

AUGUST 1973  
50c\*

# electronics

**HI-FI**

**TODAY**  
INTERNATIONAL

REGISTERED FOR POSTING AS A PERIODICAL - CATEGORY C

*Johnson*



**SCOOP TESTS:**

**BEGRAM 4000**

**SHURE V15 MKIII CARTRIDGE**

**HORN LOADED SPEAKERS**

**RADIATION DANGERS**

# TEAC

If you'd like to know more  
write to us for the TEAC Catalogue,  
price list and franchised dealer list.

Sole Australian Distributors:  
Australian Musical Industries Pty. Ltd.,  
155 Gladstone Street, South Melbourne, Vic. 3205.  
Phone: 69 5888 Telex: AA 33037  
619 Pacific Highway, St. Leonards, N.S.W. 2065.  
Phone: 439 6966

The sound of perfection



Oceanic Distributors: New Zealand; Direct Imports (N.Z) Ltd., 590W Southampton St., Hastings. Phone: 89-184. Fiji: D. Jeevan & Sons, 87 Cumming St.,  
Box 148, Suva. Phone: 22710. New Guinea, Paul Mow & Co., Box 419, Port Moresby. Phone: 2953.

# electronics TODAY INTERNATIONAL

AUGUST 1973

Vol. 3 No. 5

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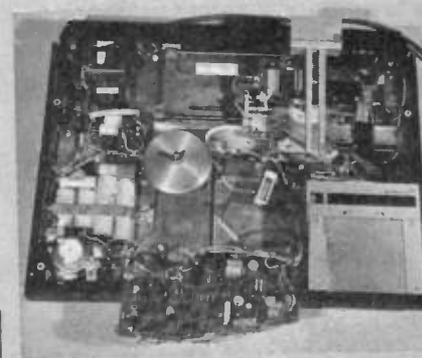
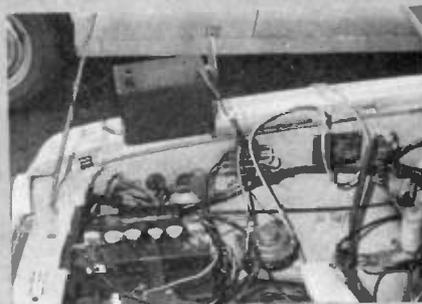
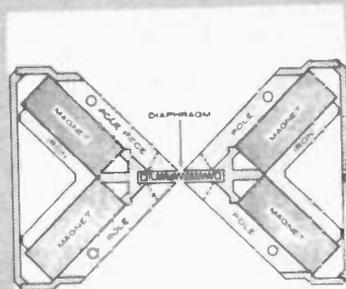
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Published by MODERN MAGAZINES (HOLDINGS) LIMITED, 15 Boundary Street, Rushcutters Bay 2011. Phone: 33 4282. Cables: MODMAGS SYDNEY. Managing director: Jules Feldman. Advertising director: Max Press. INTERSTATE advertising — Melbourne: Claire Levy, Suite 23, 553 St. Kilda Rd. (51-9836). Adelaide: W.J. Parkerson, A.C.P., 24 Halifax St. (8-4121). Brisbane: David Wood, Arday Agency, 11-14 Buchanan St. West End (44-3485) OVERSEAS — United Kingdom: A.C.P., 107 Fleet St. London EC4, U.S.A.: A.C.P., Room 401, 1501 Broadway, New York. Printed by Compress Printing Ltd., O'Riordan St., Alexandria. Distributors: Australian Consolidated Press. [\* Recommended and max mum price only.] COPYRIGHT.

COVER: Brilliant combination of modern art and engineering design is this Beogram 4000 turntable from Denmark's Bang and Olufsen (scoop review of this machine — page 66 onwards).

ISSN 0013-5216

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

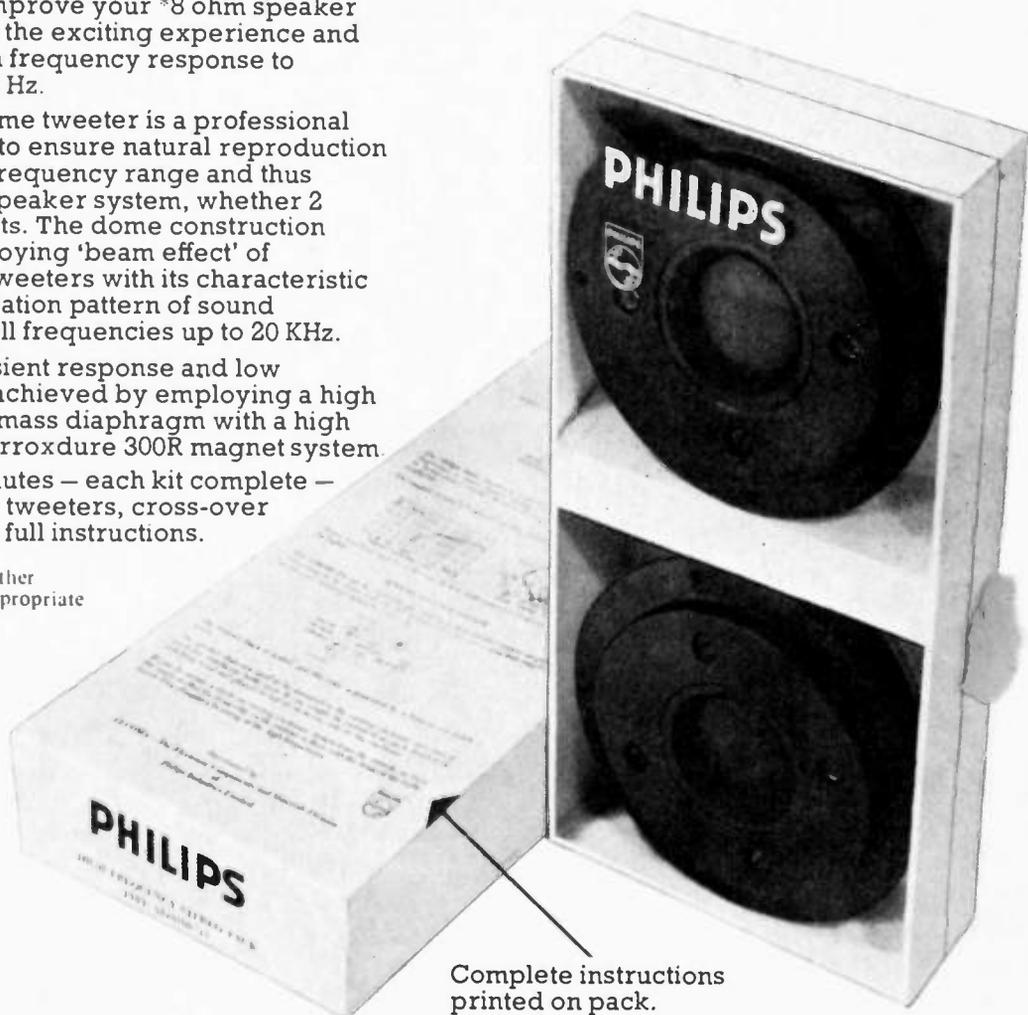
For a modest expenditure you can now significantly improve your \*8 ohm speaker system to give the exciting experience and 'presence' of a frequency response to beyond 20,000 Hz.

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

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

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

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



Complete instructions printed on pack.

## PHILIPS

For full information, specifications, etc., contact:

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ELECTRONIC COMPONENTS AND MATERIALS  
Sydney, Melbourne, Brisbane, Adelaide, Perth

153-14

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107 Fleet St., London, E.C. 4.  
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# Why sell yourself short

PERHAPS more so than with most other manufactured products, there is a fairly well defined price level below which it is not possible to purchase acceptable hi-fi.

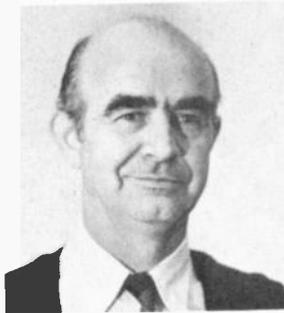
At present this price – for a complete system – is slightly under \$300.

Yet many prospective purchasers set themselves an arbitrary limit below that figure – and as a result are inevitably disappointed.

Three hundred dollars will buy you the audio equivalent of a Mini-Minor, five hundred – a Holden. Six to seven hundred dollars puts you into the Volvo/Rover class, and a thousand plus puts you up with the Mercedes and BMW.

The difference in cost between poor quality sound and good hi-fi is often less than a hundred dollars. Over a five-year period this is less than a couple of cents a day.

So why sell yourself short?



THIS month, we extend a welcome to Michel Calluud who has joined our staff as full-time Consultant Editor.

Originally from France, Michel has enjoyed a long and distinguished career in the Australian electronics industry.

With design and manufacturing experience ranging from aircraft to electronic organs, Michel has extensive knowledge of electronic engineering, both professionally, and as a hobbyist.

From 1969, until joining Electronics Today International, Michel was Chief Engineer, and subsequently Projects Engineering Manager of Natronics Pty. Ltd., where he was responsible for a wide range of advanced electronic equipment and systems. These included the world's solid-state taximeter, a range of digital instrumentation, complex data logging systems, and, shortly before leaving the company, the design and implementation of a massive computer control system for Comalco's aluminium reduction plant at Bell Bay, Tasmania.

Michel is currently working on a number of specialised projects details of which we will announce in future issues.

*Collyn Rivers*



nothing takes care of your records like your own hands...



that's why

# Connoisseur

doesn't make an auto turntable!



**BD2  
WITH  
SPEED  
CHANGE**

Even the best automatic turntable can't take care of your precious records as you do yourself. And Connoisseur recognises this. Authoritative English magazine, "The Gramophone" said: "The BD2 cannot be faulted. Its performance is superlative, and compares most favorably with units costing many times its price."

The world famous Connoisseur BD2 integrated transcription unit lays a great foundation for top stereo sound. It incorporates the SAU2 high precision tone arm, inbuilt

hydraulic cueing control placed conveniently at the front edge of the baseplate, and stop/start switch. It is powered by a 14 pole synchronous motor driving a precision-ground rubber belt, and can be supplied ready to install, or complete with base and acrylic cover. Connoisseur BD1 turntable, built to the same "no compromise" specifications as the BD2, comes without tone arm and is fitted with a smaller mounting plate to permit installation of any type of arm. It is available ready to play, or in easily assembled kit form at lower cost.

*Available from:*

- N.S.W.** M & G Hoskins Pty. Ltd., 37 Castle St., Blakehurst 2221  
Telephone: 54 1464
- Q'LD** Stereo Supplies, 95 Turbot St., Brisbane 4000  
Telephone: 21 3623
- S.A.** Challenge Hi-Fi Stereo, 96 Pirie Street, Adelaide 5000  
Telephone: 23 3599
- TAS** Audio Services, 72 Wilson St., Burnie 7320  
Telephone: 31 2300
- VIC** Encel Electronics Pty. Ltd., 431 Bridge Rd., Richmond 3121  
Telephone: 42 3762
- W.A.** Albert TV & Hi-Fi, 282 Hay St., Perth 6000  
Telephone: 21 5004

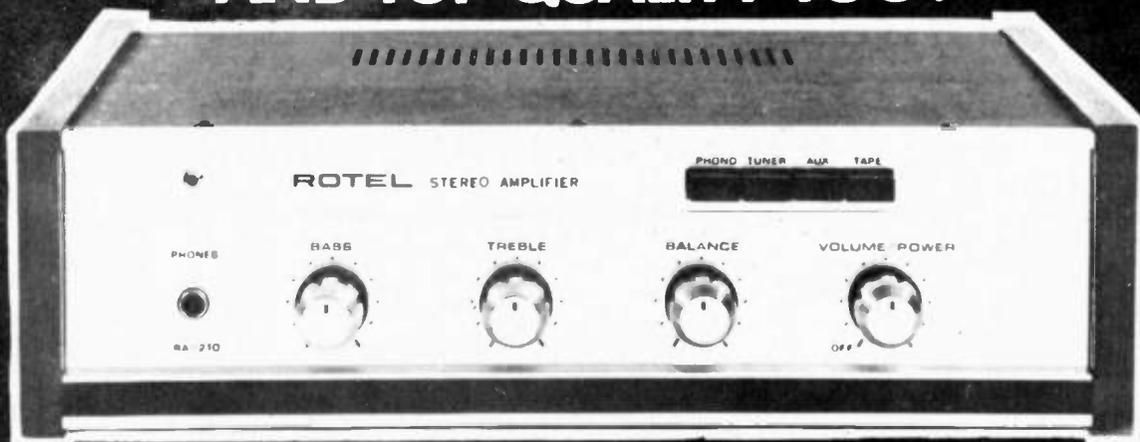
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**INTERNATIONAL DYNAMICS**  
(AGENCIES) PTY. LTD  
P.O. BOX 205, CHELTENHAM, VIC. 3192

**INTERDYN**

# BIG NAME

**SMALL PRICE (UNDER \$100)  
AND TOP QUALITY TOO!**



## ROTEL® 210

Australian Hi-Fi said "It is a delight to report on the Rotel 210 which impressed us no end for quality and performance. It is stylish, well-constructed and performs more than adequately".

The 210 is a solid state 20 transistor, 30 watt pre-main amplifier with tape recorder output. 8 watts

RMS channel at 8 ohms. Harmonic distortion less than 0.5% at rated output. As "Australian Hi-Fi" said, "Rotel 210 gives an effortless clean sound". If you want to hear performance regardless of figures, hear the best value for money amplifier ever to hit the Australian market —Rotel 210!

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- Q'LD Stereo Supplies, 95 Turbot St., Brisbane 4000  
Telephone: 21 3623
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INTERNATIONAL DYNAMICS (AGENCIES) PTY. LTD.,  
P.O. BOX 205, CHELTENHAM, VIC. 3192

# AMCROn DC-300/A

*“they’ve done it again!”*



Say farewell to the grand old DC300, and welcome to THE PROBLEM SOLVER, the amp that is going to make your job easier and your customers happier. The original model DC300 was a great amp — the first super-power low distortion amp in the world, when Amcron introduced it five years ago.

Meanwhile, top sound systems designers have used it successfully in hundreds of demanding situations, and made some excellent recommendations for improvements. The response of the Amcron design team was *not* an updated DC300, but a totally *new* and different amplifier, the DC300A. It is the *only* high power low distortion amp specifically *designed* for commercial sound applications. *[CAUTION: There are some large consumer-type amps attempting to sell in the commercial sound field without providing adequate continuous power for all load impedances.]*

#### Power You Can Count On

One of the DC300A's most outstanding features is that it had *double* the number of output transistors. This means effectively twice the muscle of the old DC300 — at the same price. Each channel has eight 150-watt devices for 1200 watts of power dissipation *per channel*. The DC300A is rated at 150 watts per channel continuous into 8 ohms with both channels driven, 300 w/ch into 4 ohms or 500 w/ch into 2.5 ohms.

#### Two Amplifiers in One

As a dual-channel amplifier with separate level controls and circuitry for each channel, the DC300A is almost *two* amplifiers in one. This gives you additional flexibility in controlling your speaker load, as when driving separate front and back speaker systems in a large auditorium, or when bi-amping a system. For 600 watts continuous output at 8 ohms, the DC300A converts to a mono amp with two plug-in parts. This makes it possible to drive a 70-volt line directly without a matching transformer.

#### Superior Output Protection

The DC300A output protection circuitry is a radically new design which completely eliminates DC fuses and mode switches and further reduces service problems to the negligible level. It is superior in every way to the old VI-limiting circuit pioneered by Amcron and now used by most other high power amplifiers, since it introduces *no* flyback pulses, spikes or thumps into the output signal, whether operating as a single- or dual-channel amp.

Gone too is the need to baby the amp by carefully juggling load configurations. The Problem Solver can drive *any* speaker load — resistive or even totally reactive — with *no* protection spikes! Parallel speakers with no deterioration of sound quality, since changing the load impedance only affects the maximum power available, not the ability of the amp to keep on producing clean sound.

#### Lowest Distortion and Noise

Also new is the DC300A's IC front end, which sets new world's records for low distortion and noise. At the 8-ohm rated output, IM and harmonic distortion is less than 0.05% full spectrum; hum and noise is 110db below.

Servicing — if ever necessary — is a snap, since removing the front panel accesses the entire circuitry.

Although it is completely redesigned model, the DC300A has inherited some characteristics from its predecessor.

**PRICE** \$795.00 less than the DC300 sold for.

**WARRANTY** — three years, covering all costs of parts labor and round-trip shipping.

**COOLING** — excellent heat dissipation provided by massive cooling fins and the entire chassis itself.

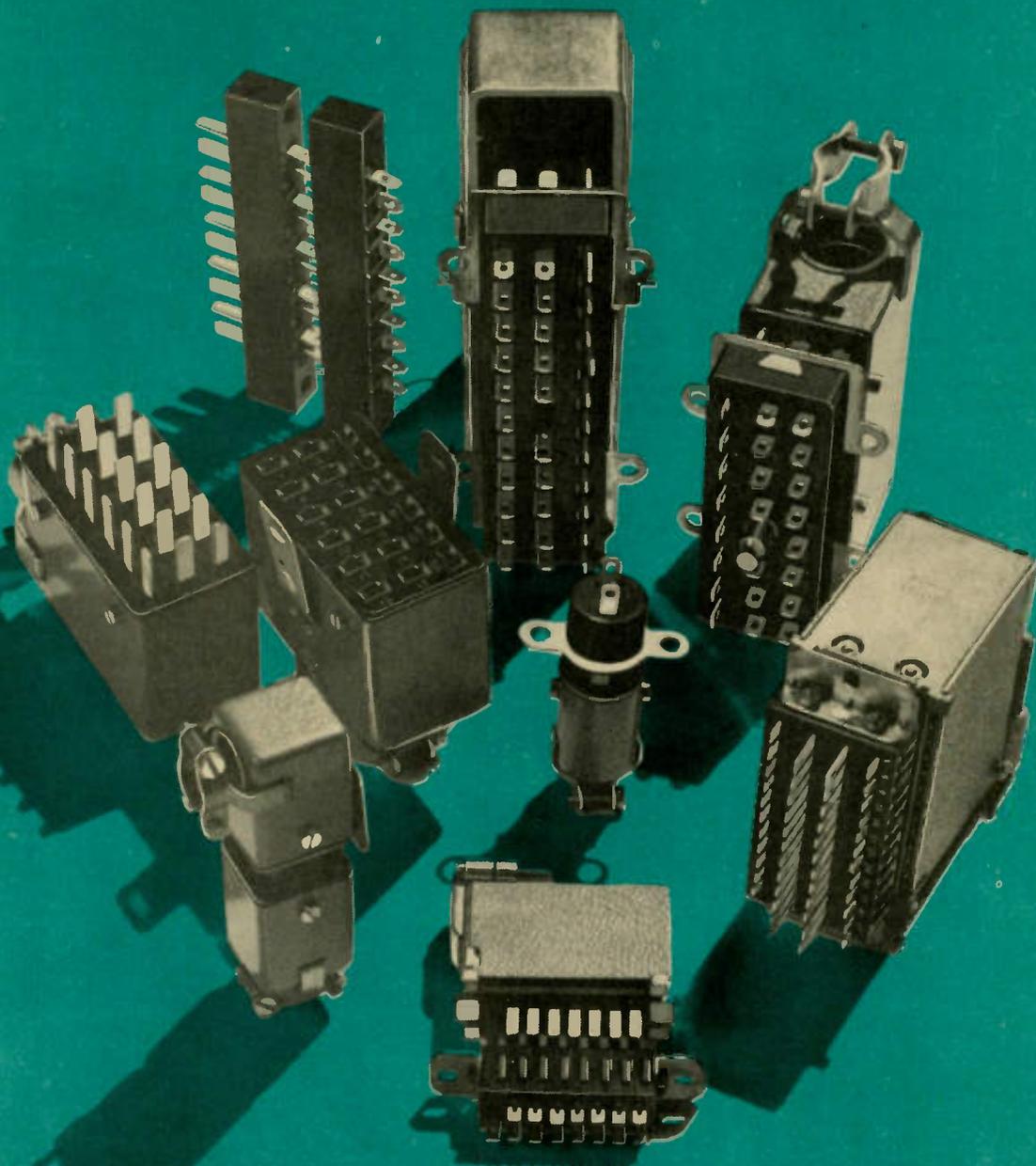
**DEPENDABILITY** — stringent pre- and post inspection and testing proves every electronic component, every circuit module and every finished unit, to bring you one step closer to install-and-forget field dependability.

**PEOPLE** — the same innovative design team and careful craftsmen who made the DC300 such a sound success. And the same knowledgeable customer-service men ready to discuss your special application and send you detailed technical data.

 **AMCROn**

#### AUSTRALIAN DISTRIBUTORS:

B.J.D. Electronics Pty. Ltd. 190 Willoughby Road, Crows Nest, 2065 N.S.W. Ph. 439-4201.  
202 Pelham St., Carlton, 3053 Vic. Ph. 347-8255



## Painton have the right connections.

Painton is the keyword for maximum space saving, reliability and quality proven multi-circuit connectors. Whether male or female, covered or uncovered side or top cable entry, with or without locks they all have the right connections... in fact a simple method of polarisation makes incorrect connection impossible.

**The 159 Series** is B.P.O. approved to PD203 and is available with from 7 to 71 poles. The series offers smaller physical size for any given contact combination. Contacts are of brass, gold flashed on silver plate as standard. Connectors fitted with hard gold plated contacts to A.P.O.

specification are available on request. The 159 Series offers a high standard of electrical performance with the added features of robust cable clamp design and optional retainer, providing a flat, strong and sturdily locked mating unit.

**The Multicon range** is quality approved to OEF-5321; is available in combinations with from 2 to 33 poles and offers many improved features compared with types of similar construction. Contacts are heavily silver plated to ensure maximum contact efficiency. Split limb clips provide four individual areas of contact with each plug blade. Other features include moulded terminal numbering and moulded

distance pips to avoid moisture build up between mated plug and socket which is instrumental in superior tropical performance.

**The heavy duty Multicon range** is basic to the Multicon range, and is designed to withstand extreme mechanical environmental conditions. Available in 7 contact combinations from 4 to 33 poles, the range incorporates the same mouldings, contacts and electrical specifications as the Multicon range. A standardised range is available ex stock. Literature is available on request to the Professional Components Division.

## PLESSEY

**Plessey Ducon Pty. Limited**  
Box 2 PO Villawood NSW 2163  
Telephone 72 0133 Telex 20384

**Melb:** Zephyr Products Pty. Ltd.  
56 7231  
**Adel:** K. D. Fisher & Co.  
42 2920  
**Bris:** Douglas Electronics Pty. Ltd.  
62 1899  
**Perth:** H. J. McQuillan Pty. Ltd.  
68 7111  
Everett Agency Pty. Ltd.  
8 4137

Henderson (N.Z.) 64 189

# INSTROL

# NEW LOWER A.D.C. PRICES

## ADC STEREO CARTRIDGES — AMERICA'S QUALITY CARTRIDGE

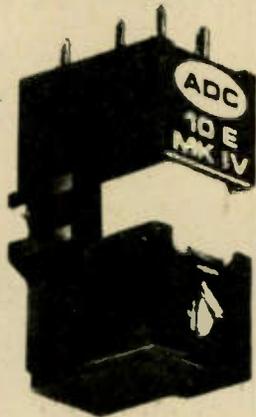
### ADC 220X . . . \$15.00

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



### ADC 220XE . . . \$18.00

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



### ADC 10E mk4 . . . \$45.00

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

### ADC 500XE . . . \$27.00

ADC 500XE. Type: Induced Magnet; Output: 5 mV at 5.5 cms / sec. recorded velocity; Tracking Force: ¾ to 2 grams; Frequency Response: 10 Hz to 20 kHz ± 2 dB; Channel Separation: 20 dB from 50 Hz to 12 kHz; Compliance: 35 x 10<sup>-6</sup> cms / dyne; Elliptical Stylus Tip Radii: Contact radius .0003". Lateral radius .0007"; Vertical Tracking Angle: 15°.



OTHER MODELS: ADC 25 — \$110.00; ADC 26 — \$75.00; ADC XLM — \$70.00; ADC VLM — \$56.00

### J.H. Turntable (complete) . . . Save \$\$\$\$



ALL THE ABOVE FOR ONLY

This outstanding turntable value consists of:—

(A) J.H. TURNTABLE

Belt drive, synchronous motor, unmeasurably small rumble, wow and flutter of better than 0.04%, negligible hum radiation, with 12" diameter of platten.

(B) EXCEL ES 801 ARM

Oil-damped cueing device; fully calibrated stylus pressure adjustments; adjustable bias compensation; universal headshell.

(C) A.D.C. 220X

Magnetic cartridge. Tracking force 1½ to 3 grams, extremely linear and smooth frequency response.

(D) INSTROL 44 STAND PLUS HINGED 'PERSPEX' COVER

This acoustically sprung player stand is available in either oiled teak or walnut, complete with moulded perspex cover and "stay-up" hinges.

**\$105.00**

(fully assembled & packaged)

### COMPLETE FULL-COLOUR HI-FI CATALOGUE AND PRICE LIST . . . ONLY 50c

Contains full specifications, gloss colour illustrations and special Instrol discount pricing on the following items—:

Turntables, cartridges and styli, Amplifiers, Amplifier kits and Dynakits, Speaker system, Speaker kits, Speaker enclosures, Tuners, Four channel equipment, Tape decks and recorders, Dolby cassette decks, Record Storage cabinets and kits, Equipment Cabinets (Built and Kits) for hi-fi, Hi-Fi accessories, Guitar amplifiers and guitar speaker systems (Built and kits), Instrol products, etc.

Please send me your complete hi-fi catalogue and price list. I enclose herewith postage stamps or money order to the value of 50c. I understand that the 50c will be refunded on my first purchase.

NAME .....

ADDRESS .....

..... P.C. ....

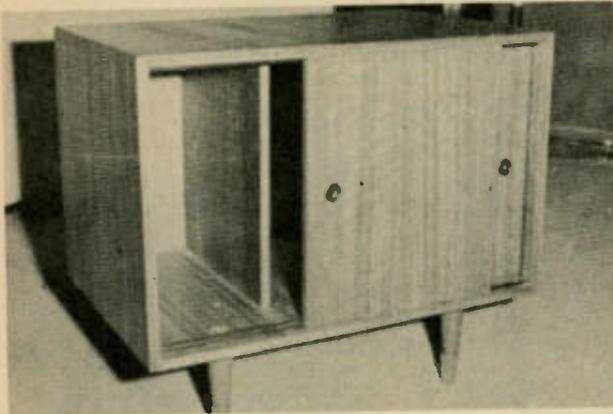
T308

# INSTROL

# RECORD STORAGE CABINETS

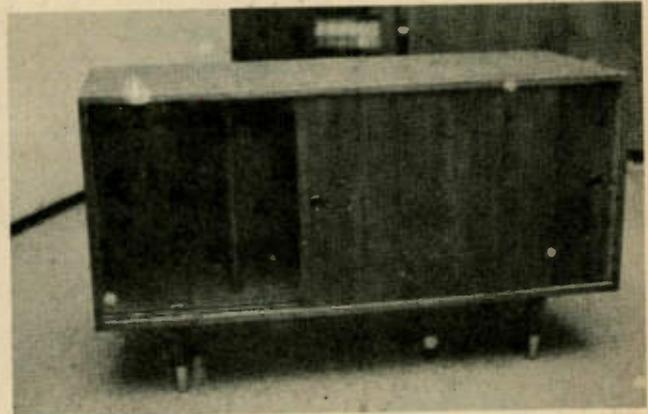
*Now available in pre-cut kits*

The Instrol range of record storage cabinets has the warmth and fashion appeal you expect of something which is to be part of your home. All veneered timbered panels are of the very best quality, both with the built and polished cabinets or with the pre-cut kits. Kits are absolutely complete in every detail, including detailed instructions.



