliable as the existing systems.

## DUAL POWER SUPPLY

There is a drawing error in the circuit published on page 72 of our November issue.

Diodes D3 and D4 have been shown with reversed polarity. The photograph of the diodes mounted on top of the filter capacitors — shown on page 75 — is correct.

## CLEAN TAPE

I am replacing the leaders of my recorded cassettes with sections of head cleaning tape cut from a head cleaning cassette. Now, everytime I play a cassette the heads are cleaned both before and after the recording.

The new leaders have been made slightly longer than before so that head cleaning will be more effective.

Would it be possible for tape cassette manufacturers to incorporate this simple and effective technique on all new tapes? — I.C.L. 9th Sqd. Vietnam.

● Any comments?

## THE 51% MINORITY

May I say how much I appreciated your editorial last month. Recently, an engineering company in Sydney advertised that it would accept girls as apprentices — and then expressed great surprise when there were no takers.

But at least your magazine understood why. — D.V. Adelaide, SA.

## PEASANTS!

I have recently installed a radio in my Jaguar XK6 — despite most careful attention to suppressing every possible source of interference I am still plagued by extraneous radio noises — oddly enough the problem is only apparent at night.

My garage have no further ideas — any suggestions? — G.R. Waverley, NSW.

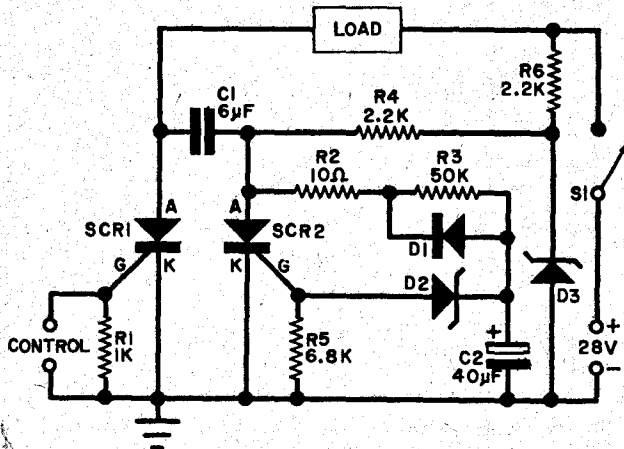
● Your problem is almost certainly caused by the quartz halogen lights fitted to that model Jaguar. The halogen regenerative cycle is prone to cause rfi — try wiring 0.1 $\mu$ F capacitors across the headlamp leads and as close to the lamps as possible.

If this fails its probably just the local peasants scratching at the windows.



# TECH-TIPS

## PULSE TIMER

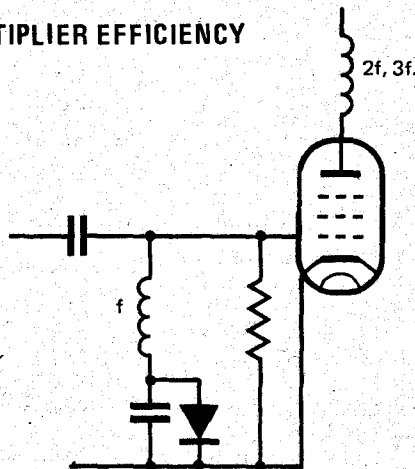


Originally developed by the Unitrode Corporation, this circuit will supply up to four Amps for a period of one second when triggered by an external positive going pulse. The timing cycle is initiated by applying a positive going pulse of a voltage exceeding SCR1's gate voltage. This causes SCR1 to lock on and apply power to the load. In the meantime SCR2 is switched off by the commutating action of C1 and timing capacitor C2 is charged via R2, R3 and R4 and the constant voltage source D3 and R6.

When C2's charge voltage exceeds the rating of Zener diode D2 by an amount sufficient to exceed the gate voltage of SCR2, this SCR conducts, discharging both C1 and C2 and thus switching SCR1 back into its former non-conducting state.

Zener diode D2 should be rated at 6.8 Volts, and Zener D3 at 18 Volts.

## IMPROVE MULTIPLIER EFFICIENCY



A cheap silicon diode may be used to improve the efficiency of a frequency multiplier.

The diode should be rated to carry the peak grid current of the multiplier stage.

# CAREER OPPORTUNITIES

**EMPLOYERS — Seeking Staff? Electronics Today is read by the very people you seek! (and our copy deadline is only 10 days). Managers, Engineers, Technicians, Draughtsmen, Salesmen, etc. • You already have a good job but seek a better one. Here they are.**

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(DATA ELECTRONICS)

Our Field Engineering Department requires a Technician who will ideally have certificate level qualifications in electronics and who has had considerable practical experience in data techniques. Excellent conditions. Apply Staff Office,

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## SOUND ENGINEERS

GOVERNMENT STORES DEPARTMENT

**ELECTRONIC TECHNICIANS, PROJECTOR TECHNICIANS AND RADIO & TELEVISION TECHNICIANS** required for vacancies for Sound Engineers, Radio and Motion Picture Branch, Sydney.

**Salary:** \$4278 range \$5073 depending on qualifications, experience and subsequent service.

**Duties:** Checking and servicing of Radio and Television Equipment, Sound Equipment, Tape Recorders, 16mm and 35mm Sound-on-Film Projection Equipment and other forms of projectors.

**Qualifications:** Intermediate Certificate and completion of some recognised technical training in electronics. Experience in fitting and/or turning and TV/Radio servicing an advantage. Driver's licence essential.

**Applications:** Staff Officer, Government Stores Department, 144 Gloucester Street, Sydney, closing 12th November, 1971. Enquiries — Mr. Kroehnert, telephone 67-0331.