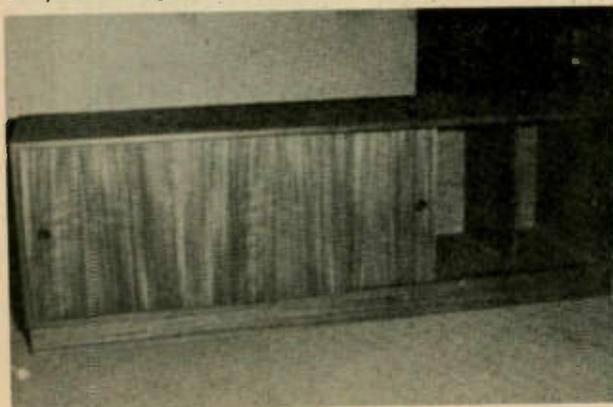
**MODEL RS No. 1**

A neat general purpose unit, designed to carry between 80 and 100 records, it measures 23 $\frac{3}{4}$ " x 14" (high) x 14 $\frac{1}{2}$ " (deep). Kit price is \$29.50 (teak or walnut veneer). Normally comes with base, but 4 $\frac{1}{2}$ " legs optional.



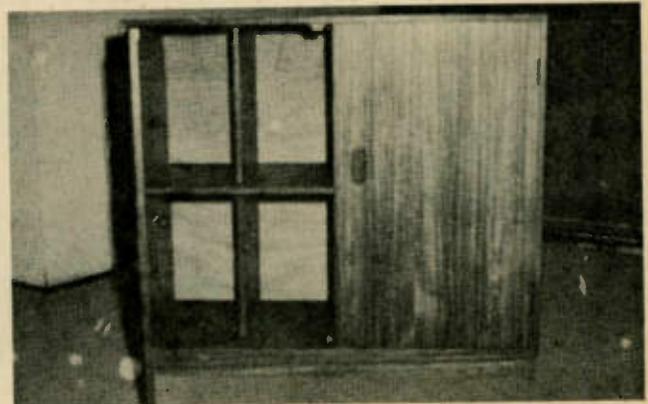
**MODEL RS No. 2**

A larger unit measuring 35 $\frac{1}{2}$ " x 14" (high) x 15 $\frac{1}{4}$ " (deep), the kit is priced at \$45.00 (teak or walnut veneer). Normally comes with base, but 4 $\frac{1}{2}$ " legs optional.



**MODEL RS No. 3**

This model measures 51 $\frac{1}{4}$ " x 14" (high) x 15 $\frac{1}{4}$ " (deep) and is priced at \$49.50 (teak or walnut kits). Normally comes with base, but 4 $\frac{1}{2}$ " legs optional.



**MODEL RS No. 4**

This attractive model is aesthetically styled with full height opening doors and recessed handles cut from solid teak. With two record storage shelves, one on top of the other, and ample vertical dividers, the unit measures 35 $\frac{1}{2}$ " x 31 $\frac{1}{2}$ " (high) x 16" (deep). Kit price is \$65.00 (teak or walnut veneer).

# INSTROL

## HI-FI ELECTRONICS CENTRE

91A YORK ST., (between King & Market Sts.),  
SYDNEY, N.S.W. 2000. Phone 29 4258

Please send me the following record cabinets or turntable system. These will be sent by road transport or passenger rail, freight payable on receipt of goods. (Cartridges will be sent freight free).

..... at \$ .....

..... at \$ .....

..... at \$ .....

I enclose my money order/cheque for \$ .....

NAME .....

ADDRESS .....

..... P.C. ....

T308

# HIS HEARING IS BETTER THAN YOURS

*THAT'S WHY HE CHOSE*

# KOSS

The stereo headphone for  
the professional — now also  
available to you!

Be impressed, hear Koss headphones  
at the following Hi-Fi retailers . . .



**ESP-9**



**PRO-4AA**



**KRD-711**

## **N.S.W.**

**Autel Systems**  
20 Pittwater Road,  
Gladesville,  
89-0663.

**Audio Engineers**  
342 Kent Street,  
Sydney,  
29-6731.

**Magnetic Sound**  
387 George St., Sydney. 29-3371  
20 Macquarie St., Parramatta. 635-0830  
331 Princes Highway, St. Peters.  
519-5284

**Mastertone Electronics P/L.**  
824 Pittwater Road,  
Dee Why,  
982-2384.

## **VIC.**

**Douglas Trading**  
185-191 Bourke Street,  
Melbourne.  
63-9321.

## **W.A.**

**Alberts TV & Hi Fi Centre**  
282 Hay Street, Perth,  
21-5004.

## **QLD.**

**Brisbane Agencies Audio Centre,**  
72 Wickham Street,  
Valley — 2-6931.

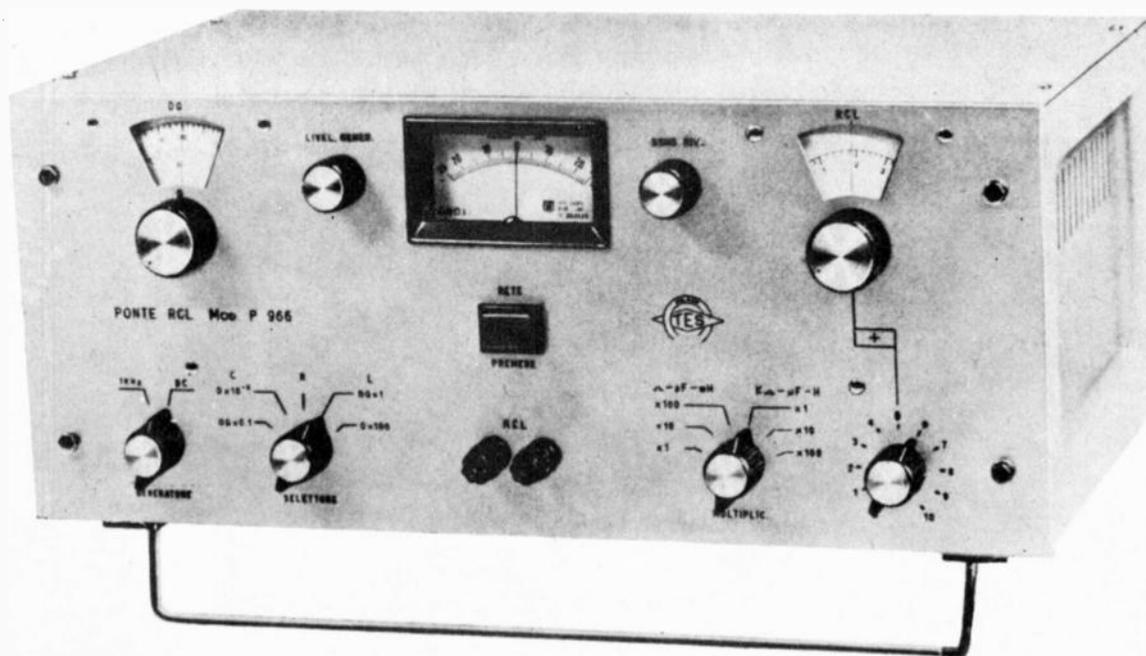
# Measure

- Inductance and storage factor, Q, of inductors
- Capacitance and dissipation factor, D, of capacitors
- DC resistance of all types of resistors

with Type P966 Technica Electronica

# Impedance Bridge

... as well as measuring the circuit constants in experimental equipment, testing preliminary samples and identifying unlabelled parts.



**SPECIFICATIONS:** Resistance: from 0.1 ohm to 11 Megohms  
• Capacitance: from 1 pF to 1100  $\mu$ F  
• Inductance: from 10  $\mu$ H to 1100 H  
• D: from  $1 \cdot 10^{-3}$  to 50 • Q: from 0.02 to 1000 • Frequency: 1 Kc/s supplied internally, accuracy  $\pm 5\%$  • R accuracy:

better than  $\pm 1\%$  from 1 ohm to 11 Megohms  
• C accuracy: better than  $\pm 1\%$   
• L accuracy: better than  $\pm 2\%$  • Q and D: better than  $\pm 20\%$  • Semiconductors: No. 17  
• Power supply: 220 V 50 c/s • Dimensions: 40 x 16 x 23.5 cm • Weight: 8 Kg

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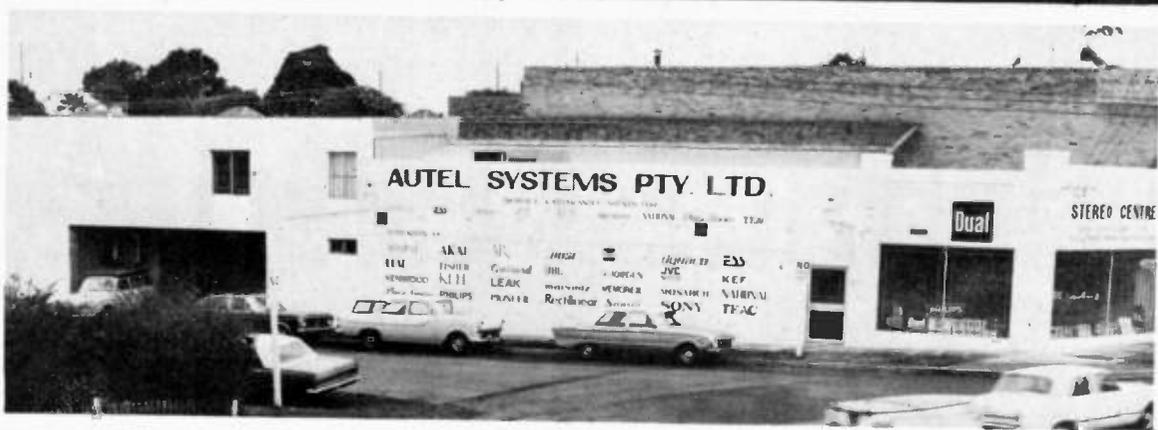
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# AUTEL SYSTEMS PTY LTD

## NORTH SHORE SUPER SOUND CENTRE



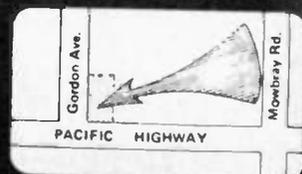
### AUSTRALIA'S LARGEST MAIL ORDER SECTION

Ask for our quotation to send equipment anywhere in Australia at our competitive prices. All new equipment with full manufacturers guarantees that we can back up ourselves.



Want a lead to suit your set to match that accessory? Want any type of plug? Also, complete stocks of spare parts for National, Nivico, Teac, Jorgen, ESS, Marantz, and many others. Largest range of equivalent parts to suit those hard-to-get spare parts for rare models.

**AUTEL SYSTEMS PTY LTD**  
639 Pacific Highway, Chatswood



# AUTEL SYSTEMS PTY LTD



No where in Australia have you the choice to buy everything you want without being forced to buy the particular brand the shop specializes in and at the best prices. Come and Compare all the brands to chose what really is the best.



## REASONS FOR BUYING FROM AUTEL

- top quality equipment at competitive prices
- free delivery and connections in Sydney metropolitan area
- Full installation for complete systems — ask for our quotation
- under guarantee service and full workshop facilities
- credit sale and terms arranged
- We are audio experts, so trust us
- We have expanded to give better service, to give you a better purchase

—PARKING IN SIDE STREET & REAR

# BUY STATE OF THE ART SOLID STATE COMPONENTS— Direct from the United States!

All listed prices are in Australian dollars, International Postal Money Orders (please send PO receipt with order for immediate shipment). Banque Chasiere check (preferably in US funds) and rated company cheques (with foreign exchange stamp approval affixed) will be accepted. Due to recent Australian government restrictions we are not able to clear personal checks... All goods are new unused surplus and are fully guaranteed. Orders will be shipped within two workdays of receipt of same. All customs forms will be attached. Minimum order amount is \$5.00, do not add postage — we pay postage. Surface mail for orders under \$10.00 and Air Mail for orders over this amount.

**DATA SHEETS ARE PROVIDED FOR EACH ITEM PURCHASED**

## DIGITAL INTEGRATED CIRCUITS (dual in line package)

|   |        |
|---|--------|
| Signetic TTL (5 volt operation)         |        |
| 8440 Dual 2/2 and or invert gate        | \$0.35 |
| 8455 Dual 4 input buffer                | 0.40   |
| 8480 Quad 2 input NAND gate             | 0.40   |
| 8H16 Dual 4 input NAND (high speed)     | 0.35   |
| 8H70 Triple 3 input NAND (HS)           | 0.35   |
| 8H80 Quad 2 input NAND (HS)             | 0.35   |
| 8H90 Hex inverter (HS)                  | 0.35   |
| 8H21 Dual JK flip flop (HS 60 MC)       | 1.10   |
| 8290 Decade counter (HS 60 MC)          | 3.15   |
| 8292 Decade counter (low power)         | 0.90   |
| 8251 BCD to decimal decoder             | 1.75   |
| 7480 Gated full adder                   | 0.50   |
| 7413 Dual 4 input NAND Schmidt triggers | 1.75   |
| 74181 Arithmetic logic unit             | 3.50   |
| 8260 Arithmetic logic unit              | 3.15   |
| 8261 Fast carry for above               | 1.35   |

Send for free brochure listing hundreds of bargains.

## Signetic DTL (5 volt operation) dual in line

|                                |        |
|--------------------------------|--------|
| SP629 Flip flop                | \$0.35 |
| SP659 Dual 4 input buffer      | 0.25   |
| SP670 Triple 3 input NAND gate | 0.25   |
| SP680 Quad 2 input NAND gate   | 0.25   |
| SP690 Hex inverter             | 0.25   |

## Signetic "Utilogic"

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

## "Utilogic" dual in line package

|                                      |        |
|--------------------------------------|--------|
| LU300 Dual 3 input expander          | \$0.30 |
| LU301 Quad 2 input diode expander    | 0.30   |
| LU305 6 input NAND                   | 0.30   |
| LU306 Dual 3 input NAND              | 0.35   |
| LU314 7 input NOR                    | 0.35   |
| LU317 Dual 4 input expandable NOR    | 0.30   |
| LU333 Dual 3 input expandable OR     | 0.30   |
| LU334 Dual 4 input expandable NAND   | 0.30   |
| LU356 Dual 4 input expandable driver | 0.30   |
| LU370 Triple 3 input NOR             | 0.30   |
| LU377 Triple 3 input NAND            | 0.30   |
| LU387 Quad 2 input NAND              | 0.30   |

## LINEAR INTEGRATED CIRCUITS

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

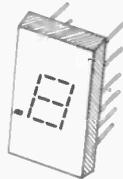
|                                    |        |
|------------------------------------|--------|
| NE526 High speed comparator        | \$1.00 |
| NE565 Phase lock loop              | 3.50   |
| NE566 Function generator           | 3.50   |
| NE567 Tone decoder                 | 3.50   |
| 709 Popular operational amplifier  | 0.35   |
| 5558 Dual 741 op amp (compensated) | 1.00   |
| 747 Dual 741 op amp                | 1.00   |

## LED DISPLAY

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

### FEATURES:

High brightness, typically 350ft.-L @ 20ma.  
Single plane, wide angle viewing, 150°.  
Unobstructed emitting surface.  
Standard 14-pin dual in line package.  
Long operating life, solid state.  
Operates with IC voltage requirements.  
**ONLY \$4.00**



## "UTILOGIC" SPECIAL

Ten (10) pieces of LU321 dual JK flip flops and four pages of application information describing ripple counters (3 to 10) and divide by 12 up/down binary and decade counters, shift registers and self-correcting ring counters.

**Complete package only \$3.60**

## LINEAR SPECIAL

Ten (10) 741 fully compensated operational amplifiers with data sheet and two (2) pages of application notes covering the basic circuits for op-amps.

**EACH \$0.65 PACKAGE \$6.00**

8 pin DIL Only 35c each  
\$2.75 for ten.

## LM309K—5 volt regulator



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

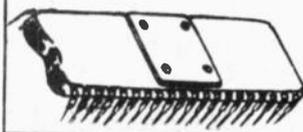
Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) at current of up to one ampere.

**EACH \$2.50  
FIVE for \$10.00**

## LSI—CALCULATOR ON A CHIP

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

Complete with data \$9.95



**Data only \$1.00**

## COUNTER DISPLAY KIT—CD-2

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

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

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

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

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

CD-2 kit complete only \$9.95  
Assembled and tested \$12.00

**Board only \$2.50**



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

## UNIVERSAL COUNTER DISPLAY KIT CD-3

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

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



CD-3 board only \$2.25  
IC's 7490, 7447 2.75  
RCA DR2010 tube 5.00

Complete kit includes all of the above plus 5 programming parts, instructions and Molex pins for IC's. **Only \$8.95**

The MAN3M is a seven segment diffused planar gallium arsenide phosphide readout. It is capable of displaying 10 digits and 9 distinct letters and is encapsulated in a high contrast red epoxy package.

- 0.127" high led 7 segment display.
- Bright red 400 ft.-L at 10ma per segment.
- Compatible with standard digital IC's.
- Compact spacing 5 digits per inch.

**\$3.00 each. Ten or more \$2.50**

# Babylon Electronics Inc.

Post Office Box J, Carmichael, California. 95 608 U.S.A.

# Sizzling!

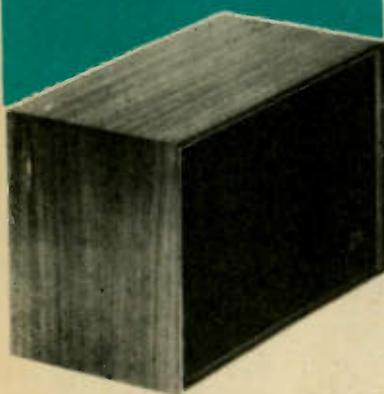
the only word to describe the extraordinary performance of the new Wharfedale "Denton" and "Linton" compact speaker systems.



Building effective compact speaker systems requires technical "know-how" and *experience* — and that's where Wharfedale really shines. For over forty years Wharfedale has been Britain's leading manufacturer of high quality wide range loudspeakers; Wharfedale advances in technology are very obvious in the all-new "Denton" and "Linton".

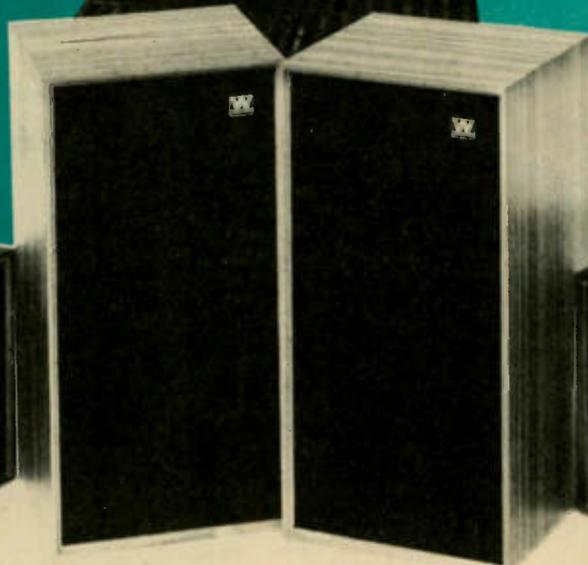
Two models of each unit are available . . . a two way system with an entirely new 8" bass reproducer and a 2" tweeter, and a three way system which specifies a 4" mid-range speaker in addition, to add further reinforcement in the "presence" frequencies.

A long throw voice coil is used in the bass speaker to provide restraint-free lower registers and the new 2" tweeter is the result of intensive Wharfedale research — high frequencies are high and satisfying. Large magnet structures offer greater sensitivity. Now examine closely these brief specifications:



## DENTON 2.

Size: 14" x 9 $\frac{3}{4}$ " x 8 $\frac{3}{4}$ "./Frequency response: 60-16,000 Hz.  $\pm$  3 dB./Power rating: 20 watts DIN./Speaker complement: 8" bass speaker, 2" tweeter./Crossover frequency: 1,400 Hz./Finish: Oiled teak or polished walnut.



## LINTON 2.

Size: 19" x 10" x 9 $\frac{1}{2}$ "./Frequency response: 55-17,000 Hz.  $\pm$  3 dB./Power rating: 20 watts DIN./Speaker complement: 8" bass, 2" tweeter./Crossover frequency: 1,200 Hz./Finish: Oiled teak or polished walnut.

## LINTON 3.

Size: 19" x 10" x 9 $\frac{1}{2}$ "./Frequency response: 55-17,000 Hz.  $\pm$  3 dB./Power rating: 25 watts DIN./Speaker complement: 8" bass, 4" mid-range, 2" tweeter./Crossover frequencies: 1,100 and 4,000 Hz./Finish: Oiled teak or polished walnut.



## DENTON 3.

Size: 14" x 9 $\frac{3}{4}$ " x 8 $\frac{3}{4}$ "./Frequency response: 65-17,000 Hz.  $\pm$  3 dB./Power rating: 25 watts DIN./Speaker complement: 8" bass, 4" mid-range, 2" tweeter./Crossover frequencies: 1,100 and 4,000 Hz./Finish: Oiled teak or polished walnut.

**WHARFEDALE**  **FINEST BRITISH DESIGN.**

Come and hear the difference Wharfedale experience makes. Call at your nearest franchised Bleakley Gray dealer — ask for a no-obligation demonstration. Imagine how well they'll sound at home . . . then find out how little they cost!

Australian National Distributors:

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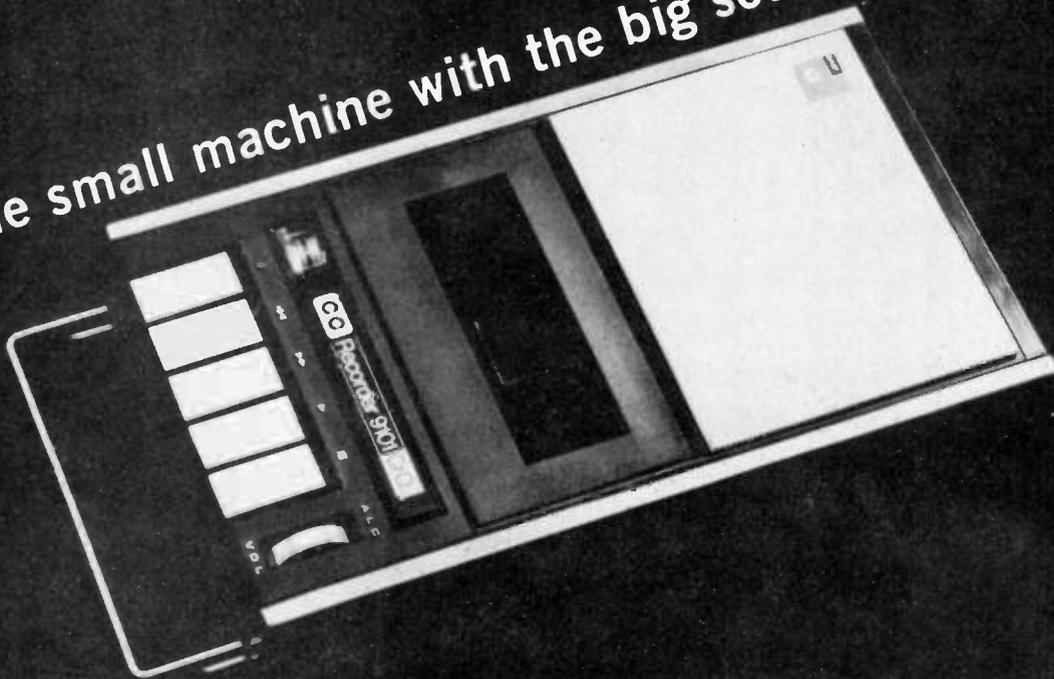
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# BASF CrO<sub>2</sub> CASSETTE RECORDER CC9101

the small machine with the big sound



There's a big new dimension in cassette sound—all packed into the beautifully compact dimensions of the BASF CC 9101 CrO<sub>2</sub> Cassette Recorder.

A difference in sound quality you will actually hear—with any cassette.

Drop in a BASF CrO<sub>2</sub> Cassette and you will hear the extra dynamic range.

Few other recorders of this go-anywhere size can boast as large a speaker, or an amplifier of this power. No other recorder can boast the technical superiority of BASF!

Here are some of the other great features that will make the CC 9101 a natural choice:—

- Automatic or manual recording control.
- Large easy-to-read meter showing recording and battery charge level.
- Only one knob to adjust for output, switching to automatic output and volume.
- DIN connections for remote control microphone, record player, radio amplifier and tape recorder, and for external loudspeaker or headphones.
- Automatic CrO<sub>2</sub> switch.
- Foldaway handle.



And it comes complete with a CrO<sub>2</sub> pre-recorded cassette to introduce customers to the new dimension in sound. BASF CrO<sub>2</sub> tapes increase

dynamic range by 80%! Background noise is all but eliminated. CrO<sub>2</sub> is magnetically stable and its smooth regular surface minimises head wear.

Its Big Brothers are coming! The versatile CC 9201 with automatic eject cut-out and instant repeat system. The professional CC 9301, the recorder/radio that can do anything. You know BASF reel-to-reel and cassette tapes—they're the world's finest. Now you have the opportunity of buying the complete BASF Cassette System. Grab it!

## The new dimension in Cassette Recorders



**Distributors: Sydney (Head Office):** Maurice Chapman & Co. Pty. Ltd., 276 Castlereagh St. 2000. **Newcastle:** W. L. Redman Agencies, 11 Hall St., N.S.W. 2300. **Canberra:** Sonny Cohen & Sons, 20 Isa St., A.C.T. 2600. **Melbourne:** Maurice Chapman & Co. Pty. Ltd., 146-150 Burwood Rd., Hawthorn, Vic. 3122. **Brisbane:** Chandlers Pty. Ltd., 399 Montague Rd., West End, Qld. 4101. **Adelaide:** Neil Muller Pty. Ltd., 8 Arthur St., Unley, S.A. 5061. **Perth:** Anderson-Tedco, 11-13B Belmont Ave., Belmont, W.A. 6104. **Launceston:** P. & M. Distributors, 87A Brisbane St., Tas. 7250. **Darwin:** Pfitzners Music House, Smith St., N.T. 5790.

# DOUGLAS

SELLS SOUND FOR LESS!



## **AKAI GXC 46-D** Hi-Fi cassette stereo tape deck

Styled right, performs superbly. With the inclusion of the famous GX Head focused-field recording system and two other top systems, Dolby Noise Reduction and Akai Automatic Distortion Reduction systems, the sound of this brand new cassette machine belies the notion that natural clear sound reproduction can only be achieved with an open reel unit. Check the features and then listen. Amazing Hi-Fi response: 30-18,000Hz at 58dB S/N (with Dolby). You'll be glad you did.

ONLY  
**\$269**

*\*POST YOUR CHEQUE OR ORDER TODAY!*

### **DOUGLAS TRADING for HI-FI SOUND**

185-191 BOURKE STREET, MELBOURNE — PHONE 63 9321  
Complete range of fabulous Memorex tapes and Jensen Hi-Fi speakers

# HAM RADIO SUPPLIERS

MAIL ORDER SPECIALISTS  
323 Elizabeth Street Melbourne  
(2 doors from Little Lonsdale Street)



**MODEL C1000 \$6.95**  
is the ideal low cost pocket meter.  
AC volts: 10V, 50V, 250V, 1000V (1000Ω/V)  
DC volts: 10V, 50V, 250V, 1000V (1000Ω/V)  
DC current: 1mA, 100mA  
OHMS: 150kΩ  
Decibels: -10db to +22db  
Dimensions: 4 3/4" x 3 1/4" x 1 1/8"

**200-H. \$12.50**  
90° quadrant meter.  
Pocket size.

AC/V: 10V, 50V, 100V, 500V, 1000V (10,000Ω/V)  
DC/V: 5V, 25V, 50V, 250V, 500V, 2500V (20,000Ω/V)  
DC/A: 50μA, 2.5mA, 250mA  
OHM: 60kΩ, 5MΩ  
Capacitance: 100pF to .01μF, .001μF to .1μF  
dB: -20db to +22db  
Audio Output: 10V, 50V, 120V, 1000V AC  
Approx. size: 4 1/2" x 3 1/4" x 1 1/8"



**CT-500/P. \$16.75**  
Popular, medium-size, mirror scale. Overload-Protected.  
AC/V: 10V, 50V, 250V, 500V, 1000V (10,000Ω/V)  
DC/V: 2.5V, 10V, 50V, 250V, 500V, 5000V (20,000Ω/V)  
DC/A: 50μA, 5mA, 50mA, 500mA  
OHM: 12kΩ, 120kΩ, 1.2MΩ, 12MΩ  
dB: -20db to +62db  
Approx. size: 5 1/2" x 3 3/8" x 1 3/8"

**AS-100D/P. \$34.50**  
High 100,000 Ω/Volt sensitivity on D.C.

Mirror scale. Protected movement.  
AC/V: 6V, 30V, 120V, 300V, 600V, 1200V (10,000Ω/V)  
DC/V: 3V, 12V, 60V, 120V, 300V, 600V, 1200V (100,000Ω/V)  
DC/A: 12μA, 6mA, 60mA, 300mA, 12A  
OHM: 2kΩ, 200kΩ, 20MΩ, 200MΩ  
dB: -20 to +63db  
Audio Output: 6V, 30V, 120V, 300V, 600V, 1200V AC  
Battery: Internal  
Approx. size: 7 1/2" x 5 1/2" x 2 3/4"



**A-10/P \$55.00**  
Giant 6 1/2" Meter. Inbuilt signal injector. Overload Protected.  
AC/V: 2.5V, 10V, 50V, 250V, 500V, 1000V, (10,000Ω/V)  
DC/V: 0.5V, 2.5V, 10V, 50V, 250V, 500V, 1000V at 30,000Ω/V  
5000V (10,000Ω/V)  
DC/A: 50μA, 1mA, 10A, 250mA, 1A, 10A  
AC/A: 1A, 10A  
OHMS: 10kΩ, 100kΩ, 1MΩ, 100MΩ  
dB: -20 to +62db  
Signal Injector: Blocking oscillator circuit with a 2SA102 transistor  
Approx. size: 6 1/2" x 7 1/4" x 3 3/8"



**MODEL OL-64D/P MULTIMETER**

20,000 ohms per volt. DC volts: 0.025, 1, 10, 50, 250, 500, 1000 (at 20K Ω p.v.), 5000 (at 10K Ω p.v.). AC volts: 0-10, 50, 250, 1000 (at 8K Ω p.v.). DC current: 50μA, 1mA, 50mA, 500mA, 10 amps. Resistance: 0-4K, 400K, 4M, 40 megohms. dB scale -20 to plus 36 db. Capacitance: 250pF to 0.02μF. Inductance: 0-5000 H. Size: 5 3/4" x 4 1/2" x 1 3/4" in.

**Price \$19.75**  
Postage 30c.

## LAFAYETTE "GUARDIAN 6600" 6-BAND RECEIVER

- Operates on 4 "C" Batteries for Portable Use.
- Operates from 220-240 Volts AC with Built-in Transformer Supply for Home Use.
- 20 Transistors, 17 Diodes and 2 Thermistors.
- Slide-Rule Dial Calibrated for Each Band plus Logging Scale for Reference Purposes.

### 6 BANDS

- LONG WAVE - 160 kHz to 390kHz
- BROADCAST - 550kHz to 1600kHz
- MARINE - 1.6MHz to 4.6MHz
- VHF FM - 88MHz to 108MHz
- VHF AIRCRAFT - 108MHz to 136MHz
- VHF FM - 147MHz to 174MHz

\$179.50

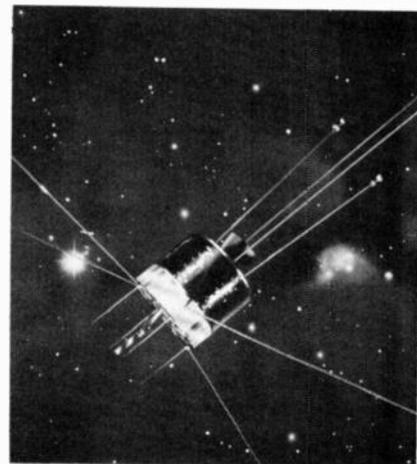
# MAILS direct

## SCIENTIFIC GEOSTATIONARY SATELLITE

The British Aircraft Corporation on behalf of the STAR (Satellites for Telecommunication, Applications and Research) consortium of European electronic and aerospace companies, has been awarded a \$22 million contract by the European Space Research Organisation for the development and manufacture of Europe's first geostationary scientific satellite - GEOS.

The three year development programme will involve 15 companies in 10 European countries.

GEOS will carry a payload of nine scientific experiments into geostationary orbit where from various positions in the magnetosphere the experiments will measure electric and magnetic fields and also particle



densities and distributions. In addition the experiment data from GEOS will be correlated with ground-based measurements.

## SUPERSCOPE PRODUCE IN TAIWAN

The US Superscope organisation are actively building a manufacturing facility in Taiwan.

Joseph S. Tushinsky, President of Superscope said that the factory, scheduled for operational use by September 1st, will produce tape record recorders and stereo systems. No less than 400 000 recorders are scheduled for production in the first year.

Previously, those Superscope and Morantz products manufactured outside the USA, have been built by SRC in Taiwan, and SRC in Japan.

## LIQUID CRYSTAL DISPLAYS

An 8 1/2 digit, seven segment liquid crystal display has been developed by RCA's Solid State division for possible incorporation in electronic calculators.

Projected selling cost is US\$1 per digit by the end of 1973.

## EUROPEAN COMPUTER PARTNERSHIP

In Europe, Philips, Siemens, and the Compagnie Internationale pour l'Informatique are planning a tripartite

venture into the computer field.

It is believed that the projected combine's intention is to compete against IBM who are increasingly taking over the European computer market. At present IBM have an estimated 65% of the market, whilst Philips, Siemens and CII share about 12%.

## CALCULATOR PRICES FALL

Prices of electronic calculators continue to plummet - with the record so far being held by US company Rapid Data Sales.

At the recent Chicago Consumer Electronics Exhibition, RDS quoted their scientific model 824 at US\$239 on Monday, and \$199 on Wednesday.

TI cut the price of their SR-10 scientific units from US\$149 to US\$119 - presumably to make room for their more sophisticated SR-20. Summit International's SQR 16M fell from US\$159 to US\$112 in a month.

The fall in prices is even more extraordinary because most calculator manufacturers are unable to keep up with the demand - many are quoting several months delivery.

Michael Corrado (US)

national sales manager, says that "no merchandiser believes what a calculator manufacturer tells him on deliveries nowadays."

Another, somewhat embittered industry spokesman observed to ETI's reporter that it was no longer a rat race — "The bloody rats won months ago!"

## SIGNETICS SECOND SOURCING NATIONAL SEMICONDUCTOR

The Signetics Corporation has released a series of operational amplifiers and one comparator IC second sourcing existing similar types from National Semiconductor. IC's available so far are types 101A, 201A, 301A and 308 op amps plus the type 311 comparator.

## IRH SEEKS US TAXIMETER MARKET

The North American market for the Australian designed and built solid state Natronic Taximeter is being investigated by a senior marketing executive of IRH Industries Limited, Mr. M. J. Martin.

Mr. Martin is visiting various centres in the United States and Canada that have expressed interest in the advanced type of electronic meter, which is virtually a miniature computer replacing the mechanically operated flag fall and fare meter traditionally installed in taxis.

The radically designed Natronic Taximeter was introduced to the Australian market about two years ago and has won high acceptance from a large number of cab operators. Recently, the meter has been further refined to meet overseas requirements and it is this version to which Mr. Martin is seeking U.S. and Canadian reaction.

## SELF ALIGNING LASER

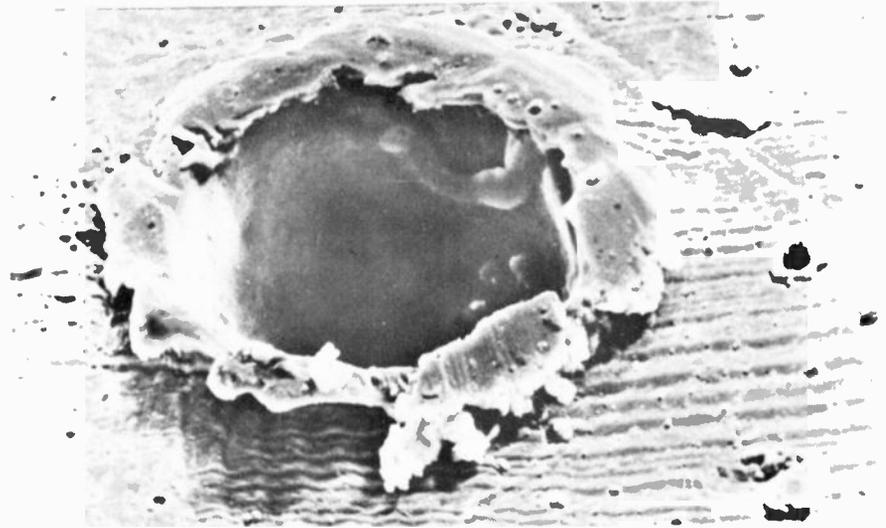
One major limitation of mobile laser communications systems has been in keeping both ends in optical alignment.

This problem now seems to have been overcome. An American company, Stabilized Optics (Cupertino, California), have developed a unit in which the transmitter and receiver are optically stabilized.

Weighing only five pounds, the equipment can transmit messages over distances of up to 20 miles and may be used on rolling steps, moving vehicles or aircraft.

Voice messages are transmitted digitally and decoded back into speech at the receiver.

## LUNAR MICRO-CRATER



A crater made on the moon by a micro-meteorite, and brought down to earth from the Caley plateau by the Apollo 16 astronauts as part of a specimen, is a mere three hundredths of a millimetre in diameter. NASA has put the moon dust specimen containing this micro-crater at the disposal of the Max-Planck Institute for Nuclear Physics in Heidelberg, West Germany, from where it has been sent to the applications laboratory at the Siemens works in Karlsruhe for examination under a scanning electron microscope.

The specimen only measures about 2 x 1 mm. and is, strictly speaking, not really moon material at all. Instead, it is an "interplanetary traveller" itself, a nickel iron meteorite which is estimated to have crashed down on the moon some 3000 years ago. Normally such meteorites vaporize on impact

and only very seldom leave behind fragments. This extremely rare specimen of meteoric iron has, in turn, been hit by a micro-meteorite whose only remaining "trace" is a crater of 0.03 mm. diameter (the thickness of a woman's hair).

All that the scientists in Heidelberg could say of the micro-meteorite was that it had a speed of more than 10 km/sec., in other words 40 000 km/h. What particularly struck the research workers at the Max-Planck Institute, however, was the presence of parallel structures in the immediate vicinity of the crater produced by the impact, this being a mineralogical peculiarity of meteoric iron. Two other and even smaller mini-micro craters to the right, which have a diameter of only two thousands of a millimetre are also noteworthy.

## VARACTORS FOR CAR RADIOS

Motorola's Semiconductor Products division has developed a varactor tuner unit for AM car radios.

The unit — designated the MVAM-1 — consists of three matched varactor diodes in a single package.

At present the device costs US\$1.50 but Motorola hope to be able to produce the device in monolithic form when the price should fall to approximately US\$1.00.

## MINICOMPUTER-CONTROLLED SECURITY SYSTEM

A comprehensive, minicomputer-controlled security network has been put into operation by a major bank in Pittsburgh, Pennsylvania.

Officials of the Mellon Bank and Trust Co. claim their new automatic security system has already been instrumental in the capture of one would-be bank robber at one of their

branches. The bandit was arrested less than two minutes after police headquarters received a teletype alert printed out on the command of a Computer Automation Alpha 16 minicomputer incorporated in the bank's new Diebold DGM-320 Security System.

This police alarm was an automatic function of the system, which continuously monitors security sensitive areas in the bank's headquarters and 22 area branch offices, through electronic sensors plugged into a private data communications network, as well as a closed-circuit television surveillance system.

Claimed to be the most comprehensive security installation ever developed for a financial institution, the system is programmed to react instantly and decisively to a broad range of pre-established conditions — ranging from burglary to fire — and was developed by Diebold Inc. of Ohio in co-operation with the

# news digest

Delco Electronics Division of General Motors.

Mellon's DGM-320 system is operated from a large control and display console manned by security personnel in the bank's headquarters. The controlling Alpha 16 minicomputer periodically monitors and gathers information from devices that simply report on-off or go/no-go conditions, using a Computer Automation asynchronous modem controller to switch data into private telephone lines connecting each bank branch to the control system.

All conditions concerning security contact points are programmed into the Alpha minicomputer's 8K 16-bit core memory. The computer knows, for example, when a given area is secured or open for entry, and reacts instantaneously to every deviation from norm, implementing a series of prescribed activities designed to meet the potential 'emergency'

The information-generating devices installed in security areas cover a broad spectrum of sensors and switches, noting such activities as the opening and closing of doors, windows and vaults. Also included are heat and smoke detectors, ultrasonic and infrared sensors. The system activates alarm devices to alert security personnel and/or the police when the vaults are entered illegally, when the bank or any of its branches are robbed, or when someone tampers with any of the multitude of security devices. The security system's minicomputer automatically determines whether a circuit has been

cut, shorted or grounded, or plugged into an external power supply.

When the DGM-320 system detects an emergency condition, it tells security personnel exactly what steps are to be taken to handle the situation by projecting a 35mm slide on a screen mounted in the system console; in addition, a teletype report is printed out and any required audio alarm is sounded. This effectively relieves the system operator of any need to interpret a given problem, and eliminates any guesswork in dealing with that problem.

## ALLEN WRIGHT FORMS NEW COMPANY

Herman D'Hondt, late of Hewlett Packard, and Allen Wright, late of Hewlett Packard and Wright Audio Developments, have formed a new company, Haltronics Pty Ltd. They will be marketing a range of low cost electronic test instruments as well as some professional audio equipment, aimed primarily at the recording industry.

Their first two test instruments, a \$135 3½ digit digital multimeter and a \$160 10 MHz autoranging counter will be available this month, along with a "Jet Sound Effect" generator for recording studio use.

Due for release in October is a \$250 MHz counter/timer with optional 200 MHz prescalers. Future products include a function generator, an ultra low distortion audio oscillator and an autonulling, digital readout audio distortion analyser. Studio monitor amplifiers and recording mixers are under development and will be built to order.

All products are intended to compete directly with imported equipment but

at a good price advantage because of local design and manufacture.

Haltronics' address is: 57 Sinclair St., Crows Nest, NSW.

## SPACE TOOL TO AID FIRE PREDICTION



Space technology joins in the fight against forest fires in the form of an unmanned instrument that warns foresters when the probability of fire is high. This unit, now in service with the California Division of Forestry at Sunol, California, checks its surroundings and passes information to Forestry headquarters in Sacramento via a NASA satellite, tracking stations, and the Ames Research Center. John I. Gien, a space technology engineer at Ames, adjusts the new device at Sunol. A team of experts at the Division of Forestry Ames Research Center are studying a system which would use the detectors over a wide area to furnish critical information on fire danger.

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# DICK SMITH & STAFF — SUPER VALUES

## SPECIAL WITH KITS THIS MONTH

### FREE copy of NEW 'BASIC ELECTRONICS'

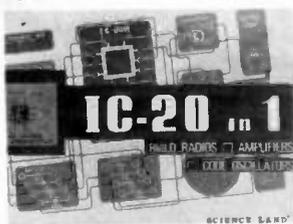
This 100 page book has only just come off Electronics Australia's press. It's an excellent follow-on book to any of the kits described here, gives a basic, easy to understand insight into electronics covering radio, t.v. etc. Crammed with illustrations, diagrams etc and normally sells for \$2. This month we're giving it away FREE with any of these kits. Yes a \$2 book for nothing with every kit.

#### 10 in 1 kit



The beaut thing about this one is that you don't need to know a thing about electronics to build radios, amplifiers and oscillator circuits. Ten of them are described, teaching the principles with actual working circuits: 4 radios, a transmitter type circuit and 5 different oscillators. A variety of applications are also covered. Very simple you don't need a soldering iron, a clever spring-grip terminal is used with pre-cut and stripped wires and each terminal is numbered for easy connection. The 20 page booklet tells you how each circuit works and about the parts which include a solar cell, ferrite bar antenna earphone, transformer etc. Some of the circuits can be run from the solar cell but a 1.5V battery (14c extra) is advisable. The kit measures 15"x10 1/2"x2" and costs \$8.95 (P&P 50c) and you get the ideal follow-up book FREE, 'Basic Electronics'.

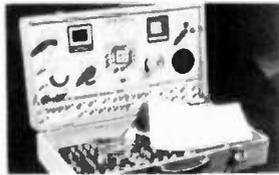
#### IC 20 in 1 kit



This kit features a specially designed, enlarged integrated circuit (IC) with the top taken off so you can see, just as if you were looking through a powerful microscope, how the capacitor, two resistors, a transistor and diode are placed. Then there are 20 fascinating experiments using

the IC. The kit uses an ingenious see-thru printed circuit idea. The components are mounted on a clear plastic sheet and you simply put the circuit you want to build underneath. You can then see where to run the wires to make the circuit work. No soldering thanks to the clever spring-grip terminals. There's a solar battery, ferrite antenna, speaker and earphone and various other components. You can build 1 and 2 transistor radios, a photo burglar alarm, a light frequency controlled oscillator, an electronic machine gun generator etc. Really educational and will give many hours enjoyment. Circuits can be built over and over again. A 9V battery is needed with this kit (53c extra) \$13.25 (P&P 75c) Including FREE \$2 'Basic Electronics'.

#### 150 in 1 The Ultimate kit



How else could we describe this truly magnificent kit which comes complete in a wooden presentation case? The 88 page manual describes 150, yes one hundred and fifty, experiments. No soldering and the kit operates off safe battery supply. An enlarged IC is included (see IC kit above). Kit includes CdS cell, solar battery, d.c. microammeter, speaker, relay, microphone, radio tuner, transformers, two transistors plus IC, potentiometer, slide switch, 15 resistors, 10 capacitors, morse key etc. Projects include Sensitive galvanometer with IC amplifier, ultra low frequency pulse generator, logic circuits, transistorised voltmeter, IC signal tracer, flickering lamp rainfall indicator, tachometer, garage door transmitter and receiver, electronic harmonica, bongo, physiotherapy shocker, wireless IC burglar alarm. The list goes on and on. Case measures 16"x8 1/2"x3 1/2" \$35.95 (P&P \$2) You'll need a 9V and 2 3V batteries also (85c extra) Dick also gives you FREE 'Basic Electronics' the next step...

### BOOKS

The Philips Pocket Book 1973 edition



Needs little introduction, a 700 page bible of everything made by Philips. Specs, parameters etc. Enormous sections on Tubes, crts, transmitters, microwave, photosensitive nuclear devices etc; semiconductors and ICs (280 pages in this section alone); Components and materials (257 pages). Every hobbyist, engineer, technician, amateur, yes everyone should have one. At \$2.30 it's under 1/2 cent per page! (P&P 50c extra)

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This one describes some 40 interesting projects, many of which could have industrial applications, (they're not just fun circuits). But first a useful chapter on fundamentals of all the parts — SCRs, diacs, triacs etc. Then the projects are split up into groups: audio, motor-car, games, home and workshop. Typical circuits include CD ignition, burglar alarm, electronic dice, battery operated fluorescent lamp, speed controller, precision thermostat etc. In all 250 pages for just \$3.40 (P&P 50c)

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We've managed to get a further supply of this hard to get manual. A text book that's in great demand. The 7th edition has 596 pages and covers theory right through to applications in 20 chapters on every semiconductor. Typical chapters include biasing and dc amplifiers, logic, digital circuits, feedback and servo amps, regulated power supplies, unijunctions, tunnel diodes, silicon controlled switches. Various GE specs are also included. \$3.50 (P&P 50c).

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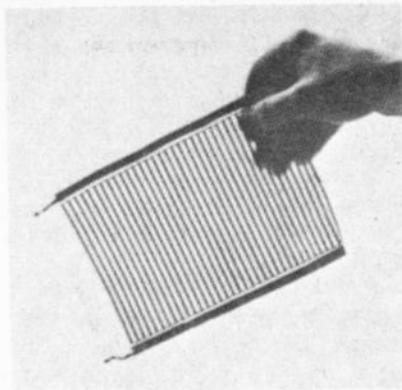
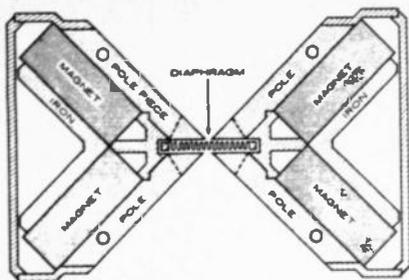
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# HI-FI - the state of the art

*Editorial Director, Collyn Rivers, reports.*



*Photograph reproduced by courtesy of Trio Electronics, Tokyo*



## Heil Air Motion Principal

Diaphragm of Heil driver is a convoluted polythene membrane carrying a continuous-foil conductor analogous to the 'voice coil' in a conventional speaker.

This diaphragm is inserted between two large magnetic pole pieces.

When the electrical audio signal passes through the conducting foil, the folds of the diaphragm vary their spacing, thus altering the space between them and hence generating the acoustic signal.

The unusual action of the driver produces a very large air movement for a small motion of the diaphragm — thus it is very efficient — about 3 to 4 percent say Heil.

Not apparent from the drawing is that the magnetic pole pieces are in fact an open grip of parallel strips thus allowing the sound to be emitted from both sides of the diaphragm.

Practically unique in its operating principle, the Heil driver has extremely low inertia and no resonances within its operating range.

DESIGNERS, whether of hi-fi equipment, motor cars, or even houses, tend to fall into two main groups — categorised by the way in which they think, or are allowed to think.

The first type of designer thinks 'vertically'. He develops new devices by building on the accumulated experience of what went before — examples of this are the Shure V15 Mk III cartridge (reviewed on pages 32 & 33 of this issue), the Rolls-Royce motor car and the majority of domestic architecture.

The second type of designer thinks 'laterally'. He takes advantage of modern technology but little heed of the form in which previous generations thought things should be. Here, examples of lateral thinking include the Beogram 4000 turntable, the Heil Air Motion loudspeaker, the ID Citroen and Mini-minor, and, in the field of housing, Buckminster Fuller's geodesic domes. (readers interested in lateral thinking should study the numerous books by Edward de Bono).

Until recently, the hi-fi industry has been characterised by vertical design with very few truly fresh approaches to problems:

There have been a few exceptions — such as Henry Kloss' development of the AR range of acoustically suspended speakers, Ray Dolby's noise reduction system etc, but these are examples of what one might describe as 'diagonal thinking', owing as they do, something to both design approaches.

The biggest problem afflicting the

designer committed to the horizontal approach is that he is almost invariably competing with conventional systems that despite their fundamental 'wrongness', have, nevertheless, been refined over decades of vertical development. A classic example of this is the reciprocating internal combustion engine, another is the deep keel yacht.

It is then all the more to the credit of Bang and Olufsen that their new Beogram 4000 turntable is so good.

Now, all over the world, design engineers are taking a fresh look at many areas of hi-fi equipment design and, in our opinion at least, the next two or three years will see some most dramatic developments in the recording and reproduction of sound.

### VALUE FOR MONEY

On a more down to earth level, some very worthwhile developments have been taking place primarily in the upper and lower thirds of the hi-fi price range.

A couple of years ago we wrote that 'hi-fi starts around \$350'. This is still very largely true today — although several companies are producing complete systems at \$300 or slightly less. One example of these is Pioneer's new 'Prelude 500' system (sold only as a total package of amplifier, turntable and two speakers) at a recommended retail price of \$299. Included within this package is the excellent little SA 500 amplifier.

Two years ago the optimum amount of money to spend on a hi-fi system — judged purely on a performance/price

basis — was somewhere between \$650 and \$850. Surprisingly, despite inflation, the best value for money is now achieved by spending slightly less — probably between \$575 and \$750.

The reason for this is the recent introduction of a number of really good loudspeakers costing between \$120 and \$175. Many of these, such as the smaller products from AR, Advent, Dynaco, Audiosound, Rectilinear etc, compete with their larger and more costly counterparts in practically every way except power handling capability.

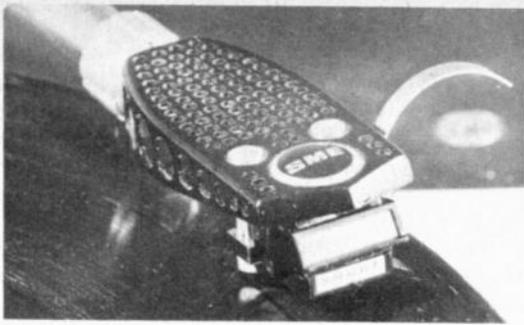
True, it is still not possible to obtain really deep bass from a small loudspeaker, but for the great majority of hi-fi enthusiasts the limitation on bass reproduction is the size of their listening room rather than the depth of their pocket. As this is a point rarely understood by hi-fi enthusiasts, we have included a table within this article listing the lowest bass frequency that can be realistically reproduced in rooms of various lengths.

### TOP OF THE SCALE

At the upper end of the price scale, recent developments include the Beogram turntable previously described — even at its selling price of \$500 plus, people are queuing up to buy it. Shure's new V15 Mk III is somewhat of a mile stone (kilometre stone ?) in cartridge design for it typifies what may well be the ultimate manifestation of this type of design. It is difficult to see what further improvements could reasonably be made whilst staying within the bounds of current technologies.

In the field of loudspeakers, the Heil Air Motion Loudspeaker may well be the first of a new generation of loudspeaker designs. At present it is available only as a mid-range and treble unit, but the manufacturers are actively developing a bass driver as well. We have not heard this unit ourselves, but authoritative sources in the USA are lavish in their praise. Hirsch-Houck Laboratories for instance wrote 'Even if we had never listened to... this speaker, its measured frequency response alone would invite the use of superlatives. This is one of the few speakers we have tested, in a normally 'live' room, whose overall frequency response and smoothness are comparable to those of a good high-fidelity amplifier — and that is no small achievement'.

For those who prefer a more conventional approach, Acoustic Research's LST is probably the loudspeaker equivalent of the new Shure cartridge. It is best described as the ultimate AR3a, and for those who can afford the room — and the price — it is well worth consideration.



Shure's superb new V15 Mk III cartridge.



Trend-setting 'Prelude 500' system from Pioneer retails for less than \$300.

## TAPE RECORDERS

Enormous improvements have been made in cassette decks and it is now possible to buy cassette machines that have a standard of reproduction virtually indistinguishable from reel to reel machines. Inbuilt Dolby or other noise reduction systems are now standard in all top quality cassette machines, and the use of these circuits has removed the tape hiss that was characteristic of cassette players until recent times.

Regrettably there is still a shortage of pre-recorded cassettes of any worthwhile standard and far too much pre-recorded material is produced on tape of such poor quality that one can but marvel at the sheer cynicism of the producers. This is rather a pity because some truly excellent tape cassettes are now readily available, and these high quality cassettes must be used if the performance built into the top cassette players is to be exploited.

The arguments and counter-arguments between protagonists of iron oxide and chromium dioxide tapes still rages. At the risk of losing all our good friends in the tape business it is our opinion that there is very little difference in listening quality between any of the tapes made by the leading contenders. It's a bit like the light platter versus heavy platter turntable affair — it doesn't really matter which technique is used just so it is used properly.

It is of course true that chromium dioxide tape must be used with a machine for which it is specifically intended as quite different bias levels and erase levels are required.

Equally important is to use the tape recommended by the machine's manufacturer, or, for those with the necessary technical ability, to optimize bias for one brand and type of tape and to use that tape only.

Advances in reel-to-reel machines are now confined almost entirely to those machines intended for professional use. Excellent reel-to-reel machines are still marketed for domestic use, but their sales seem to be mainly limited to tape enthusiasts who find that editing is so much simpler with this type of machine.

## AMPLIFIERS

Amplifier development continues along conventional lines, although there is an increasing tendency toward higher power outputs. The justification for such large amplifiers is the inefficiency of many new types of speaker systems. In fact it is probably true to say that were it not for the availability of multi-hundred watt amplifiers, the transmission line speaker (and others) would not have been commercially feasible.

Performance of top quality amplifiers is now very good indeed — they are fast approaching the ideal of a piece of non-inductive wire with adjustable frequency characteristics and gain.