## ELECTRONIC TECHNICIAN

A vacancy has occurred in our Intercom Service Section for a Technician with several years' experience in design and maintenance of solid state switching circuitry.

Experience in Xbar equipment is a distinct advantage. He should be mature and be able to work unsupervised and quickly adjust himself to troubleshooting on different types of electronic Communication Equipment. Applicant should be between 20 and 40 years old and hold a N.S.W. Driver's Licence.

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Our Company will be moving to North Ryde early in 1972.

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Further information can be obtained by telephoning or writing to:—

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P.O. Box 202 MASCOT 2020. Telephone 67-0533.

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### Sutherland Area

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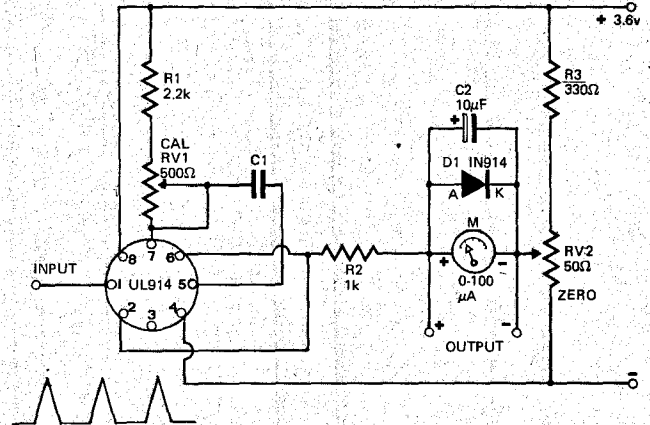
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# TECH-TIPS

## FREQUENCY TO VOLTAGE CONVERTER

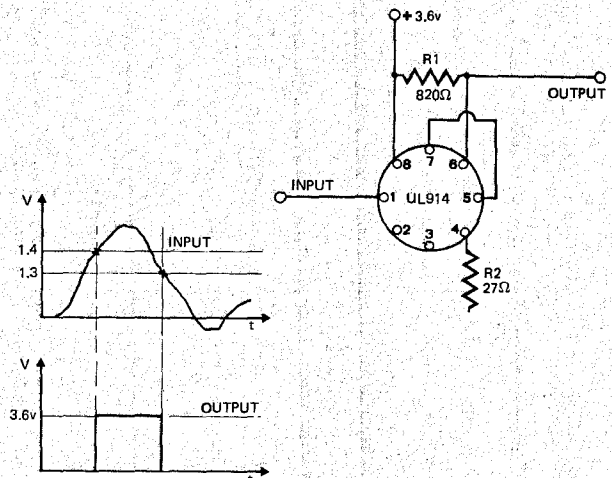


This circuit may be used as a pulse counter, tachometer, or if preceded by a Schmitt trigger, an analogue frequency meter.

Output linearity better than 2% can be obtained with duty cycles of less than 30%. The meter is selected so that it reads full scale when the duty cycle of the uL 914 is 30%. The choice of C1 and the meter sensitivity determines the range of measurement.

Potentiometer RV1 is used to calibrate the meter to full scale deflection, and resistor R2 counteracts the slight zero offset of the saturated IC. Diode D1 protects the meter.

## SIMPLE SCHMITT TRIGGER



One cheap IC, uL914, can be used as an extremely simple and effective Schmitt trigger suitable for many applications. Hysteresis of the circuit is about 0.1 Volt. This may be varied by altering the values of R1 and R2.

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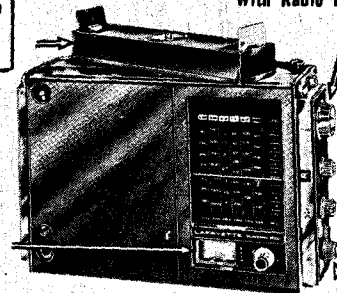
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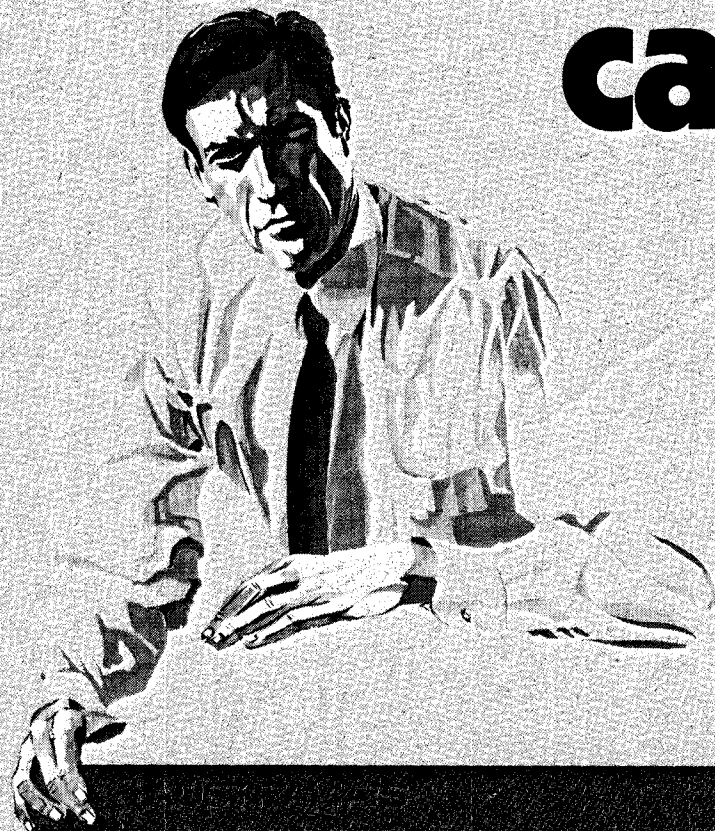
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