At the lower end of the scale there are now some excellent amplifiers priced between \$120 and \$200, which are more than adequate to drive the new generation of similarly priced speakers described above.

## THE GREAT FOUR-CHANNEL WAR

One day in the future, battle scarred marketing executives are going to take their grandchildren on their knees and tell them wondrous tales of the Great Four-Channel War.

Now well into its third year, there is still not the slightest sign of a reconciliation between the competing matrix and discrete camps, although the battle lines are now more clearly defined, for, going along with that fine old Middle Eastern proverb that 'the enemy of my enemy is my friend', the various matrix proponents (with the possible exception of Sansui) now appear to see the RCA discrete system as their common enemy.

## MATRIX SYSTEMS

Basically all matrix systems are the same in that they attempt to encode four channels of information onto a two channel record (or tape). Decoding circuitry built into the receiving equipment then decodes the encoded material — aiming (but not always succeeding) to direct each information channel to its 'correct' loudspeaker.

The only real difference between the competing matrix systems lies in the proportions and phase relationships in

which the original four channels of programme material are mixed down to two — and expanded out to four again. Following some furious technical battles between a dozen or so companies, there now remain only two major contenders, Columbia's SQ system, and Sansui's QS system.

The Columbia SQ system is favoured in the USA, and, according to Benjamin Bauer of CBS Laboratories, 75 brands of audio equipment produced by SQ licencees are now available, or are about to become available, both in the USA and overseas. These 75 brands, claims Mr. Bauer, account for more than three quarters of the sales of audio equipment world-wide.

United States patent 3 708 631 has been issued to Columbia covering various and broad aspects of logic decoders, and cross-licencing agreements have been signed with Electro-Voice that enables SQ licencees to take advantage of developments from both companies.

The main advantage claimed for the SQ matrix is that it is compatible with both stereo and mono playback systems — and this is of prime importance when it is realised that at least 90 percent of record buyers listen to records on mono players.

Sansui's QS matrix — which is being adopted by an increasingly large number of Japanese companies — is far less satisfactory in this respect. QS encoding yields a disc that has very poor left to right hand separation when played on stereo equipment and very strange effects indeed played monophonically.

Against this, front to rear separation is much better than with SQ although the so-called 'gain-riding' circuits that are added to the more expensive decoders increase the channel separation on most programme material. These gain-riding circuits are available for both QS and SQ systems.

Actually it is slightly misleading to speak of QS and SQ matrices, for both systems have been modified several times during the past few months. Parameters of the two systems are becoming closer together, and, whilst QS decoding is still not very satisfactory for SQ discs — and vice versa — the differences between the

two systems are now relatively small and it is more than likely that there will eventually be a common format or one so similar as to be virtually identical.

The SQ system has been chosen by the great majority of FM broadcasting stations. These stations transmit SQ records by conventional stereo broadcasting which are then decoded by the listeners' receiving equipment. In the US, over 200 stations broadcast four channel programmes in this manner.

Commercially, the cost of SQ decoders should fall substantially following Motorola's development of a solid-state integrated matrix chip (MC 1312). Two further associated chips from Motorola are logic module MC 1315 and power transfer module MC 1314.

The MC 1314 module is technically interesting in that it acts as a gain control and speaker balance element permitting the gain of all four channels to be adjusted simultaneously, with a tracking error of less than 1 dB over a range of 80 dB.

At present the highest degree of separation that any matrix system can achieve is 20 dB in all directions — but this can only be obtained with the most sophisticated of gain-riding systems. Neither system can reproduce different sounds from all four channels simultaneously.

## DISCRETE FOUR-CHANNEL

Discrete four-channel sound suffers from few of the limitations of its matrixed counterpart, being recorded, as its name implies, on four quite separate information channels.

Initially, discrete four-channel consisted of reel-to-reel tapes and associated tape decks, but the system did not meet with any noticeable success until RCA's release of 8-track

cartridges under the trade name Quad-8. Subsequent legal complications caused RCA to change the name to Q-8 and they are still marketed under that name.

In 1972, RCA introduced the Japanese-developed CD-4 disc. Unlike the matrix recordings that attempt to cram channel routing information into the two normal stereo channels, the CD-4 disc actually carries an additional two channels of information. This is achieved by extending the frequency range to 50 000 Hz. The frequency range up to 15 000 Hz is used to carry the combined front and rear signals for both right and left channels — and the higher frequency channels carry information necessary for separating front and rear channels.

A demodulator, operating in a very similar manner to decoding circuits in FM tuners, sorts out the various signals routing each (subsequently amplified signal) to the appropriate loudspeaker.

Sceptics — who almost without exception have not heard the CD-4 system in operation — doubt the ability of a stylus and pick-up cartridge to operate at frequencies as high as 50 000 Hz. Nevertheless the Shibata stylus (specifically designed for the CD-4 system) copes admirably and both JVC and Panasonic are

producing the necessary cartridges and decoders.

Decoding circuitry for the CD-4 system is very complex but a well known manufacturer of specialised IC's will have a CD-4 decoding chip available in the very near future and this will reduce the complexity of the CD-4 decoders enormously.

All RCA records are now produced in the CD-4 format as the system is totally compatible with both stereo and mono record players. The use of a new vinyl formulation for the records has ensured that four channel information is not destroyed when the record is played on mono equipment.

Original CD-4 discs were cut at one third playing speed, however recent advances have enabled this to be increased to one half playing speed and it is hoped that they will eventually be cut at normal operating speed.

Due to the increased bandwidth of the CD-4 record, it is not currently possible to broadcast a CD-4 signal, and this is a major obstacle in the way of total acceptance of the system.

The discrete and matrix systems are totally incompatible. If both are to remain in use, equipment must either contain decoding circuitry for each — or the user must purchase two different systems — or at least decoders.

Although a number of world famous equipment manufacturers are not yet producing four channel equipment, it is now practically certain that four-channel is here to stay — the only remaining question seems to be the really big one of which system will win out — or will be have two competing systems with all the attendant complications?

Or, although the equipment industry needs this like a hole in its head — will a lateral thinker come along with a new and brilliantly simple approach!●

TABLE I

| Length of room<br>(in metres) | Lowest<br>reproducible<br>frequency<br>(in Hz) |
|-------------------------------|--|
| 4                             | 85.75  |
| 5                             | 68.60  |
| 6                             | 57.10  |
| 7                             | 49.0   |
| 8                             | 42.8   |
| 10                            | 34.3   |
| 12                            | 27.5   |

## ESSENTIAL BOOKS

**THE MODERN DICTIONARY OF ELECTRONICS.** Contains concise definitions of more than 18,000 terms in electronics, communications, micro electronics, fibre optics, semi-conductors, computers, medical electronics. Fully illustrated. Essential to any collection of electronics reference books. Ideal for workshop and laboratory. A\$13, post free.

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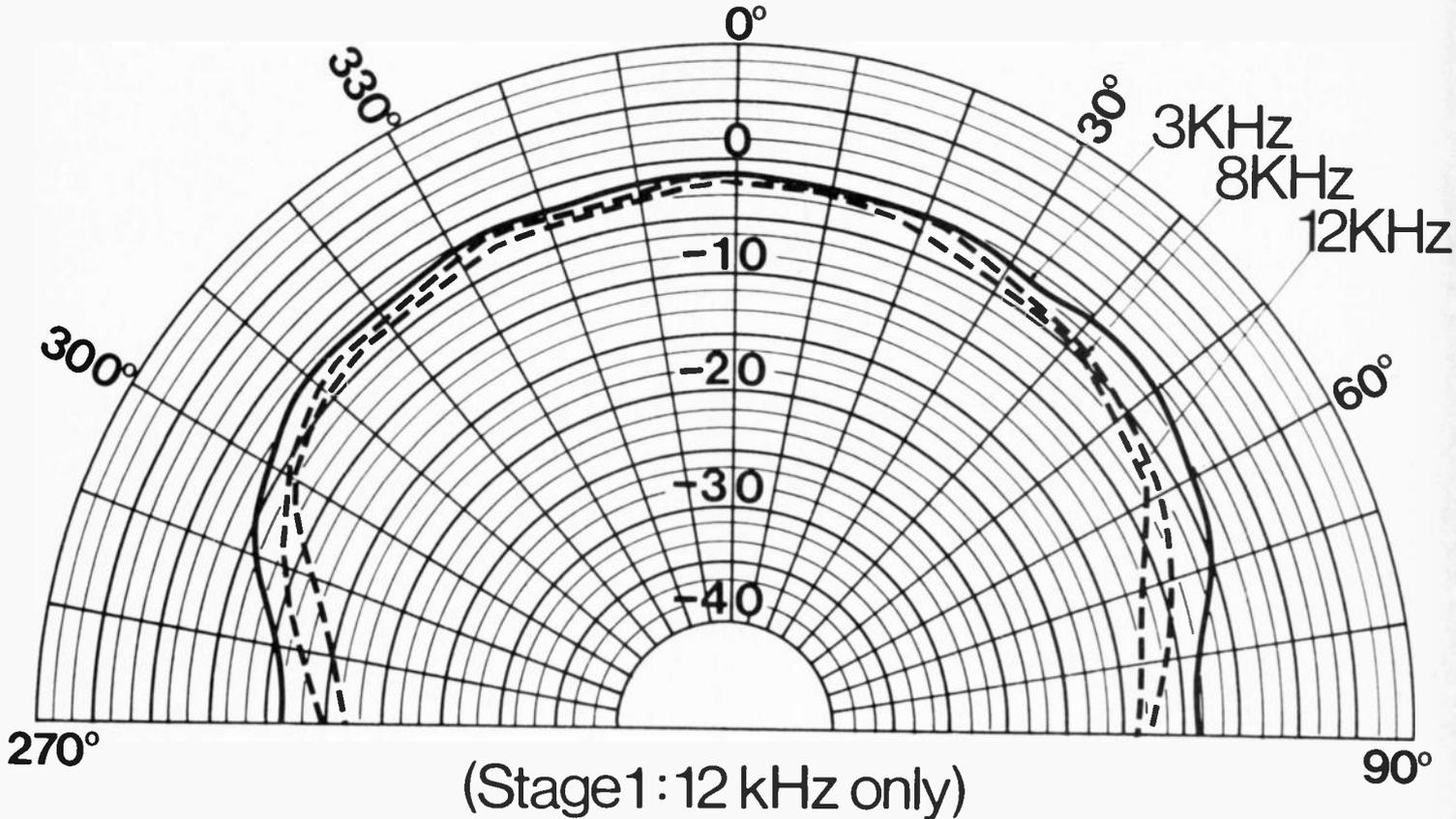
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# HOW TO CHOOSE A GOOD TO READ

## With Wide-Focus Acoustic Lens:



# HOW TO CHOOSE A GOOD KNOW HOW TO

As usual, the graphs show a very simple thing in a very complicated way. The graph on the left shows the way sound travels when a loud-speaker is fitted with a wide-focus acoustic lens.

The graph on the right shows the way sound travels without the lens.

As you can see, the sound has a more even spread with a wide-focus acoustic lens. You probably worked that out already.

From which you'll gather that a wide-focus acoustic lens is a good thing.

The question is, why do you need one?

Look at the way you listen to your present speaker system: at some point mid-way between the two speakers, and the same distance away from them. It's the

way most high fidelity showrooms like to demonstrate their equipment.

And you know why you sit or stand there? Because if you move too far back, or left or right, the high frequency sound-waves travelling in a narrow cone would miss you, and you'd hear a blurred version of stereo.

It's because of this narrow cone that you need a wide-focus lens, to open out the cone and send the high frequencies to all listeners in the room.

You can demonstrate this to yourself by sitting in a chair on castors when you listen to a Coral demonstration. Take yourself for a test-drive. You shouldn't notice any difference, either in quality or in stereophonic or quadrophonic effect, wherever you move to.

This means that when you get the

speakers home, you can fit them into your existing room design, instead of having to make drastic alterations, as you may with more conventional systems.

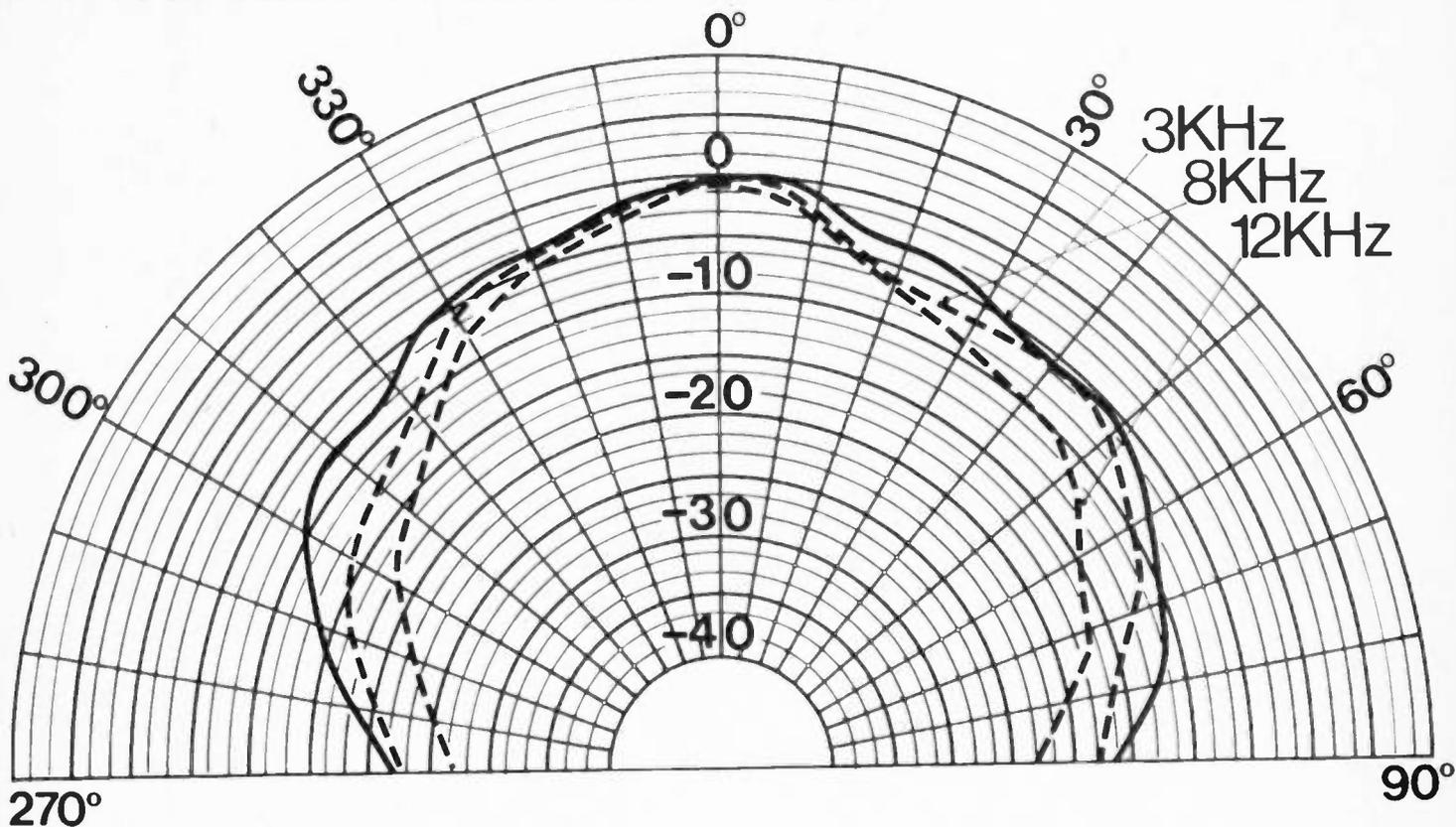
Size of the speaker enclosure is a personal matter. But it's safe to say always go for the largest enclosure you can afford, so as to get the best bass reproduction.

But having a large bass speaker or woofer, calls for a very sturdy and airtight enclosure, to ensure low-frequency damping and minimal vibration distortion, even at high volume.

With Coral, you don't have to worry about the enclosure. It's airtight, and it's solid. The woofer, whether it's a 12" in the Stage 7 or 6" in the Stage 1, is set into a polished walnut baffle flat on both sides to eliminate a very nasty phenomenon known as acoustic bounce.

# SPEAKER IF YOU KNOW HOW A GRAPH.

Without Wide-Focus Acoustic Lens:



# SPEAKER IF YOU DON'T READ A GRAPH.

You may wonder why we go to all that trouble to polish up a baffle.

Partly it's because we don't want you to be disappointed when you take the grille off. And partly it's because no-one else goes to the trouble.

There aren't many other people who bother to make the grille removable at all. But then, they don't have silver whirligig acoustic lenses to show off.

Even without taking the grille off, you can tell that. Just by stepping out of their high frequency range.

## CORAL STAGE SERIES SPECIFICATIONS:

STAGE 7 Speakers: 12" (305 mm) woofer, 5" (127 mm) mid-range 3 1/2" (89 mm) tweeter, 2" (51 mm) super-tweeter, Capacity: 80 W, Impedance: 8 ohms, Frequency Response: 25-20,000 Hz,

Crossover Frequency: 700, 4,000, 10,000 Hz, Sensitivity: 93 dB, Dimensions: 27" (686 mm) H x 16" (406 mm) W x 13" (330 mm) D, Weight: 55.1 lbs (25 kg).

STAGE 1 Speakers: 6" (152 mm) woofer, 2" (51 mm) tweeter, Capacity: 30 W Impedance: 8 ohms, Frequency Response: 30-20,000 Hz, Crossover Frequency: 8,000 Hz, Sensitivity: 93 dB, Dimensions: 18" (457 mm) H x 11" (279 mm) W x 9" (229 mm) D, Weight: 19.8 lbs (9 kg).

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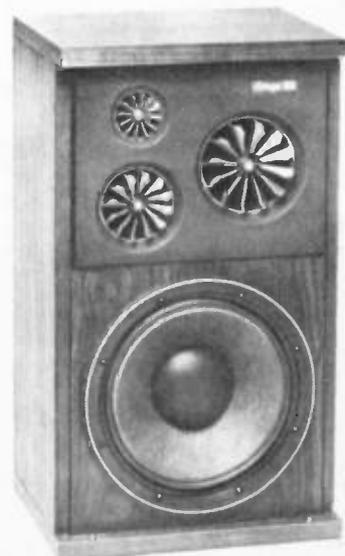
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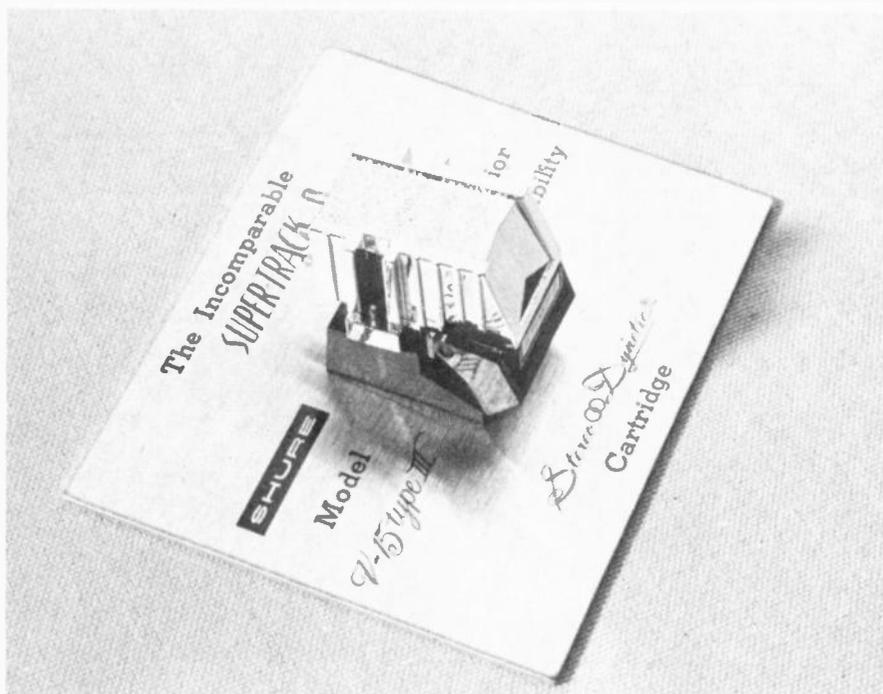
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CORAL



# SHURE V15 MK III PHONO-CARTRIDGE

"One of the world's top cartridges — it is quite probable that it is the best."



at improving several aspects of performance; perhaps the most important of which was to flatten the frequency response in the region between 10 kHz and 20 kHz. Those familiar with the design of transformers will realise that the high frequency roll-off of the V15 Mark II was primarily attributable to the lack of an optimally laminated core structure. However, it is one thing to *propose* a laminated core structure and quite another to *produce* the type of lamination required when the miniscule size of such a transformer is appreciated.

Nevertheless, Shure have developed manufacturing techniques that has enabled them to build laminated cores and these are now fitted to all Mark III cartridges.

A second major change was that the geometry of the pole pieces needed optimisation in order to eliminate — or reduce — the effect of non-linearities in the air gap. The result of this is improved efficiency, flatter frequency response and significant improvement in cartridge output at the top end of the frequency spectrum.

The next area attacked was in the actual stylus and stylus assembly. We know from simple mechanics that a lower mass is easier to move than a heavier one, hence the lower the effective mass in the stylus, the greater the ease with which the stylus can follow the record groove. But a simple reduction of mass itself is not the sole criteria. Rather it is the correct improvement of dynamic compliance in order to be able to cope with the high velocities that exist on many records. Whilst the V15 Mark II had an effective tip mass of 0.45 milligrams, the Mark III is reduced to 0.33 milligrams. This reduction is not dramatic, not could it be, because of the need to produce a stylus lever strong enough to work.

Having looked at Shure Brothers' design philosophy, it now remains for us to see what the V15 Mark III achieves in practice.

When one has for review what may well be the best cartridge in the world,

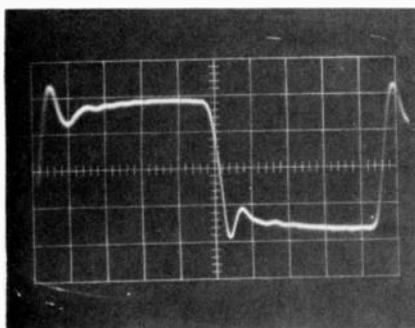
**electronics**  
TODAY  
INTERNATIONAL  
**product test**

FOR many years, the Shure V15 Mark II cartridge has been regarded by audiophiles as being one of the best cartridges that money can buy. The reason for this is simply that in terms of the main criteria of fidelity, trackability and lack of colouration, the V15 Mark II has few peers. However, the linearity of the Mark II never quite matched the excellence of the rest of the cartridge, and in this one respect there are many cartridges which are undoubtedly superior.

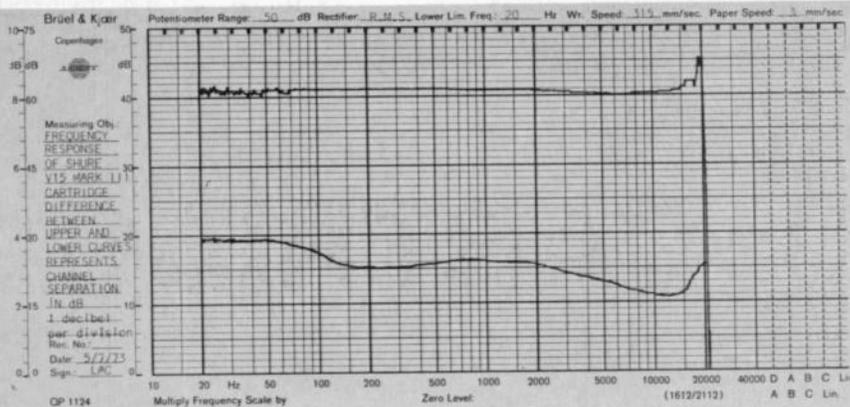
This clearly bothered Shure and so, over a period of seven years, they have developed a cartridge which is a worthy successor to the Mark II. Quite naturally, the designation for the new cartridge is the V15 Mark III.

Each new cartridge that Shure Brothers have released has generally been a state of the art improvement over their cartridges that have gone before — the new Mark III is no exception.

The designers of the Mark III aimed



Shure V15 Mk III cartridge with 1 kHz square wave input (7cm/sec)



the techniques available to evaluate its performance are critical. The Shure Brothers' test record "Acoustical Obstacle Course" TTR101 did not really provide a good enough test for the trackability of the Shure V15 Mark II, let alone the Mark III. So how do we evaluate the performance of the Mark III? This problem obviously worried Shure Brothers long before it became *our* problem, and their approach was to develop two new records. The first of these, the TTR110 "Audio Obstacle Course, ERA III" was specifically developed to show the difference in performance between the V15 Mark III and other "lesser" cartridges. Unfortunately whilst Mark III cartridges are now available, the record has been delayed in production and we look forward to reviewing it later. Shure Brothers have also produced another professional record, the TTR103, specifically designed for laboratory testing. This would have been particularly useful,

but again was not available at the time we performed our tests.

Hence we were obliged to use programme material from standard demonstration records such as Shure's TTR101. Fortunately, apart from assessing trackability, we had no difficulty in measuring all other parameters, nor in subjectively evaluating the overall performance of the cartridge.

The frequency response of the Mark III has a maximum excursion of  $\pm 1$  dB between 20 Hz and 20 kHz when installed in the average tone arm, and  $\pm 0.5$  dB when fitted to an arm such as the S.M.E. Whilst the level recordings show a rise at 18 kHz, this is a characteristic of the test record not the cartridge. This measured response is significantly better than that of the Mark II.

Cross-talk in the critical region between 200 Hz and 20 kHz showed a channel separation of not less than 25 dB generally, and nowhere less than 20

#### MEASURED PERFORMANCE OF SHURE V15 Mk III CARTRIDGE

Frequency Response  
(20 Hz - 20 kHz)  $\pm 0.5$  dB  
Sensitivity  
(at 1 kHz at 5 cm/sec) 1.75V  
Channel Separation  
(at 1 kHz) 25 dB

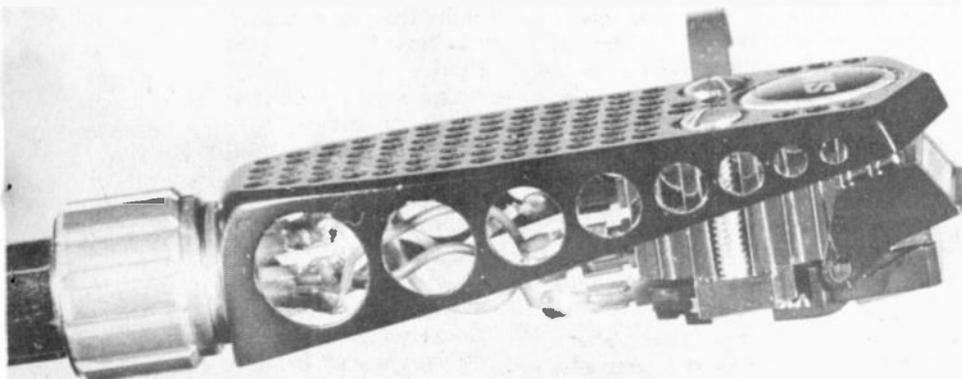
dB. Again the limitation here is the quality of the test record.

Square wave tests showed that the effective frequency response extends to at least 25 kHz without any significant resonance effects being apparent. The square wave response showed less ringing than any cartridge previously tested.

It is in the region of trackability and lack of colouration, however, that the Mark III really excels. This cartridge has the cleanest response of any that we have had the pleasure of testing, and can cope with the most demanding programme content that we have in our record collection. We could not fault it in any way.

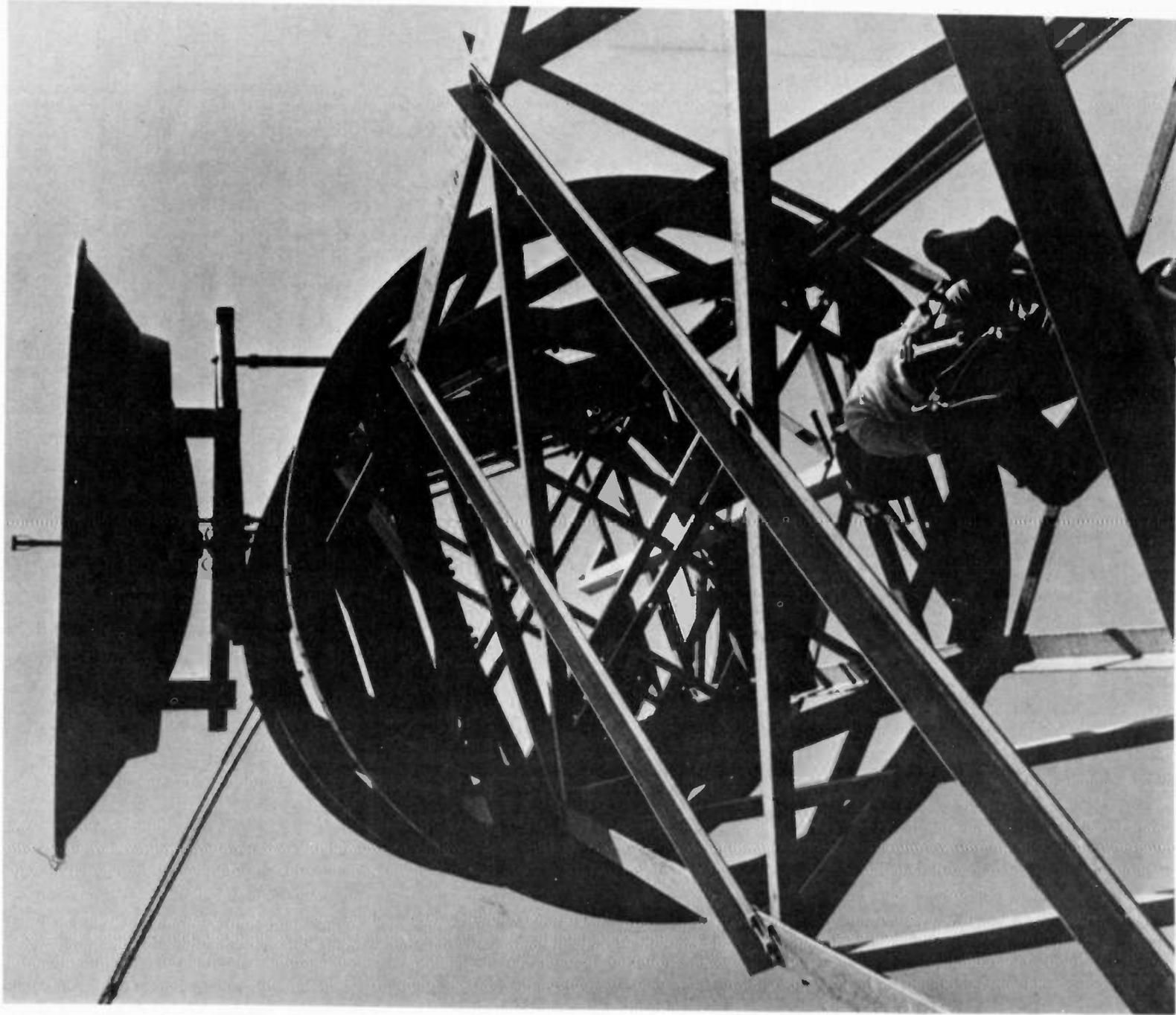
The Shure V15 Mark III is a truly excellent cartridge, but for its full potential to be realized it *must* be used with a top quality amplifier and speakers (we used a Thorens TD125 table, plus an S.M.E. arm; a Pioneer SA1000 Amplifier, and JBL Control Monitors). Top line records are also necessary or the results are unquestionably poor. But provided that good quality equipment is matched to this new cartridge, the results will be truly superb.

The Shure V15 Mark III is one of the world's top cartridges - it is quite probable that it is the best. ●



Shure V15 Mk III shown here in an SME tone arm.

# UNREASONING RADIATION



MODERN life has brought a plethora of man-made sources of radiation. Among the most subtle are those generated in the microwave spectrum, at frequencies from 30 Megahertz to 300 Gigahertz — nestled between radio and infrared waves at wavelengths from 1,000 to 0.1cm.

The Russians have long maintained that microwaves can cause a wide range of psychological and physiological abnormalities; particularly the "asthenic" syndrome: irritability, fatigue, headache, loss of memory and indecisiveness. Soviet scientific faith in microwave-induced aberrations is based on several years' observation of workers in industrial microwave environments conducted by the Academy of Medical Sciences (Moscow) during the late 1950s and early 1960s. As a result of these studies, permissible microwave exposure levels in the Soviet Union are one-thousandth of the U.S. ASA Standard for continuous exposure in industrial and military situations.

American scientists have remained generally skeptical about the potency of low-energy microwaves; it was not until the late 1960s that their researchers were able to replicate Soviet laboratory experiments. Thus, the U.S. project charged in 1957 by the three military services with determining microwave hazards, mainly investigated large-scale thermal effects; it set a 10 milliwatt/cm<sup>2</sup> exposure ceiling which is still in widespread though not mandatory, use in the United States. However, recent American findings indicate that microwaves *do* produce seemingly inexplicable physiological effects.

### THE SOUND OF MICROWAVES

Exploring low-power-induced biological responses for several years, Allan Frey of Randomline, Inc., Willow Grove, Pa., has shown that human beings can bear microwaves directly. He reports in *IEEE Transactions on Microwave Theory and Techniques* for 1971 that his subjects report a variety of sounds, including buzzing and humming, when they are irradiated with trace amounts of radio frequency energy in the UHF and VHF spectrum. However,

according to Frey, the microwave beam must be amplitude modulated or pulsed at audible frequencies to produce the effect. He says that some researchers who failed to confirm the phenomenon used unmodulated microwaves.

The intensity of the sensation is a function not of the average energy of the pulsed waveform, Frey maintains, but of the peak energy. Those familiar with high fidelity equipment are aware of the controversy about "peak music power" versus the more useful rms power ratings. Frey has shown that as far as hearing microwaves is concerned, peak power is a better measure than rms power. Since a microwave beam of low average power can be highly modulated, people can hear such low rms, high peak power beams; Frey reports a statistically significant threshold — about 0.3 mW/cm<sup>2</sup> average power — at which highly modulated signals become audible.

It is not clear how microwaves produce the sensation of sound, but Frey has ruled out one possibility: fluctuations in external air pressure impinging on the eardrum. In the hope of learning something about the mechanism, he looked for the periodicity pitch phenomenon associated with ordinary hearing: perception of tone from a pair of conventional acoustic pulses is related to the time delay between them. No relationship between delay and perceived frequency was observed for microwave hearing. In fact, trained musicians, irradiated with low level UHF energy carrying a 200 Hertz signal, reported hearing a mixture of higher frequencies, including harmonics of the original tone. Thus, Frey concludes that microwaves do not act directly and exclusively by a simple linkage with the ear-brain network.

### STRAIGHT TO THE NERVES

Another possibility is that microwave electric fields trigger nerves directly; nerves transmit pulses electrochemically, the balance of sodium and potassium ions on either side of a nerve cell membrane being critical to the hearing process.

Hermann P. Schwan of the Moore School of Electrical Engineering, University of Pennsylvania, has argued against direct stimulation of nerve tissue. Using a theoretical model of nerve action, he has shown that the electric field strength required across the boundary of a nerve cell is about 500 kilovolts per centimetre; a microwave beam of such intensity would burn a living organism to cinders. Frey, however, says that very intense microwave beams may not be required for nerve tissue stimulation; he suggests that the imperfect state of knowledge of nerve operation is sufficient reason for not rejecting out of hand a possibly delicate and subtle interaction between microwaves and flow of information to the brain.

In experiments with cats, Frey has evoked brain stem electroencephalographic activity with microwave pulses as small as 30 microwatts/cm<sup>2</sup> average energy with 60 milliwatts/cm<sup>2</sup> peaks. Different neural phenomena associated with microwaves have been observed by other researchers: G.E. Hearn has shown that microwaves influence the frequency at which a flashing light is seen as a continuous image — an accepted indication of neural dysfunction; A. E. Bourgeois, Jr. has found that the sound threshold required for auditory perception decreases during microwave irradiation.

### AN AVERSIVE RESPONSE

There is also evidence from American scientists that low-level microwaves can affect behavior. In 1965, for example, Dr. Susan Korbel and W. D. Thompson, University of Arkansas psychologists, reported increased activity from rats irradiated with 1 mW/cm<sup>2</sup> rf energy. Allan Frey has constructed a shuttle box — a miniature room divided into two compartments by a low barrier; when he illuminated one side of the box with 1 mW/cm<sup>2</sup> UHF microwaves, lab rats distinctly avoided the irradiated side, spending only 30 per cent of their time there. Microwaves are clearly responsible for this behavior, Frey concludes, although he has no explanation for how the rats sense the

# UNREASONING RADIATION

radiation — at such low power levels, body temperature rise is insignificant — or why they dislike it.

Drs. Don R. Justesen and Nancy Williams King of the Neuropsychology Research Laboratories, U.S. Veterans Administration Hospital, Kansas City, Mo., and Rex L. Clarke, University of Kansas, have pursued microwaves' aversive effects further. In a conditioned suppression environment, they found that the radiation stimulates an aversive response in rats — the cessation of licking associated with a photoelectrically triggered sugar solution reward — by warning the animals of impending electric shock. The conditioning of aversive behavior is impressive because the subjects have no natural inclination to make such responses, as they would with appetitive behavior; in situations where the biophysical mechanisms are mysterious and conclusions based on statistical analysis of behavior, it is absolutely essential to exorcise artifactual uncertainty.

These researchers suggest that modulated microwave cues suppress licking almost as efficiently as do audible tone cues. The subjects reacted to microwave signals as low as 1.2 milliwatts/gram of body weight, and one rat was able to sense .6 mW/gm — equivalent to about 1 mW/cm<sup>2</sup>. The team writes in the US magazine *Science* for April 23, 1971, "We offer our data as evidence that confirms and extends the generality of Frey's findings; mammals are sensitive to something that inheres in or accompanies illumination by microwaves at low levels of available power."

Although U.S. scientific findings of specific low power biological effects are growing in number, the only microwave health hazard officially recognized in the USA is general body heating. The present exposure tolerances appear to be more than adequate in safeguarding against known heating effects: heat prostration, testicular damage and the formation of cataracts. However, scientific opinion and government concern, partly engendered by the Radiation Control Act of 1968 and the Occupational Safety and Health Act of 1970, appear to be motivating much more comprehensive studies.

## THE NAVY INVESTIGATES

Is there a clear and present microwave danger? If not, what is the precise nature of the phenomena? The Navy, in particular, has embarked on an extensive research program. One of

their most ambitious experiments is being conducted by Dr. Dietrich Beischer at the Naval Aerospace Medical Institute, Pensacola, Florida. Beischer has constructed an 8x8x10-foot chamber in which Navy volunteers will live for several months at a time; they will be under uniform exposure to microwaves beamed from a 16-foot antenna outside their quarters. (*Microwaves*, April, 1972) Beischer will be looking for long-term effects of extremely low power microwaves, initially less than 1 mW/cm<sup>2</sup>, on a gamut of physiological and psychological variables: body weight, temperature, EEG and ECG rhythms, decision making, reaction time, anxiety, etc.

Dr. Beischer was reluctant to tell me more; the Navy has become sensitive since the appearance of a columnist's story about the project. The use of human guinea pigs is less shocking than it appears, however; communications technicians and plywood workers, who use microwave ovens to dry their products, are routinely exposed to the low level radiation that will be employed in the experiment. Except for cases of inadvertent overexposure, there have been no reports of microwave injury. The possibility of insidious long term damage exists, of course; high-power-microwave-induced cataracts have gone undetected for years. In any case, Beischer has had difficulty in procuring volunteers because of manpower shortages in the Navy, and it will be some time before any firm conclusions can be drawn from the project.

## A DIFFERENT KIND OF HEAT

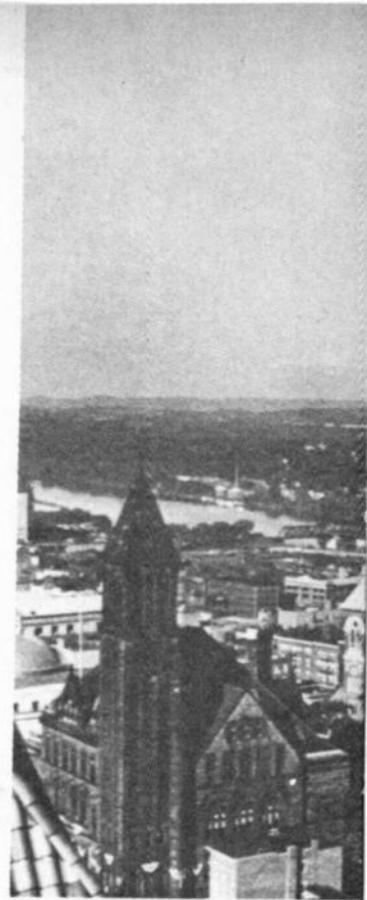
Animal experiments have highlighted phenomena which may represent clear hazards to man. Although these studies used not insubstantial amounts of microwave energy, the injuries they produced may not be of thermal origin in the usual sense. In 1961, for example, C.A. Van Ummersen, a Tufts University biologist, exposed chick embryos to microwaves for five hour periods, elevating their temperature only 3.5°C above the normal incubation temperature, but producing many abnormal embryos. Raising embryo temperature by other means had no serious consequences.

Dr. Russell Carpenter of HEW's North-eastern Radiological Health Laboratory and Elliot M. Livstone, Presbyterian University Hospital, Pittsburgh, reproduced Van Ummersen's results with the meal-worm beetle. Irradiating 140 pupae in 80 mW or 20 mW waveguides for 20-30 minutes or 120 minutes, respectively, they found that only 36 developed into normal adults. Again, pupae exposed only to the equivalent

temperature ambient were mostly normal. Speculating about the mechanisms responsible for microwave-stymied growth, the researchers write, "Successful development and metamorphosis depend upon a system of delicate chemical balances involving so many enzymes and hormones and their interactions that there must indeed be almost countless targets for microwave radiation to strike." (*IEEE Transactions on Microwave Theory and Techniques*, February, 1971).

Carpenter has also attempted to understand how microwaves cause cataracts. The lens of the eye is particularly susceptible to microwave damage; Carpenter has shown that microwave injury is cumulative at subthreshold doses, i.e. repeated exposure to small amounts of microwave energy can create the same opacities produced by much larger single doses. Thus, cataract formation cannot be a purely temperature dependent phenomenon. In collaboration with Dr. Jin Kinoshita, Harvard Medical School, Carpenter detected a significant decline in ascorbic acid in rabbit lenses soon after irradiation. Drs. Van Ummersen and Frances Kogan found the DNA-synthesis-and-mitosis inhibition were also characteristic concomitants of microwave exposure.

The combination of microwaves with another stressor, such as physical





*A microwave transmitter, one of more than 6 million in the US. Government agencies are undertaking a new look at the radiation hazards to man.*

the scientific traditions of the two nations. The Soviets are satisfied with subjective observations of behavioral changes, a practice going back to Pavlov; American scientists are more reductionist. They must have hard objective statistics on behavior and a microscopic understanding of the mechanism involved. Moreover, Russian experiments have frequently been reported without sufficient detail about experimental procedure. When US scientists have learned of these crucial fine points, they have often been able to confirm results which originally appeared to be dubious.

But a research effort of significant proportions is finally getting underway. The Office of Telecommunications Policy, part of the Office of the President, is co-ordinating the research activities of various government agencies implicated in microwave safety: Defense, HEW, Environmental Protection Agency, FCC, FAA. The Electromagnetic Radiation Management Advisory Council (ERMAC) associated with the OTP has drawn up plans calling for an expansion of microwave study and an increase of funds from the presently allocated US\$4 million to an impressive US\$63 million.

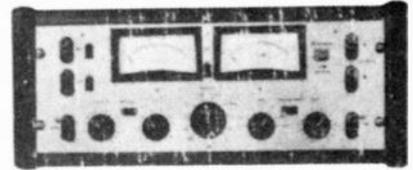
In a report issued in December, 1971, ERMAC emphasized the uncertain safety of the 6,000,000 transmitting devices now in use and the 200 000 microwave ovens predicted for the seventies. Using such phrases as "increasing anxiety," and "an era of energy pollution," the report concludes on this note: "Thus, the consequences of undervaluing or misjudging the biological effects of long-term, low-level exposure could become a critical problem for the public health, especially if genetic effects are involved."

The document, which was prepared with the obviously tendentious purpose of obtaining a major increase in funds, may exaggerate the urgency of the situation. Allan Frey, who is a member of the U.S. Standards Institute committee on microwave safety, told me there is insufficient reason to tighten the present 10mW/cm<sup>2</sup> limit, at least until more evidence is in. However, the pioneer in low level effects did say that he is still bothered by the sight of a major radio station opposite an elementary school.

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Volume Thirteen Number  
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restraint, can synergize, according to Dr. Justesen. Harnessed rats subjected to 10.5 mW/gm radiation showed rises in body temperature 1°C greater than those of unharnessed rats exposed to the same radiation. Indeed, a few of the restrained rats succumbed to hyperthermia at a deep colonic reading of 43.5°C, while their untrammled peers sweated it out at a more comfortable 39°C for a full four hours. Justesen told me that the irritation of the restraint, coupled with the novel stress introduced by the microwaves, can lead to a potentially lethal endogenous release of heat. "The heat at the seat is a good reflection of an animal's emotional state," he said. Microwaves can precipitate an emotional upheaval.

Concern about the biological effects of microwave radiation has been slow in coming in the U.S. One reason, ironically, is the thoroughness of the earlier military research on the thermal hazard. For years, the vast Russian documentation on the subject has been relegated to the back rooms of scientific establishments — the catch basins for persistent irritations which do not conform to prevailing patterns of thought.

The explanation of this benign neglect is complex. Allan Frey has pointed to the generally inadequate quality of available translations from the Russian. But perhaps of greater importance is the great gap between

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Sonics three-way speaker 8", 5½", 3¼".

**Complete system: \$335**



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J.V.C. Nivico 100 watt four-channel amp.

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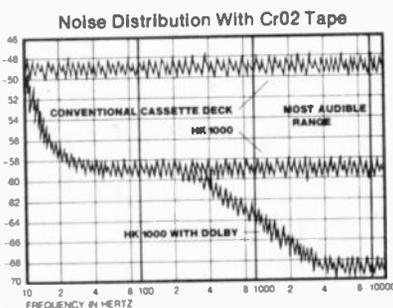
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# Never before has this little noise accompanied this much music.

If you're sophisticated enough to be reading this magazine, you're probably familiar with the two main characteristics of cassette decks: hiss and nonlinear frequency response.



## Noise.

Which should make you thoroughly unfamiliar with the performance capabilities of our new HK-1000. As the charts indicate, it behaves more like reel-to-reel than a cassette deck:

Signal-to-noise (unweighted) is  $-58$  dB with Dolby and  $-70$  dB in the audible hiss level above 4,000 Hz. The frequency response curve is essentially flat from less than 30 to beyond 15 kHz,  $\pm 1.5$  dB, with CrO<sub>2</sub> tape. (This curve is due largely to the way we drive our heads. Instead of the conventional constant *voltage* drive to the head, the HK-1000 is designed for constant *current* drive. Many studio model reel-to-reel decks are designed the same way.)

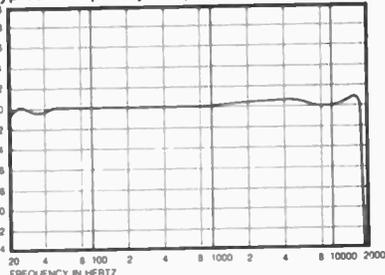
Because of a new low in noise and a new wide in frequency, the HK-1000 brings you a new clarity in music.

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The HK-1000 is also designed so you can use it often

Typical Frequency Response With CrO<sub>2</sub> Tape



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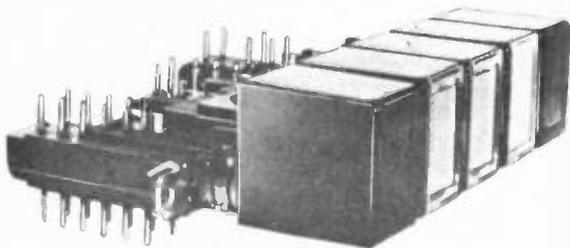


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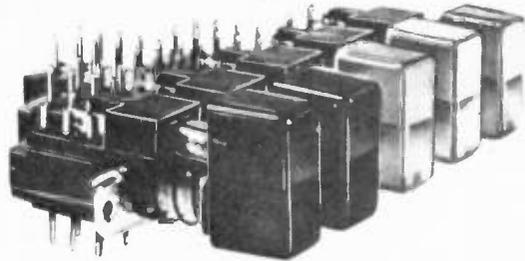
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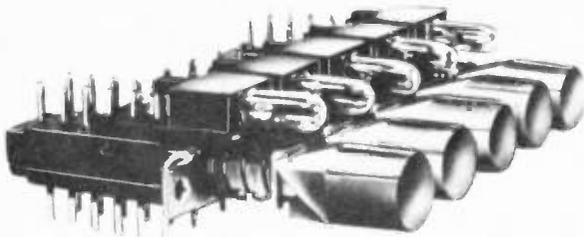
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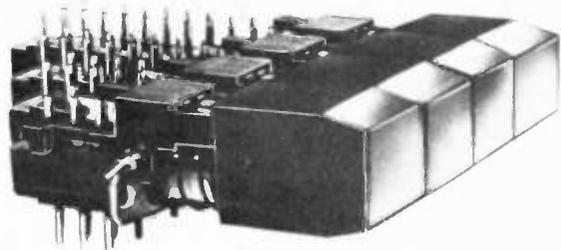
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Button with snap-in lens 15 m.m. pitch.



Style 3.  
Integral button frosted for maximum light dispersion 10 m.m. pitch.



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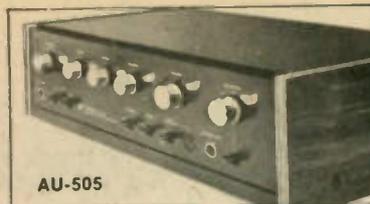
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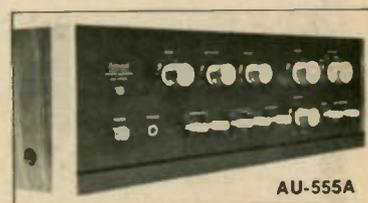
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AU-555A

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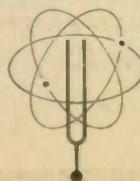
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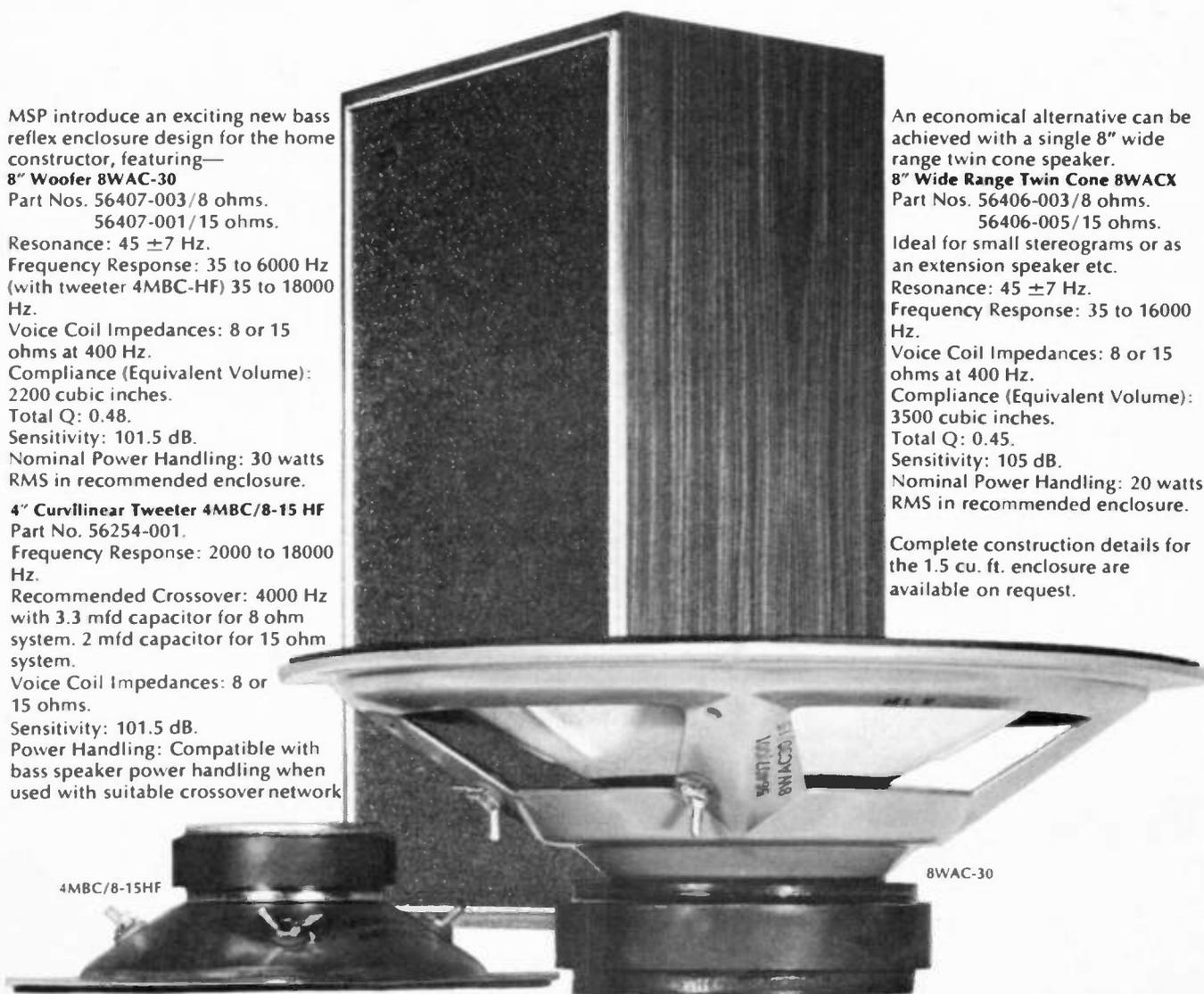
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A.D. 30

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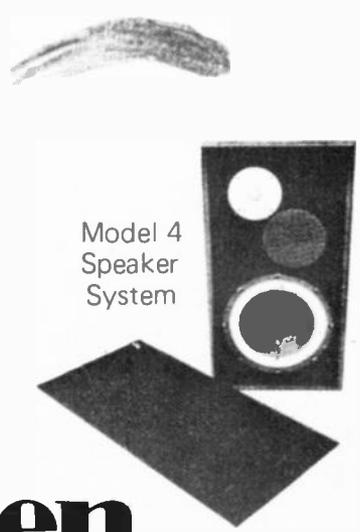
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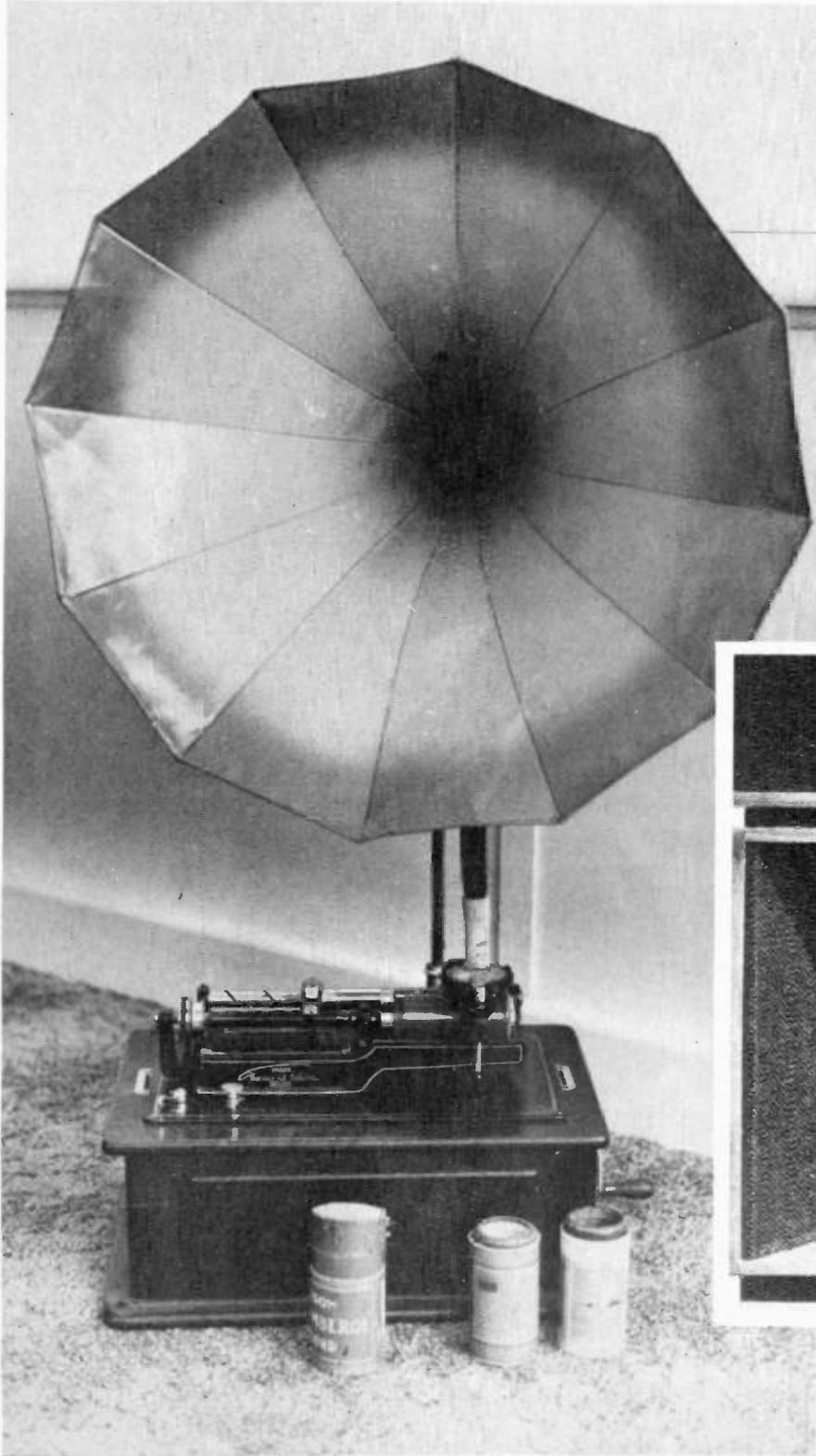
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# Horn loaded loudspeakers

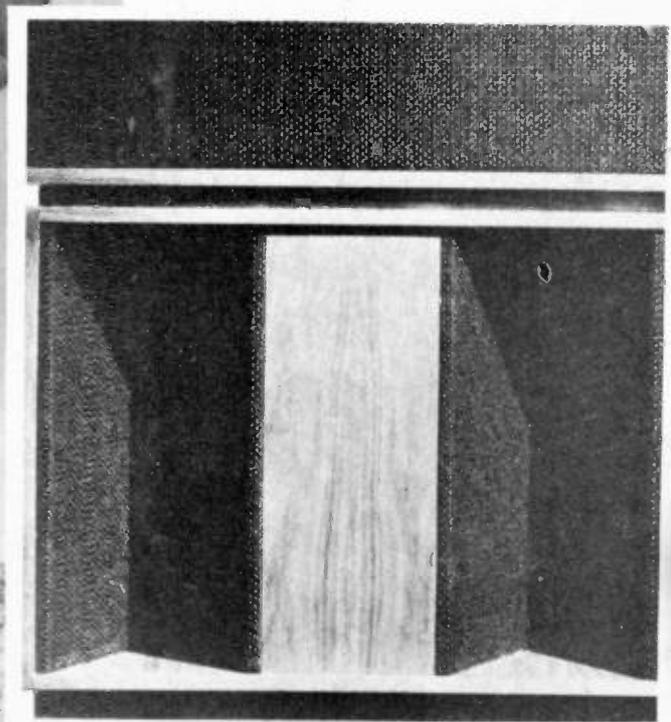
— Terry Mendoza reports



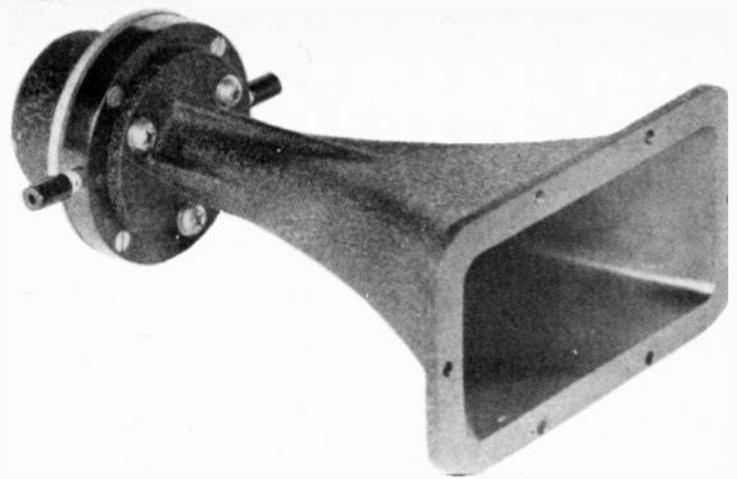
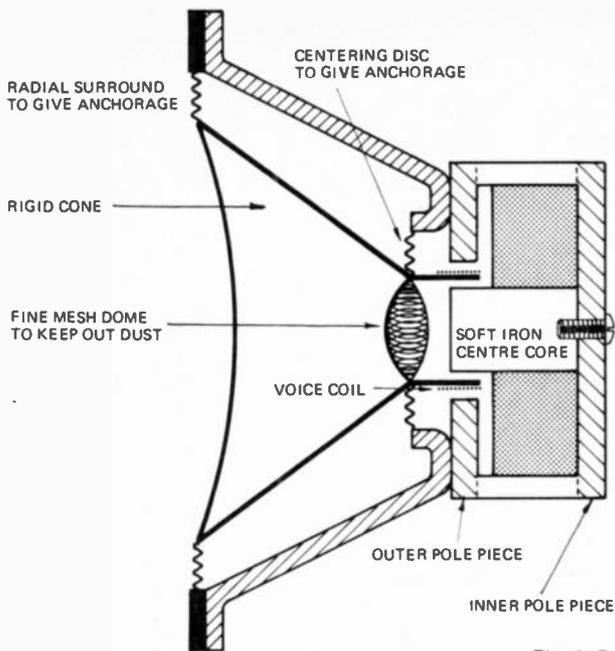
THE function of a loudspeaker is to *transduce* electrical energy from an amplifier into corresponding mechanical movements. Under the influence of these movements the loudspeaker cone impresses similar pressure fluctuations on the body of air adjacent to itself, and it is these pressure variations reacting with the tympanum of the outer ear that produce what we perceive as sound.

Generally loudspeakers are very inefficient, in fact most direct radiating types convert only about 1% of their electrical energy input into sound. This means that to produce the 0.5 acoustic watts that is generally considered to be the minimum requirement for hi-fi reproduction at least 50 watts of power must be supplied by the amplifier.

Numerous factors contribute to this low efficiency. Some energy is lost within the loudspeaker coil in the



*Belle Klipsch is a domestic horn loaded speaker derived from Klipsch units made for theatre use.*



Goodmans Midax 650 mid-range driver

Fig. 1. Section through typical moving coil loudspeaker.

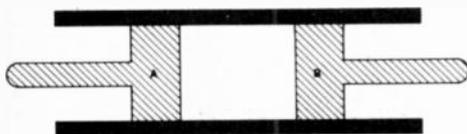


Fig. 2

form of heat. More is lost overcoming the inherent stiffness of the coupling of the paper cone to its radial anchorage. The stiffness is a deliberate attempt to hold the cone such that it can only rigidly pump the air — faithfully following the electrical variations in the coil. (Fig. 1). Loose radial anchorage would permit cone oscillation after the sudden cessation of a signal.

The majority of the efficiency loss however is due to the poor coupling between the 'piston' of the loudspeaker cone and the body of the air that the cone has to push before it.

In Fig. 2 'A' and 'B' represent two frictionless perfect pistons within a cylinder. If the gap between 'A' and 'B' is filled with air and 'A' pushed in, 'B' will move out — though not exactly in phase with 'A' due to the compressible nature of gases. When 'A' is suddenly halted the inertia of 'B' will cause it to overshoot. The lower pressure thus caused will 'suck' it back and this cycle will then be repeated until B oscillates to a halt. A situation similar to this is found in two separate aspects of loudspeaker systems.

Firstly, when a signal is impressed across the speaker voice coil, the coil and cone (known collectively as the driver) will move in one direction; when the voltage polarity across the coil is reversed (half a cycle later) an

ideal driver would start to move in the opposite direction. This it does, but only after first overcoming the inertia of cone and driver that only half a cycle earlier had been intent on impelling itself forward.

Secondly consider the loudspeaker cone which has been pushing a volume of air before it. As the cone begins to retrace its steps, the thin layer of air nearest to the cone, with less mass (and consequently less inertia) than the cone/voice coil combination, follows them back again instead of transmitting its energy to the next (hypothetical) thin layer adjacent to it.

Reverting to Fig 2, piston 'B' can only exactly complement the action of piston 'A' if the gap is filled with an incompressible fluid. Unfortunately, with actual loudspeakers the driver 'A' has a harder task than to pump incompressible liquid or compressible air down an enclosed 'energy link' to react on an eardrum — represented by piston 'B' — the driver has to pump into the open air. It is like trying to power a car with the cylinder head removed from the engine block!

But if the air could be made to behave like an incompressible liquid, a very efficient coupling between the driver and the air would result. A number of methods have been devised to approach this ideal; by far the most effective of these, with efficiencies of up to 50%, is the method known as 'horn loading.'

The acoustic properties of horns have been understood for thousands of years — the 'bell' of wind instruments relies on the horn principle for efficiency, directivity, and

characteristic tone. The antiquated 'hearing trumpet' was another application utilising the horn for sound reinforcement.

As already discussed, the task of the horn is rigidly to link the movements of the driving diaphragm to the air in the vicinity. The more rigid the linkage, the better the transfer of energy will be, thus giving the desired increase in efficiency. When energy is transferred, work is performed. Work, as far as the driver is concerned, is the overcoming of the acoustic impedance presented to it. This impedance has two components — a resistive one due to the energy radiated (the productive part of the work), and a reactive one due to the energy stored. This is where there is fruitless cyclical interchange with the driving surface (which is in fact happening in the example quoted earlier when the thin air layer follows the cone on its return journey).

Essentially, the horn acts as an acoustic transformer; it works on the principle of trying to avoid a rapid expansion of wavefront area at any frequency.

This avoidance assumes especial importance in the region near the driver. To understand why this should be so, consider a theoretical point source of sound. It pulsates at a constant frequency and near the source the wavefronts rapidly grow in area. Further away the percentage increase in wavefront area is not nearly so marked. This can be seen by considering wavefront expansion near the sound source.

Let us assume that the radius of this expansion increases from 1 unit to 2 units. The surface area of a sphere is

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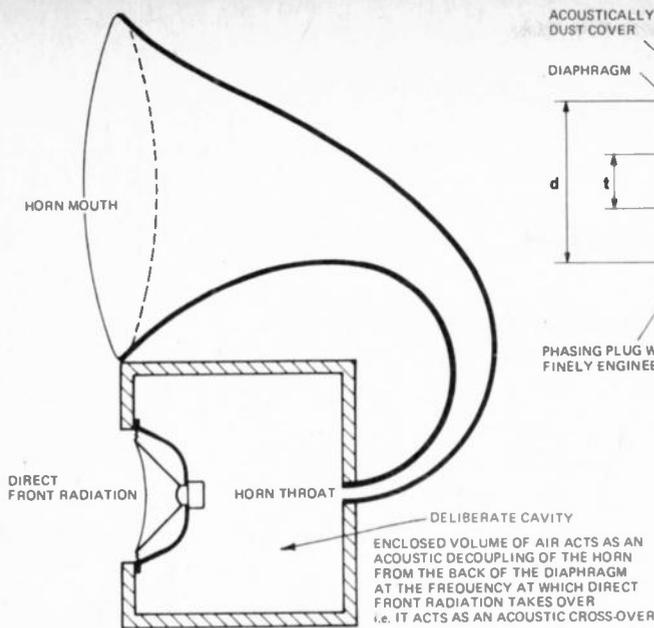


Fig. 3. Horn loading is used for the output of the rear of this speaker to augment the direct radiation from the cone.

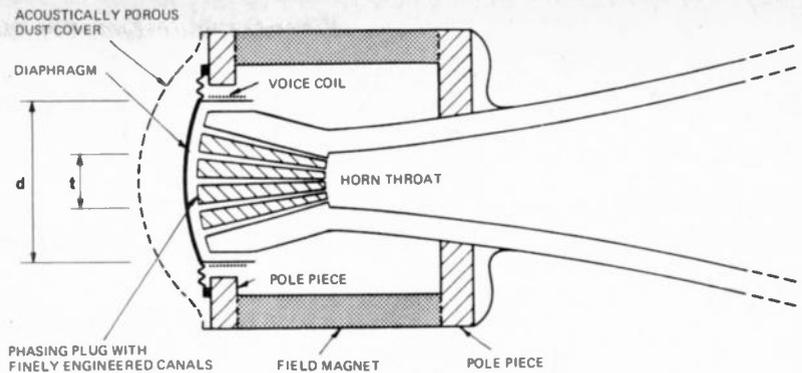


Fig. 4. Cross-sectional drawing of a typical horn-loaded high frequency driver. Note the difference between diameter 'd' and throat diameter 't' that is necessary for efficient loading.

## Horn loaded loudspeakers

$4\pi r^2$  therefore the percentage increase in area is

$$\frac{4\pi (2^2 - 1^2) \times 100}{4\pi 1^2}$$

This equals 300% increase. But considering adjacent wavefronts further away, where the radius is going from 10 units to 11 units the area increase is less rapid.

$$\frac{4\pi (11^2 - 10^2) \times 100}{4\pi 10^2}$$

= 21% area increase

So it can be seen that the narrower end of the horn, nearest the source, is the most critical area for satisfactory acoustic loading.

The horn throat, as it is called, has an aperture lying between one third and one quarter of the active area of diaphragm driving it. Increased loading is possible with a smaller throat/diaphragm ratio, but this is never carried out in practice as it leads to distortion due to friction of the air as it enters the throat.

Horn loaded speakers nowadays are designed to cover an audio range of no more than three octaves, additional horn loaded assemblies being used as required.

However it is fairly common practice to use horn loading for the rear of a loudspeaker — to provide good bass response, the front of the cone being used to directly radiate the output above that handled by the horn. (Fig. 3).

When horns are to be used for high frequencies, a phasing plug is

interposed between the diaphragm and throat to ensure the correct phase relationships by reducing any effective cavities. Even a small cavity can become a resonating chamber at high frequencies — this will give rise to a shrill harsh output from the horn. (Fig. 4). The extremely small clearances used for the phasing plug of a high frequency horn ensure that such cavity resonances as do occur will fall above the range handled by the horn.

### HORN CONFIGURATIONS

After the throat comes the horn itself. There are five inter-related

variables involved here — flare shape, flare rate, horn length and cross-sectional shape, and size of mouth.

The ideal would be a horn possessing a shape that would provide an acoustic resistance that remains constant and of high value for all frequencies within the audible spectrum.

The rate of flare expansion will be dependant upon the algebraic function chosen for the flare curve (Fig. 5) and on the length of horn between throat and mouth. The slower the flare rate, the deeper will be the lower frequency

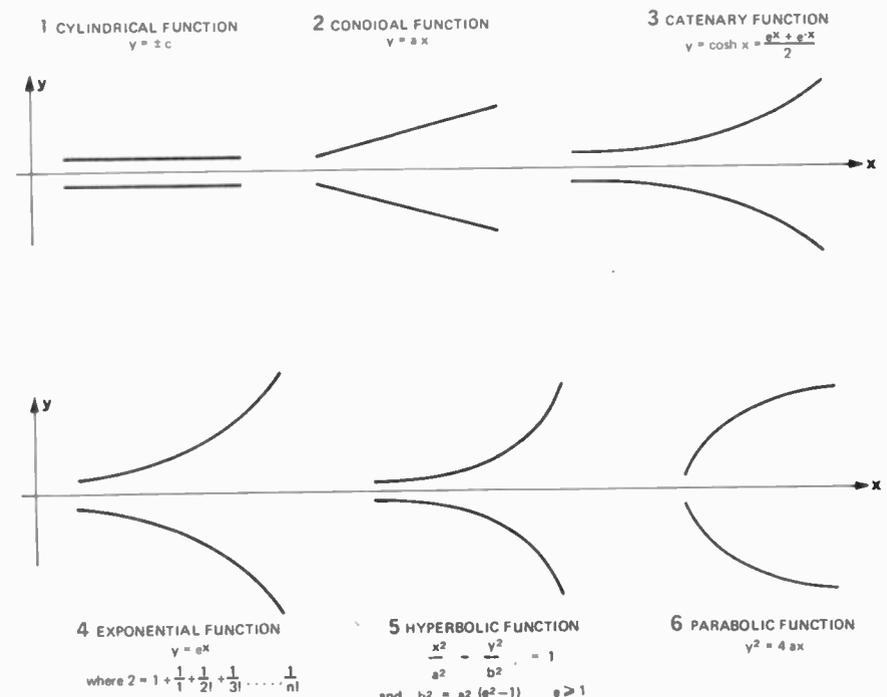


Fig. 5. Flare curves generated by various algebraic functions (see text). Note that 'a' and 'c' are constants.

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The Corona is an attractive two-way bookshelf system that delivers excellent sound throughout a wide frequency range. It has a continuous power rating up to 45 watts but may be used with amplifiers rated as low as 10 watts per channel. A high compliance 10-inch speaker is mounted in an infinite baffle to provide



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And most important of all? It's ALTEC sound. *And ALTEC sound is quite unmistakable.*

Ask any of the sound engineers who specify and enthuse over ALTEC quality monitors. Once you've heard and enjoyed ALTEC sound, *you'll never be satisfied with anything else.*

ALTEC's 893B Corona is the one speaker that can fit into your system beautifully, be it high powered or low powered.

### SPECIFICATIONS

Frequency Response: 50 — 18,000 Hz • Power Rating: 45 watts • Impedance: 8 ohms  
Crossover Frequency: 2500 Hz • Dimensions: 22" H x 12 1/4" W x 9 1/2" D

Speaker Systems are priced from \$250 pr.

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cut-off e.g. for a particular flare curve, if the flare length is doubled (i.e. flare rate reduced by 50%) the cut-off at the lower end of the frequency spectrum will drop by one octave. (Fig. 6).

The flare curve may follow any algebraic function from phase (where  $x = 0$  for all values of  $y$ ) which is known as infinite baffle, to cylindrical — passing through parabolic and hyperbolic.

The hyperbolic group covers conical, exponential and catenary curves. The first type of horn to be used in conjunction with a sound reproducer was the conical variety. This became popular in the days of Berliner's phonograph.

However a conical horn, with zero flare, has an acoustic loading that changes almost continuously throughout the frequency spectrum. It has very poor frequency response because of its extremely low acoustic impedance at the bass end — as can be seen from Fig. 7. Nevertheless, a zero flare gives the lowest distortion of all the curves.

It should be noted that the theoretical results illustrated in Fig. 7 can never be fully achieved in practice because an actual horn system has a finite length and mouth size dictated by space considerations. Even disregarding the enormous horn sizes that would be involved, the cut-off frequency found in practice varies between 1.2 and 1.7 times the theoretical cut-off frequency.

A cone shaped horn has a constant slope giving zero flare. The parabola is one case in which the flare is negative i.e. the slope decreases with distance from the throat. It can be seen from Fig. 7 that the acoustic resistance afforded by a parabolic curve is even less consistent than for a conical one. Taking cases where the flare has a

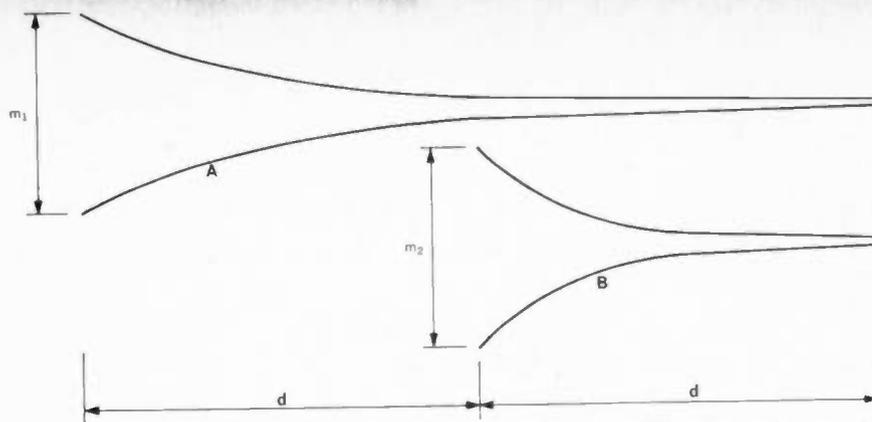


Fig. 6.  $m_1 = m_2$  and flare curves for both horns are the same however horn A has length  $2d$  and horn B has length  $d$ ,  $\therefore$  horn A has a cut-off frequency one octave below that of horn B.

positive value we can see that the graph of acoustic impedance continues to improve up to the point where an exponential function is reached. The exponential or logarithmic horn gives the best overall compromise and this is the most commonly used curve for domestic and public entertainment speaker horn applications.

If the positive flare is increased still further, one comes to the shape known as the catenary curve (this is the curve taken up by a slack rope or chain hanging freely under the action of gravity). The catenary function has the property of providing a virtual cylinder at the throat with almost no wavefront expansion in this area. At regions remote from the throat it approaches the exponential shape.

Finally we come to the cylindrical form of horn. At first sight this comes nearest to our already stated 'ideal' with its uniform acoustic resistance throughout the spectrum. But a moment's consideration will reveal that at the remote 'mouth' end the wavefronts will still be in the same (plane) configuration as they were at the throat. There will be a 'virtual source' at the mouth end and no means to prevent the rapid spherical

wavefront expansion — the very condition we are seeking to avoid.

The wider extremity of the horn terminates in the mouth. The greater the mouth area, the lower is the bass frequency that it can effectively handle. A mouth circumference of around forty feet and a diameter of thirteen feet is required to propagate a frequency of 100Hz.

How then could the reproduction afforded by such devices as the Edison Bell Phonograph be tolerated? The answer is to be found within the mechanism of the ear which produces difference tones corresponding to the successive pairs of partial tones of a musical note. Thus it can provide a bass even when none is given out by the apparatus.

Several compromises are often adopted to bring the dimensions of a bass horn to a manageable size.

One method is to employ 'horn folding' so that the horn is compacted to a cabinet-like enclosure. (Fig. 8). This solution has two main disadvantages; firstly it is almost impossible to retain a true exponential curve if the horn is folded. In addition, the treble frequencies, which tend to travel along the horn axis, have their relative phase affected by successive reflections and this leads to various peaks and troughs in the response curve. Apart from this, unless the reflecting material is chosen with great care, diffusion and absorption can occur.

A second solution, usually combined with the folded-horn design, is to create a triangular cabinet termed a corner horn. The principle — somewhat loosely applied in this case — is that the corner of the listening room can be utilised as an extension of the horn flare. This is intended to provide loading down to a lower frequency than that permitted by the horn alone. Of course it is a rare corner of a room that has an exponential shape, but this approximation does in practice lead to an enhancement of the bass end of the frequency spectrum.

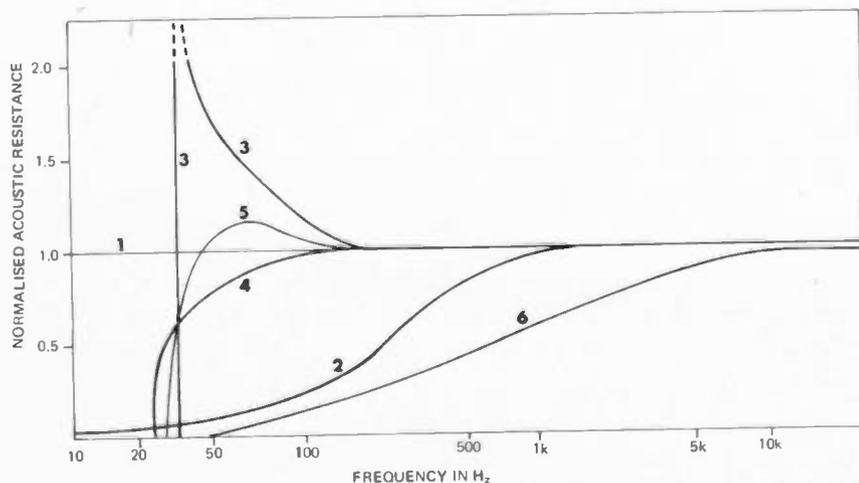


Fig. 7. Acoustic resistance at horn throat for various flare shapes — numbers on curves relate to functions shown on Fig. 5.

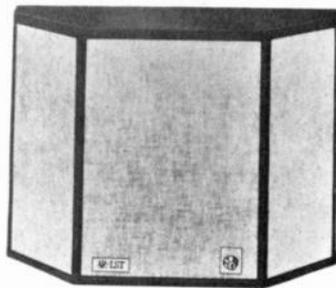
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Highly detailed data available.  
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## AR 7

This speaker is very small (248 x 400 x 150 mm) and therefore particularly suitable for 4 channel use where space is at a premium. It uses a tweeter essentially the same as that used in the renowned AR 6. The smooth and well dispersed energy output of this speaker is well balanced by a newly designed woofer which offers a standard of low distortion bass exceeding that of speakers of much greater size and cost.  
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## AR 2AX

The performance standard in the design of the AR 2AX was the same as that for the 3A: natural reproduction of music without exaggeration or artificiality of sound. But where quality in the case of the AR 3A has been limited only by the state of the art and our own engineering skill, for the 2AX price was also a consideration. "American Record Guide" said '1970 brings us a better than ever 2AX and I am nuts about it'.  
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## AR 6

In the three years or so that the AR 6 has been available it has already become the speaker that all others are compared to in its price range. It employs the very best technology in its cone woofer and tweeter that the state of the art permits and stands comparison with the most expensive AR systems. Also available in unfinished pine.  
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The AR 5 is only different to the AR 3A inasmuch as it uses a 10" woofer and a slightly different crossover. As always the standard of accuracy is the comparison to live music. At AR the best repose curve for a speaker system, like that for a microphone or amplifier, is the one that most closely matches the input. The specifications of the AR 5 are obtained, as in all models, from production units, not prototypes.  
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# Horn loaded loudspeakers

is less and therefore mechanical resistance on the driver can be made much higher than for a direct radiator type speaker. This improves the acoustic damping on the cone.

Horn loading, to sum up, is the principle of the effective coupling of a loudspeaker drive device to the

surrounding air. It is exactly parallel with transformer practice — the horn transforms high-pressure high impedance conditions at the driver to low-pressure, low-impedance conditions, facilitating the effective transmission of sound waves through the air.

## SPEAKER COLORATION

Commerical loudspeaker units tend to each have their own distinctive 'sound' — largely attributed to coloration by the speaker unit or cabinet.

The main component that can lead to coloration in horn loudspeaker systems is flimsiness of horn cabinet construction materials — lack of rigidity leads to resonance of the panel materials thereby absorbing low frequency energy. Thus the advocacy by the experts of sand-filled panels or concrete slabs for the walls of the horn.

Many compromises are involved to bring the chief benefit of vastly improved efficiency of transduction between electrical fluctuation and air-pressure fluctuation.

A major advantage of horn loading is that a smaller, lighter diaphragm can be used, this has less inertia and a correspondingly reduced tendency to 'overshoot'. Also the cone movement

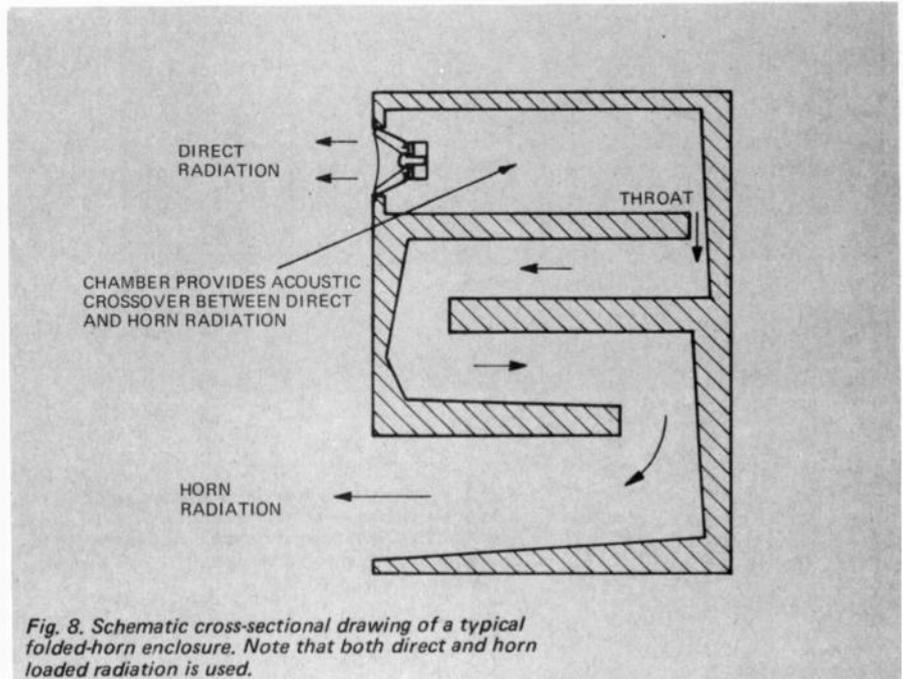


Fig. 8. Schematic cross-sectional drawing of a typical folded-horn enclosure. Note that both direct and horn loaded radiation is used.

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# The loudspeaker

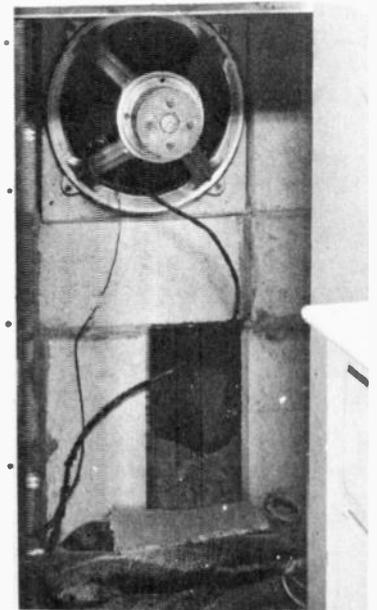
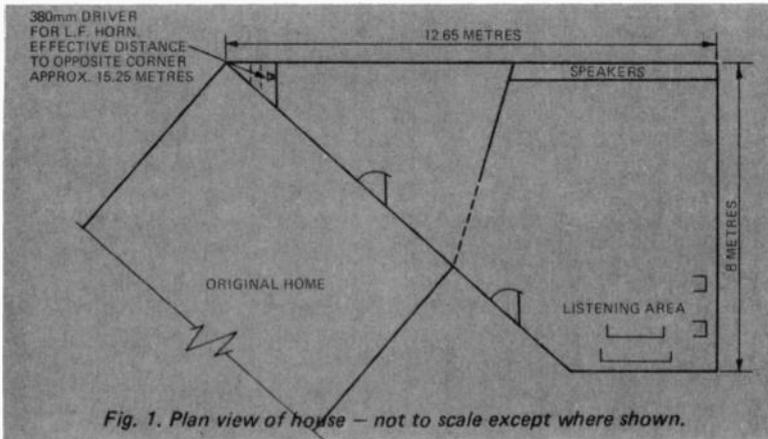


Fig. 2. A 38cm (15") bass driver is mounted in a concrete enclosure at the throat of the horn (see Fig. 1.). This driver is driven by a signal common to both stereo channels.

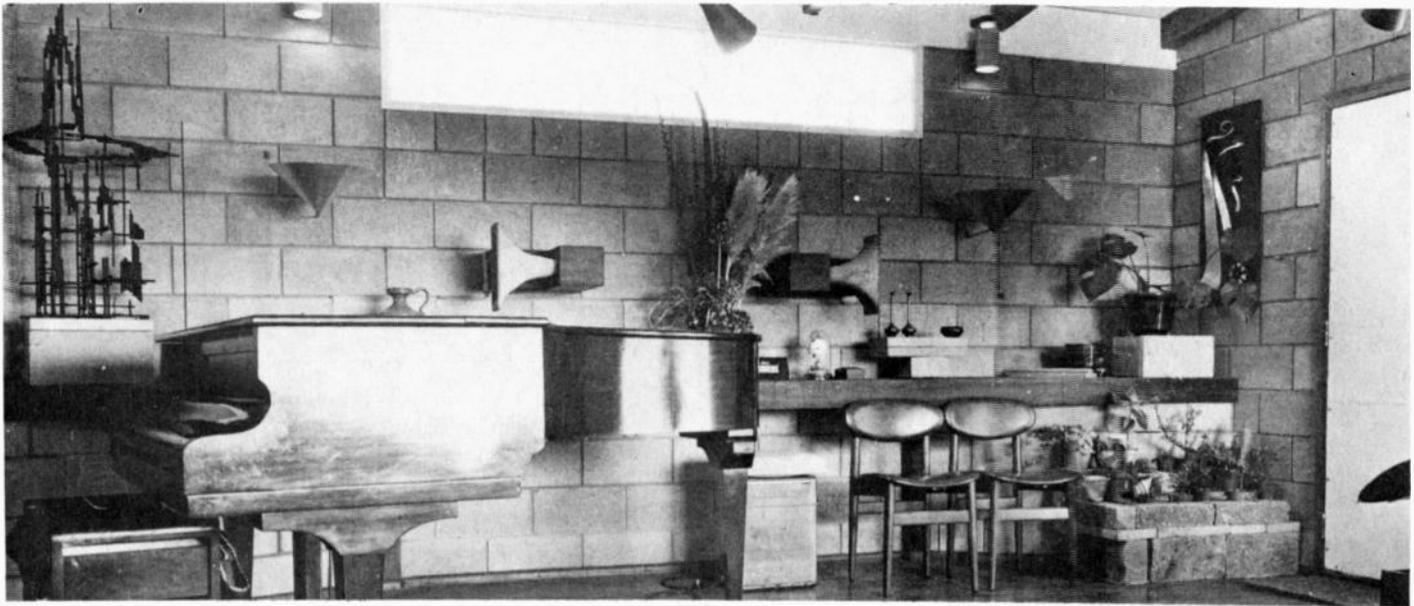


Fig. 3. The speaker system for the stereo channels is unobtrusively mounted. Concrete pressure horns will be hidden in a cupboard.

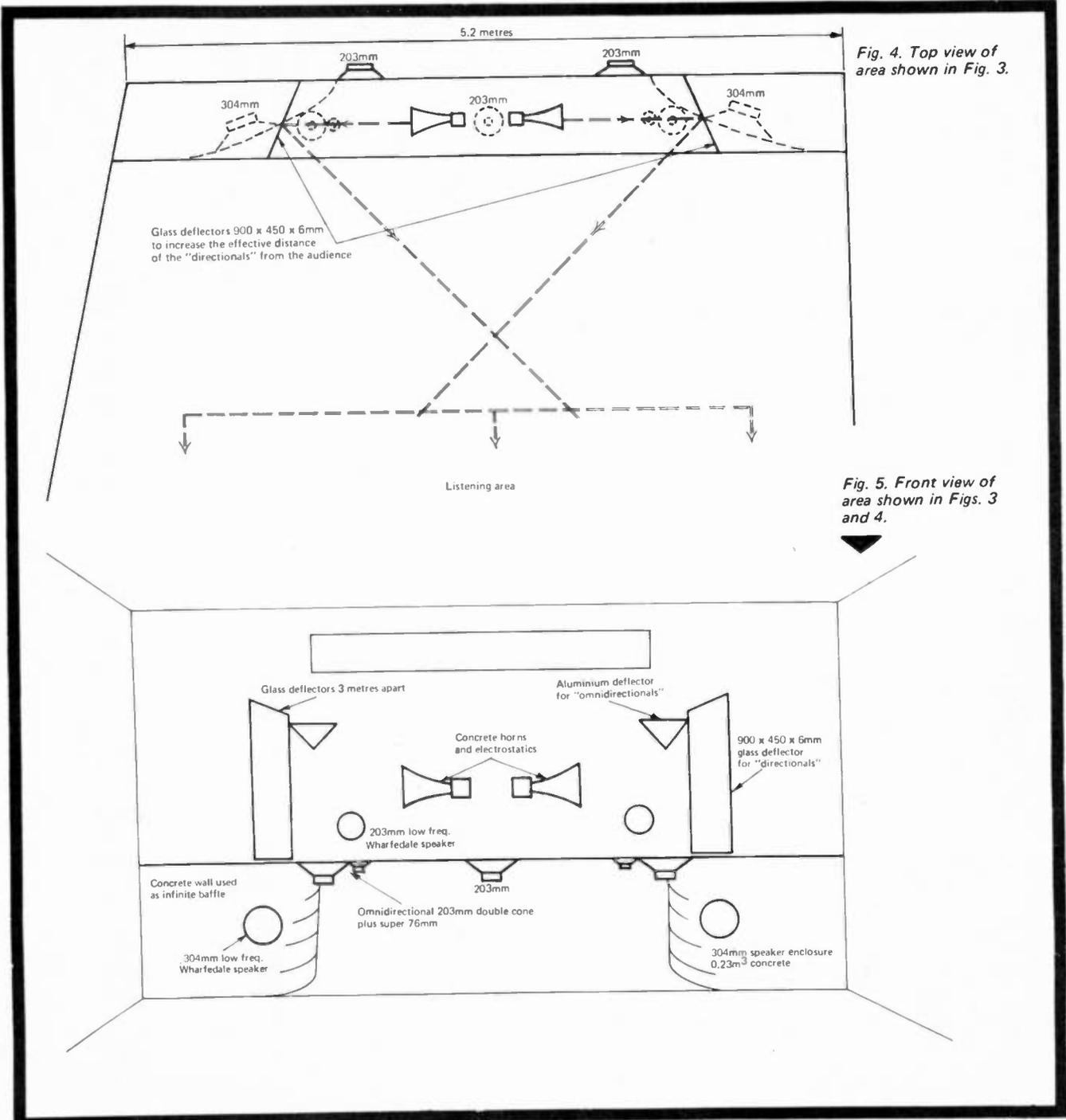
AUDIO fans are forever saying "If only I had a better bass response — perhaps if I used a . . .". Most go no further than the day-dream stage as the cost and sheer magnitude of obtaining really good bass response is usually beyond them.

There are some, however, who determine that the day-dream shall become a reality, regardless of the work, cost and self sacrifice involved.

Such a man is Peter Schmedding of Canberra.

Peter has had a life-long love of organ music and, having for one reason or another missed the opportunity to learn the organ himself, decided to build an audio system capable of reproducing recordings of the "King of Instruments" with sound as faithful to the original bass as possible.

It soon became obvious that the



main limitation to reproduction at 20 to 30 Hz was the acoustic properties of the room itself and hence, undaunted, Peter decided to design a special music room as an extension to his house which could at least reproduce the octave 30 to 60 Hz.

He sought the aid of Brian Sudding of the ABC who designed the room and furniture to the, one would think, incompatible standards of building

codes and acoustic requirements.

Apart from the roof, the entire extension including the reinforced concrete block walls, was built by Peter himself with the aid of his wife who mixed up the odd batch of mortar etc. — what a wife!

We heard about Peter and his music room from a friend at the ABC who said 'you really must go and see it. He's actually designed the room as an

exponential horn — and it sounds good'. So, somewhat tongue in cheek, we decided to go and see and hear it — together with our acoustical consultant Louis Challis and a stack of test gear and records.

The layout of the room can be seen from Fig. 1. It is of concrete block construction with the new front wall extending from the original house at an angle of 40°. The design of the

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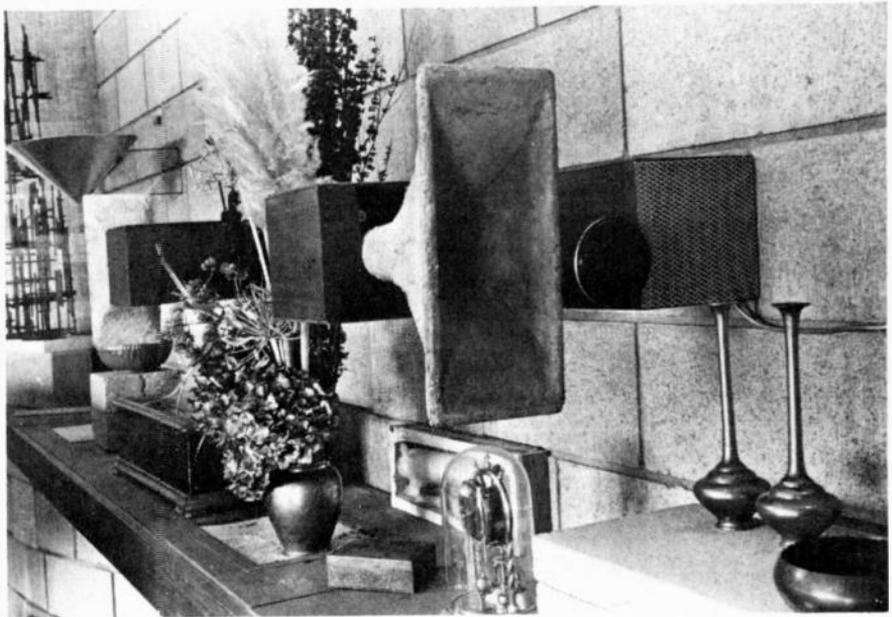
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## The loudspeaker house

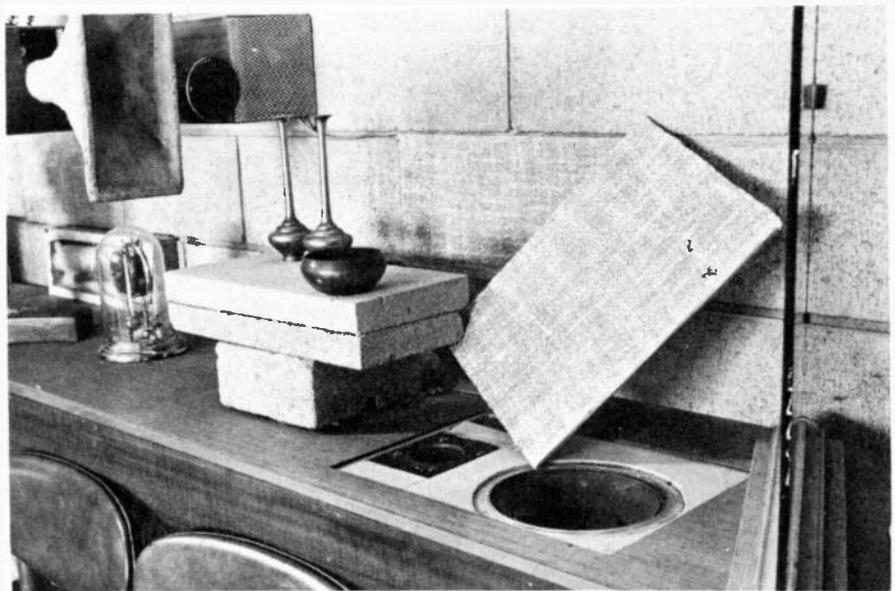
room started with this basic angle and was calculated in wavelengths rather than feet and inches to fabricate an LF horn to cover one octave only, 30 to 60 Hz. The driver for this horn is a 38 cm (15") woofer in a concrete enclosure at the throat of the horn. This is carefully installed so as to be invisible until a louvred door is opened, at the end of what is otherwise used as a sewing room. The ceiling of the room slopes from 3.15 metres at the centre to 2.65 metres at the sides.

The sounds from this low frequency unit propagate out with diminishing intensity towards the main music room and surprisingly, through a louvred-panel room divider which introduces some reflections and some minor degree of transmission loss in the sound path. The drive for the horn is the summed left and right signals in the 30 to 60 Hz octave. The other speakers for the two stereo channels are mounted on one 'side' of the horn and propagate their sound by direct radiation to the listeners.

From the description it may be assumed that Peter has built a room and a system, with money as a secondary consideration — but such an assumption is far from the truth.



*Fig. 6. The concrete pressure horns and Magnavox electrostatics will eventually be hidden in a cupboard in accordance with Peter's view that speakers should be heard and not seen.*



*Fig. 7. The 3 inch and omnidirectional speakers are mounted face up in the bench top. A copper cone reflector (visible in Figs 3 and 6) disperses the sound horizontally.*

The power amplifiers, for example, are Sinclairs — two Z30's and two Z50's. Preamplifiers are home constructed using locally available components.

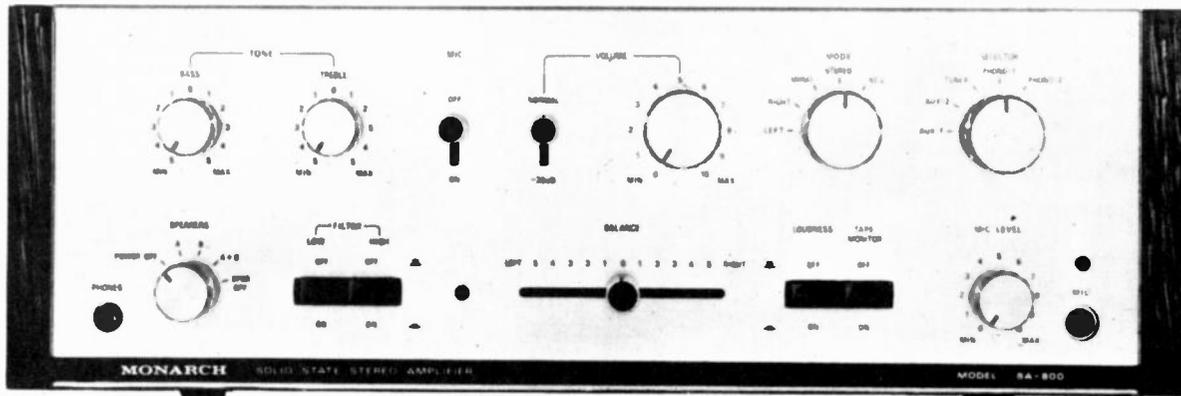
Loudspeakers are mainly Wharfedales, but with carefully modified crossover networks to provide an almost flat frequency response in the middle of the listening area.

Whilst most speaker manufacturers

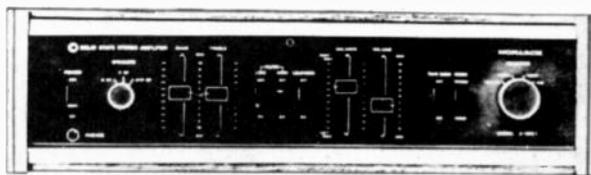
favour direct radiators at high frequencies, Mr. Schmedding has chosen to use plate glass reflectors which are intended to provide — but do not do so totally successfully — added diffusion. In fact, off axis, the high frequency performance above 12 kHz suffers a significant loss of level due to the directivity of the source and the reflectors. A slight curvature in the glass would probably cure this minor problem.

*Fig. 8. The equipment rack contains two turntables (one with a homemade arm), a tape recorder and the four Sinclair 25 watt amplifiers.*

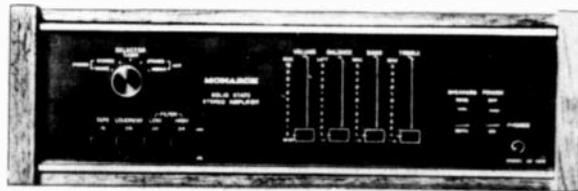
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## MEASURING ROOM CHARACTERISTICS

Our signal source was a beat frequency oscillator, Bruel & Kjaer type 4014 to which was coupled a high speed level recorder. (Bruel & Kjaer type 2305B). A signal from this source was fed directly into the auxiliary input of the main amplifier system.

The acoustical signal was detected by a 1.25 cm diameter. Bruel & Kjaer pressure microphone fitted to a remote preamplifier of a Bruel & Kjaer



Fig. 9. The listening area with the equipment rack on the right. (Extraordinary looking device held by Louis Challis is a sound level meter)

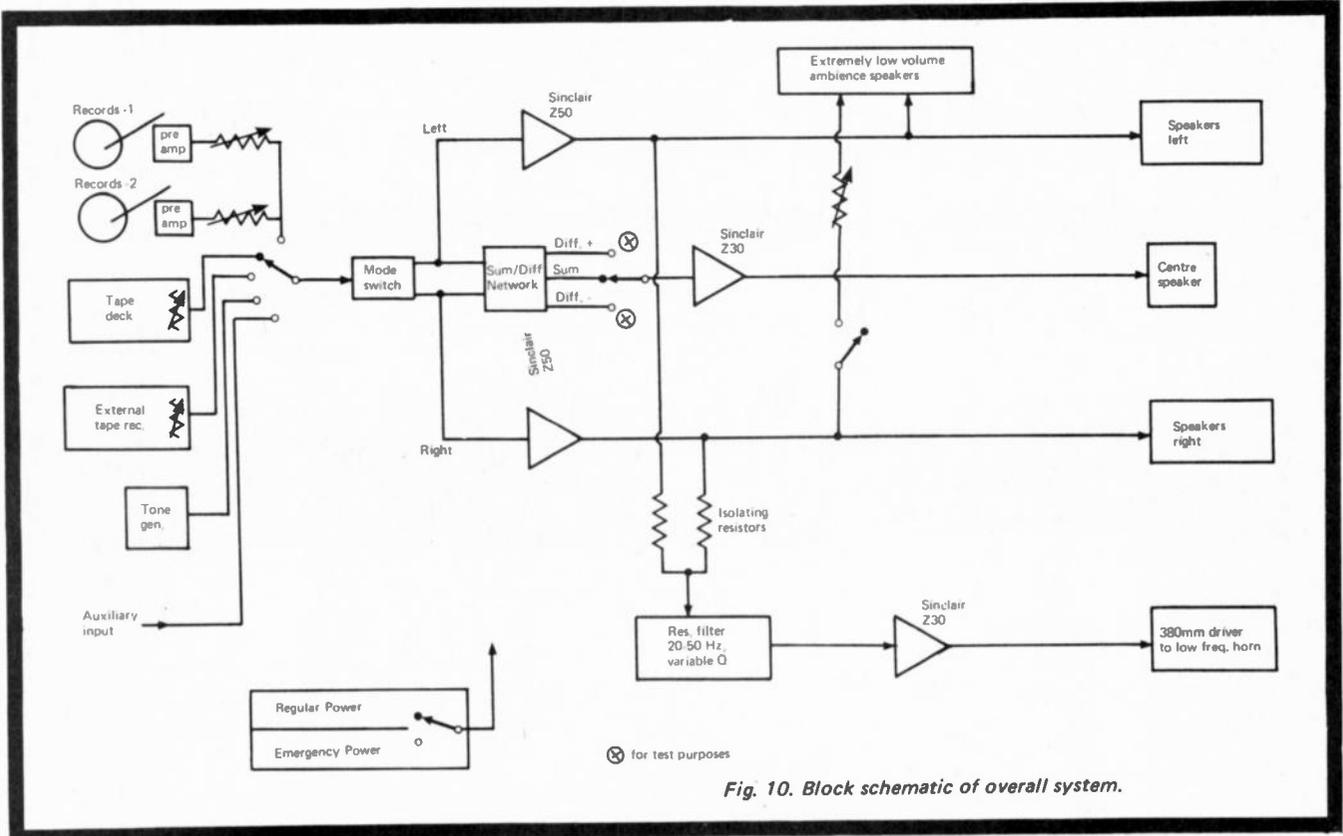


Fig. 10. Block schematic of overall system.

sound level meter. This functioned as a signal amplifier for the level recorder.

The first signals were recorded with the microphone in the middle of the room. The results were excellent. Firstly, the overall response was better than  $\pm 10$  decibels from 20 Hz to 20 kHz, and although the response was not flat, the notches in the response were not excessive.

For comparison we repeated this measurement with the beat frequency oscillator's output modulated by an 8 Hz signal with a 20 Hz deviation. This clearly showed up the overall shape of the room's response which is unusually flat to 17 kHz.

By opening the windows it was found that the audible low frequency response was boosted by as much as 10 dB between 25 Hz and 100 Hz, and simultaneously the response between 200 and 600 Hz was depressed.

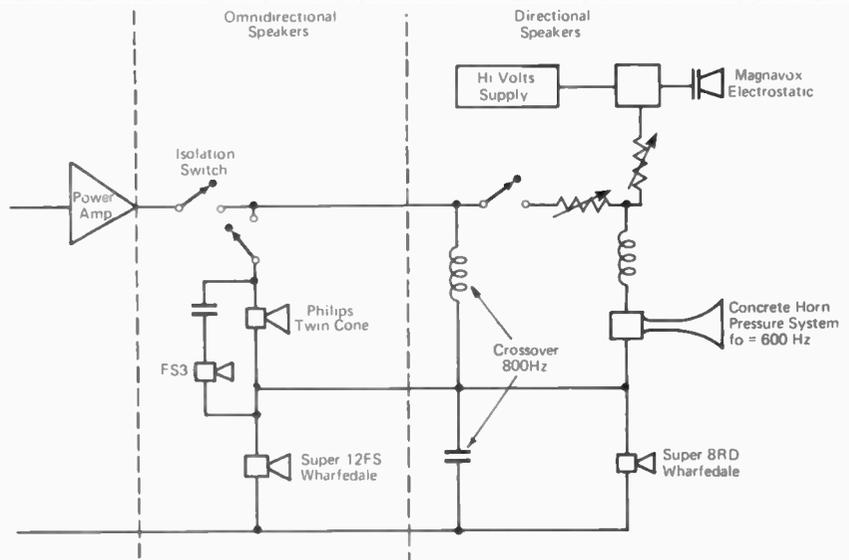


Fig. 11. Speaker system for one channel of stereo system.

## The loudspeaker house

Having established the room characteristics we then used a swept tone frequency response test record to measure the real performance of the built-in record playing system. This test record, which requires external equalization, provides a correctly equalized performance between 20 Hz and 1 kHz.

This measurement showed that the record player preamplifier provides exemplary performance above 30 Hz but degrades the basic room and speaker performance between 20 Hz and 30 Hz.

Peter Schmedding's system has two minor limitations. Firstly, recordings of classical music with any real content below 40 Hz are few and far between — although, surprisingly this is less true of contemporary music. Secondly, the main cartridge fitted to Mr. Schmedding's tone arm is a low cost unit which does not provide the trackability that his system so justly deserves.

But overall, Peter has achieved his aim. The bass response is clean and very dramatic. On records that do have content down round 30 Hz, those reinforced concrete block walls could be felt to shake!

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This is a charming duet, or perhaps can be described as a "conversation" between two harpsicords.

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*Peter's system is so famous in Canberra that he runs music evenings for charity. Here is a typical programme. From 25 to 50 people generally attend these evenings.*

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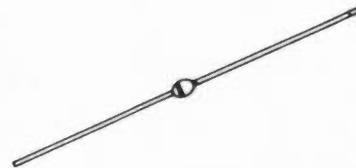
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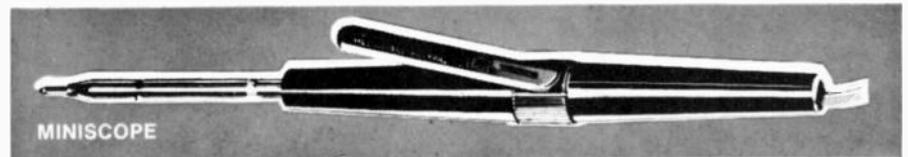
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# Klipschorn folded horn speakers

Virtually unchanged since 1948, Klipschorn speakers still have a very great deal to offer.



THIS is an unusual review, in that, to a greater degree than any we have previously published, it highlights the present lack of internationally agreed standards for audio equipment measurements.

The review is that of the Klipschorn KDFB, one of the range of speakers manufactured by Klipsch and Associates in America.

Paul Klipsch originally demonstrated the folded horn technique back in the 1940's, as a means of improving bass response of horn loaded bass speaker units. The basic physical design of the Klipschorn has not changed since 1948, and units built since then can be brought up-to-date with minor modifications.

Our review is unusual in that Paul Klipsch — a well-known and thoroughly respected engineer and manufacturer — claims efficiencies of 50% to 80% for his products. Yet our most carefully conducted measurements — using several (and duplicated) methods — consistently resulted in efficiency figures around 3% — higher than most other speakers of course — but far short of what is claimed.

Over the past years we at Electronics Today International have been plagued, as have other reviewers, with difficulties in performing measurements on a diverse range of speakers, many of which seem to have a different set of physical characteristics, thus complicating our task of reviewing, evaluating and measuring the performance of the system. One of the most difficult of these tasks, by and large, is that of measuring speaker efficiency, which by definition is the ratio of acoustical output to electrical input. At first sight such a measurement seems particularly simple, but this is not in fact so, and measurements of acoustic power output require very carefully controlled conditions in order to be able to provide an accurate result.

## THE MEASUREMENT OF ACOUSTIC POWER

There are two main methods available for the measurement of acoustical power. The first is to place the loud speaker (or other acoustical source) in a free field, and perform a large number of measurements on either a full sphere, or hemisphere, around the object, thus providing the integrated sound pressure level from which sound power can be derived. The second method is to place the acoustic source in a reverberant chamber to measure the reverberant sound energy (preferably using pink noise as the excitation if the source is a loud speaker). These methods

provide particularly accurate measures of acoustic power.

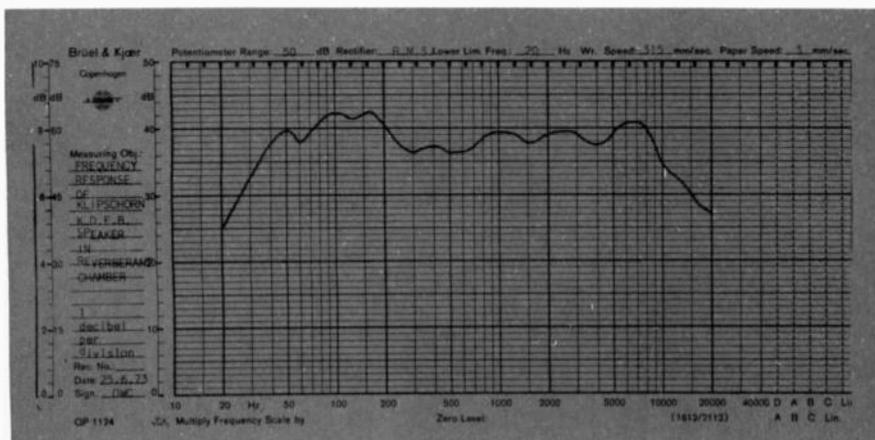
Until recently, we did not have a suitable reverberant chamber at our disposal, but we have now built our own 340 cubic metre reverberant chamber. This has a nominal cut-off frequency of 63Hz and an upper limit of 10kHz. This provides us with an excellent means of measuring the acoustical output from any loudspeaker. In particular, frequencies above 250Hz require a minimal number of measurements precisely to quantify the sound pressure level, and thus the sound power being radiated from the source. Electrical power input to the speaker is measured by a precision high-frequency watt meter which has a nominal 0.1% precision, this being considerably more accurate than the degree to which anyone can specify the acoustical power.

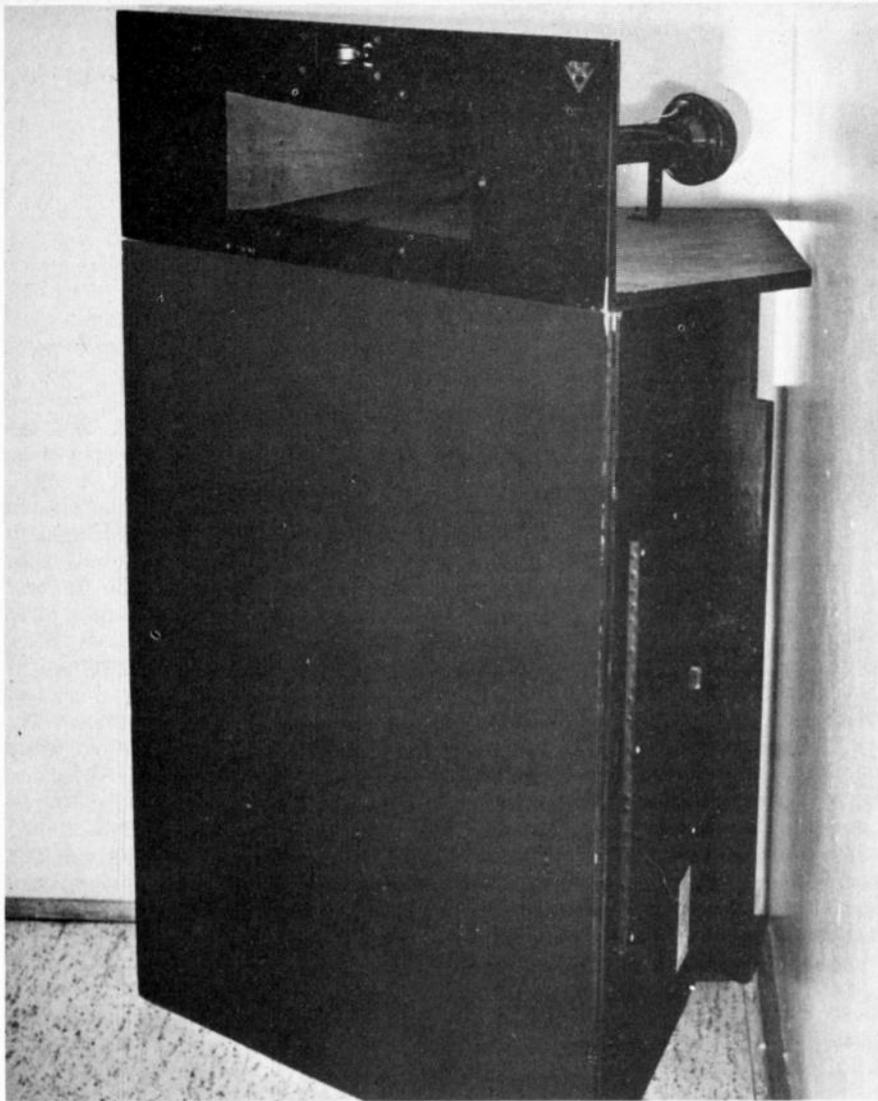
The Klipschorn enclosure is extremely large, measuring 125 cm high in its most elaborate form, and requires a corner location, preferably with two hard reflective walls, with no obstructions for some distance on either side. These walls then form an extension of the bass horn.

The front panel is 75 cm wide and may be veneered in a range of timbers with various finishes to suit all tastes. (The unit tested was the 'decorator' model and is intended for finishing to the purchaser's requirements). The top section, which contains a mid-range horn, and the horn type tweeter, is covered with a black grille cloth extending around the side for approximately four inches.

The main enclosure contains a 36 cm (15") bass speaker radiating into a double folded horn via twin passages, which approximate an exponential shape. The claimed cut-off frequencies for the bass speaker are 28Hz and 550Hz, and the cross-over network for the bass horn rolls off at approximately 440Hz at the top end.

The mid-range unit has a cast horn approximately 55 cm long, and is mounted on a separate panel that mounts on to the top of the bass enclosure. This panel also supports the horn tweeter which has a moulded plastic horn 3.6 cm long. The mid-range unit covers the frequencies





*The Klipschorn enclosure must be located in a corner of the listening room.*

from 400Hz to 6kHz, and the tweeter covers the range from 5kHz to 19kHz. The cross-over network is complex and includes an ideal protection circuit around the tweeter. The circuit arrangement is shown on the diagram attached. The two zener diodes wired back to back in parallel with the tweeter started limiting the tweeter voltage above 3.5 volts, with an upper limit of approximately 5 volts. In the past the manufacturers experienced considerable problems with transients burning out the tweeter driver. This modified network has almost completely eliminated damage to the tweeters, at the expense of generating distortion, which however is not audible.

A removable panel on the side of the main enclosure facilitates easy removal of the woofer by the loosening of four wing nuts. The woofer itself is particularly interesting for a number of reasons: Firstly, it has a huge magnet assembly, measuring 15 cm by 15 cm by 3.6 cm; and secondly,

because of the lack of the roll surround which is seen on most woofers today. The omission of the roll surround is because the excursions required by the speaker are smaller than for the standard acoustical suspension type, or similarly loaded bass units.

### **DOPPLER DISTORTION**

Klipsch has stated that a major design aim of his speaker systems is the reduction of distortion caused by a Doppler effect. Briefly, as a speaker cone radiates complex sound waves into a room, a Doppler shift of some frequencies is necessarily caused by its very back and forth motion. Hence, many spurious tones, or sidebands not related to the desired sound, are created by the frequency modulation action, thus introducing a form of intermodulation distortion. This form of intermodulation is more serious (its magnitude is higher, and its audible

effects more disagreeable) than the more familiar kind of intermodulation in which relatively isolated tones interact.

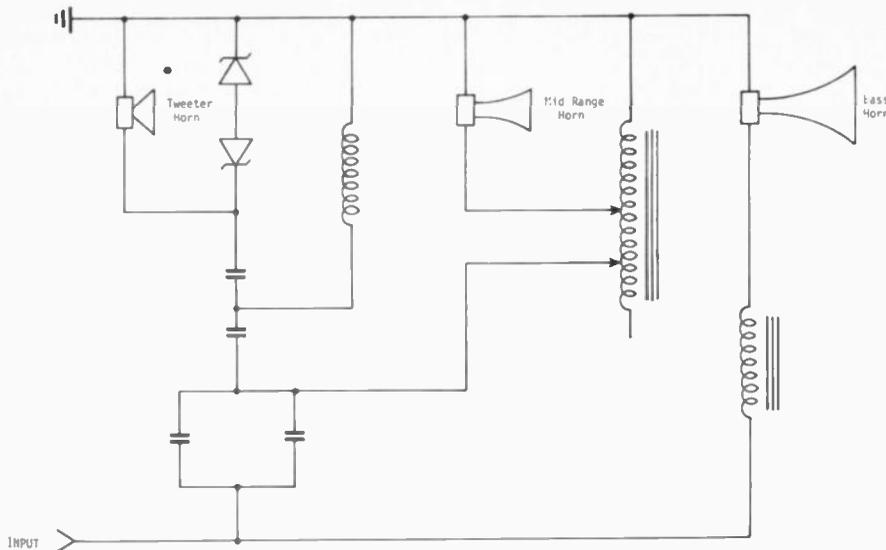
Paul Klipsch has stated that the bass diaphragm motion should not exceed 0.15 cm if this type of distortion is not to be created. Careful computation shows that diaphragm distortion is not significantly different in its components to intermodulation distortion, and these cannot be readily disassociated from one another. To prove this we carried out a series of measurements on a number of different types of speakers driving them with simultaneous low frequency high level signals together with a standard imposed high frequency low level signal.

We computed that by feeding the speaker with a two-tone signal consisting of a 50Hz component together with a 500Hz component, the measured significant components ( $f_2 + f_1$  and  $f_2 - f_1$ ) which lie respectively at 450 and 550Hz should be -30dB with respect to the 500Hz component when the 50Hz component has a peak velocity of 0.24 cm/sec. These components are known technically as the first order sideband components. We then proceeded to carry out extensive laboratory measurements to assess the subjective effect resulting from the generation of such components, and then to correlate these with our computations. The results of our measurements show excellent correlation between the theoretical and practical results.

The results of our subjective tests were that, on most — but not all — programme material, it is particularly difficult to detect this phenomena even if listened for by trained musicians.

To evaluate a speaker such as the Klipschorn subjectively or in fact, even to use them in his house presents the intending purchaser with a significant number of very real problems. The first of these is that in order to utilise them in the manner in which they are intended one needs a considerable spacing between the pair, (Paul Klipsch recommends 10 metres). Secondly, to develop the full low frequency response down to approximately 30Hz, one needs a room with unusually large dimensions. Last but not least, each speaker has to be mounted in a corner of the room with no obstructions near the speakers.

At the time of performing our evaluation we experienced difficulty in finding any room which met these requirements. Hence, the tests that we performed were conducted in rooms the dimensions of which were significantly smaller than those recommended, and out of fairness to



Circuit diagram of Klipschorn cross over network

the speakers we must emphasize that the low frequency performance was of necessity degraded. Nevertheless, when tested under conditions which were imperfect in terms of the criteria stated, the results were still gratifying, and the performance would satisfy most audiophiles in terms of clarity and lack of colouration.

Due to the speaker response being dependent on a corner location, we had to measure the response in a reverberant chamber and make corrections for the room characteristics. To perform this test, pink noise was used as a source and the spectrum was scanned with a third-octave spectrometer. The resultant hand plot of the frequency response does not show the peak to trough excursions normally seen on our free field frequency response test. Tests at different points on the spectrum however, showed that the peak and trough deviations were not greater than 3dB above or below the spectrum shown. The overall frequency response from 30Hz to 15kHz is within  $\pm 6$ dB.

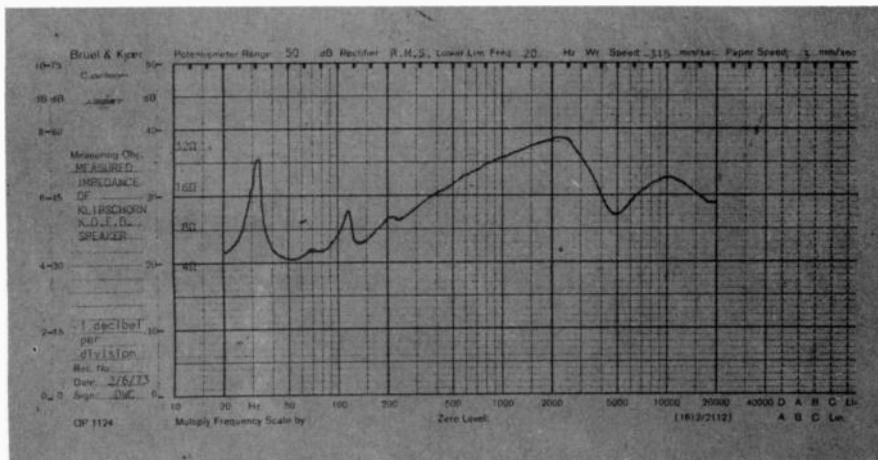
The impedance curve for this speaker system was the most non-linear that we have measured to date. In particular there is a very significant peak at 32Hz — of 27 ohms impedance — and another peak at approximately 2kHz, in excess of 32 ohms impedance. Such a range of impedances would have bothered a valve amplifier but would be unlikely to cause significant distress to most modern transistorised amplifiers, unless it was desired to use an additional speaker system in parallel with the Klipschorn horns.

In his literature, Paul Klipsch claims a typical efficiency of 50 per cent and maximum efficiency of 80 per cent, depending upon frequency. But we cannot see how these claims can be substantiated if efficiency is measured by generally recognised methods.

We proceeded to measure efficiency using a number of different methods. All of these methods gave us answers which were consistent within the order of accuracy of the acoustical measurements  $\pm 3$ dB ( $\pm 30\%$ ). Our measured results show that the typical

efficiency was 3% in the octave band centred on 500Hz. A close examination of Klipsch's papers leads us to believe that the discrepancy between our measured results, and those quoted by Klipsch, is the result of our performing our measurements on the basis of total radiated acoustical power over a total electrical power input in accordance with current international practice. We believe that Paul Klipsch most probably carried out his measurements with a microphone on axis of one or more of the drivers, so that his measurements were based on the combination of the directivity of these speakers together with the resultant sound pressure level. If our efficiency of 3% is multiplied by the computed directivity factor for the mid-range horn, our apparent efficiency (on axis of the speaker) is approximately 50%. Whilst Paul Klipsch may be completely correct in his appraisal and statement of the efficiency, the lack of standardisation in measurements for such speakers does leave much to be desired.

We would like to emphasize to prospective purchasers, that Klipschorns *will* sound louder — at any point in a room — than conventional speakers. But it is only when the listener is positioned within a 90° (horizontal) and 30° (vertical) sector in front of the speaker that the sound will be *dramatically* louder. But such a segment of a room is quite extensive and the serious listener is unlikely to find this limitation to be a major handicap. We also wish to emphasize that, despite our different results, these speakers *are* more efficient than most. To illustrate this, if a typical



### MEASURED PERFORMANCE OF KLIPSCHORN SPEAKER SERIAL NO: 4K475

#### Frequency Response:

30Hz to 15kHz  $\pm 6$ dB

#### Total Harmonic Distortion

(for 1 watt input):

100Hz 1.7%

1kHz 1.7%

6.3kHz 1.4%

#### Electro-acoustic Efficiency at 1kHz:

3%

#### Cross-over Frequencies:

250Hz

5000Hz

#### Measured Impedance:

100Hz 8 $\Omega$

1kHz 27 $\Omega$

6.3kHz 13 $\Omega$

#### Dimensions:

124.8cm x 75cm x 67cm.

#### Weight:

67kg

acoustic suspension speaker were to require 100 watts to generate a certain (high) sound level, the Klipschorns would need a mere five watts to generate a similar level anywhere in the listening room — and even less than that if heard directly in front of

them.

Klipschorns are for serious audiophiles. They are large, heavy and costly — and for optimum results it is almost literally necessary to design the listening room around the speaker.

But serious audiophiles willingly

tolerate such idiosyncracies and for such people Klipschorns have a lot to offer.

The sound produced is most certainly one of the cleanest we have heard to date, and there is a distinct advantage in the smaller cone excursions of the bass unit in reducing distortion.

*As our measured figures for efficiency were so much at variance with those quoted by Klipsch, we telephoned the company — in Arkansas, USA — for their comments.*

*A company spokesman, Richard R. Moore made the following comments:*

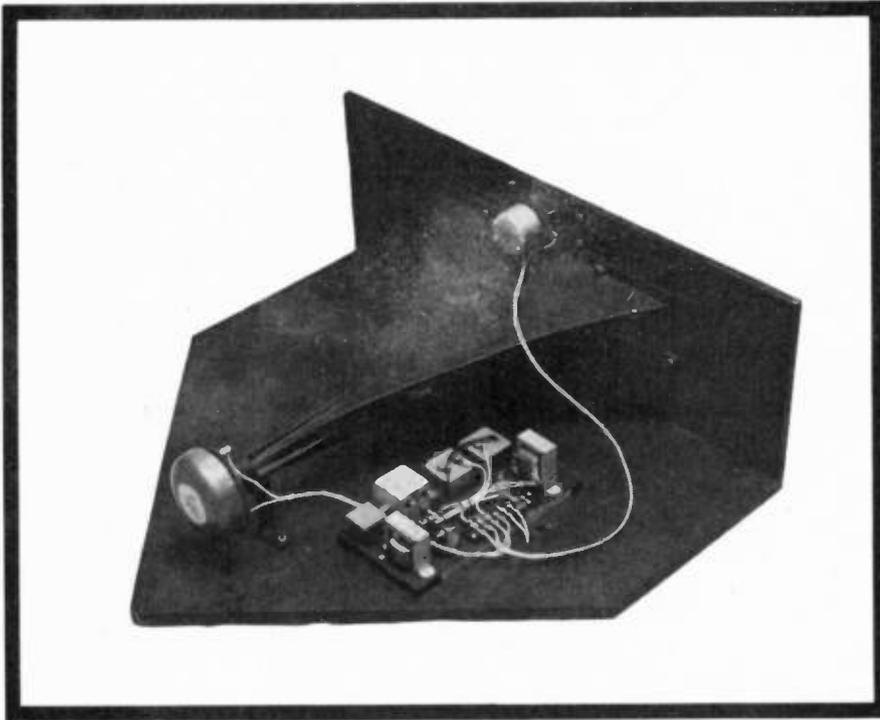
*"Klipsch have never had the opportunity to perform measurements of efficiency using a reverberant chamber. Because of this we have not been in a position to reconcile many of the earlier figures quoted in our literature with our more recent data."*

*"Whilst not disagreeing with ETI's measurements of efficiency, we would have expected a figure somewhere between 5% and 10%."*

*Mr. Moore pointed out that our choice of 500 Hz for the octave band pink noise centre frequency used in our measurement would have been close to the Klipschorn's lower crossover frequency (nominally 400 Hz) and this would have affected our figure by 2-3 dB.*

*"We totally agree that measurements such as these should be standardised and approve of your use of a reverberant chamber for efficiency measurements."*

**Recommended retail price: approximately \$2000 pair. ('decorator' model as tested).**



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### STC SELENIUM RECTIFIER POWER SUPPLY

Housed in handsome Grey hammer-toned metal case measuring 7" x 7" x 4". Input voltage: 200/250V A.C. 50 cycles single phase. Output: 40/52V D.C. 0.4 amps. and 60V A.C. 0.04 amps. Sound value at only \$7.50 plus \$1.00 post and packing. (Illustrated). As above but with an output of 35V D.C. 0.4 amps. Case dimensions, 5 1/2" x 4 1/2" x 3 1/2". Only \$5.50 plus 50c post and packing.



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KEY SWITCHES — brand new Siemens Type (SATO P/No. 475). 4 changeover 95c. 8 changeover \$1.25.

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|---|-------------------|--------|
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|   | 14,000 mfd 13v    | \$3.00 |
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|   | Postage 35c.      |        |
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This month only!

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All 10 watt stud mount

|             |        |
|-------------|--------|
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| 1N1353 12v  | 80c    |
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| 1N1359 22v  | 80c    |
| 1N1368 51v  | 80c    |
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| 1N3014 180v | 80c    |
| 1N3015 200v | \$1.00 |

Post 10c.

#### CERMET MULTI-TURN TRIMMING POTENTIOMETERS

These are precision wire-wound pots for P.C.B. mounting. All at less than half price! Values 50, 250, 2500, 5K, 15K, 20K, 25K, 250K, 500K, 1M ohms. Limited quantity at just 75c. each.

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#### 120 AMP SILICON RECTIFIERS



Suitable for outputs of  
100 amperes (Direct  
forward current) at  
crest working voltages  
of between 50 & 700v.  
These rectifiers  
incorporate an alloyed  
silicon junction in a  
stud ended hermetically  
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S.T.C. RS8  
Series  
HIGH POWER  
SILICON  
RECTIFIERS

Type 108 Power Transistor in T036 case.  
Mounted on large finned Heat-sink.  
Transistor is G.E. (PNP) similar to  
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These precision 10 turn instrument pots  
are ideal for power supplies, level controls,  
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control is required. Suits standard 1/4"  
diameter knobs. Compact in size but with  
5W rating. Values available (limited  
quantity) - 25, 50, 500, 25K, 100K ohms  
plus 10K (5 turn). Normally around \$9.00  
each, to clear at \$3.50., post 25c.

## SPECIALS

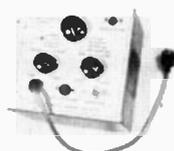
POSTAGE 20c

|                    |   |        |
|--------------------|---|--------|
| 4                  | 2N3638 Transistors  | \$2.00 |
| 2                  | TT3643/2N3643 Transistors                                     | \$2.00 |
| 2                  | TT800 Transistors   | \$2.00 |
| 1 Pr               | TT800/TT801 Transistors                                       | \$2.00 |
| 2                  | 40408/TT801 Transistors                                       | \$2.00 |
| 2                  | 40409/TT798 Transistors                                       | \$2.00 |
| 2                  | 40410/TT797 Transistors                                       | \$2.00 |
| 10                 | EM401, 100PIV, 1A Rectifiers                                  | \$2.00 |
| 8                  | EM404, 400PIV, 1A Rectifiers                                  | \$2.00 |
| 6                  | EM406, 600PIV, 1A Rectifiers                                  | \$2.00 |
| 5                  | EM408, 800PIV, 1A Rectifier                                   | \$2.00 |
| 4                  | 600 PIV 18A Rectifiers  | \$3.00 |
| 1                  | MB1, 100PIV, 2A, Bridge Rectifier                             | \$1.20 |
| 1                  | MB4, 400PIV, 2A Bridge Rectifier                              | \$1.90 |
| 2                  | 2N2646 U.J.T.   | \$2.50 |
| 2                  | 2N3055 Transistors  | \$3.20 |
| 2                  | 2N5459, F.E.T   | \$2.00 |
| 2                  | 2N5485, F.E.T   | \$2.50 |
| 1                  | TC1102 (STC) 400V 6A Triac and<br>Trigger Diode, complete kit | \$3.00 |
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| 6                  | BC107 Transistors   | \$2.00 |
| 6                  | BC108 Transistors   | \$2.00 |
| 6                  | BC109 Transistors   | \$2.00 |
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| 1                  | ST4 GE Diac   | .98c   |
| 3                  |   | \$2.00 |
| 1 pr               | AY6108/6109   | \$1.50 |
| 2                  | AY9149 PNP T03  | \$3.20 |

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A 3 transistor electronic switch featuring  
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Ideal for batch counting, industrial  
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diagram and application data included.  
Operates from 12V DC and is housed in  
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An attractive valve oscillator with a  
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ranges plus spot calibration frequencies of  
100 HZ, 1 KHZ, 10 KHZ. Frequency  
adjustment is by way of fine and coarse  
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Australian-made. Finished in grey  
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\$13.50., post 50c.

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MAGNAVOX 8-30, 30W RMS - \$16.50  
ROLA 12U 50, 50W RMS - \$35.00  
ETONE 12HX8 or 15, 50W RMS - \$35.00  
ETONE 12PH8 or 15, 35W RMS - \$29.00

Freight Extra.

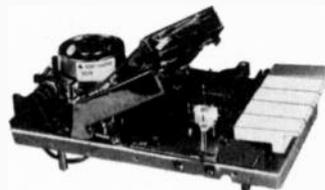
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#### SINCLAIR MODULES

|                                     |         |
|-------------------------------------|---------|
| 20W R.M.S. Amplifier Z-30           | \$13.32 |
| 40W R.M.S. Amplifier Z-50           | \$16.00 |
| Pre-Amp/Control Unit 60             | \$31.30 |
| Power Supply PZ5, 30V, 1.5A         | \$15.42 |
| Reg. Power Supply PZ6, 35V,<br>1.5A | \$27.23 |
| Reg. Power Supply PZ8, 45V, 2A      | \$23.27 |
| IC-12 6 watt IC                     | \$8.50  |
| Transformer for PZ8                 | \$12.00 |
| Active Filter Unit                  | \$21.40 |
| Case/Chassis - teak panel           | \$12.00 |

Special offer not applicable

#### STEREO CASSETTE DECK



'VORTEX' Stereo Cassette Deck  
mechanism with tape eject facility and  
resetable counter. Easily operated by 5  
push-button (piano key) controls, and  
includes high quality heads. Price \$29.00.  
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#### RECORDING AND PLAYBACK PRE-AMP KIT

This professional stereo pre-amp has been  
designed to operate with the VORTEX  
CASSETTE DECK Mechanism. The  
recording and playback pre-amps are  
independent so as to give the best  
performance from each and will provide  
equalization to standard NAB  
specifications. The recording/playback  
switch can be fitted to the VORTEX deck  
"record" button to take advantage of the  
foot-proof interlocking record mechanism.  
Two recording VU edgewise meters and a  
mains power supply are included - no  
extras required.

Price ..... \$28.50  
Post ..... .50c  
SPECIAL OFFER NOT APPLIC.

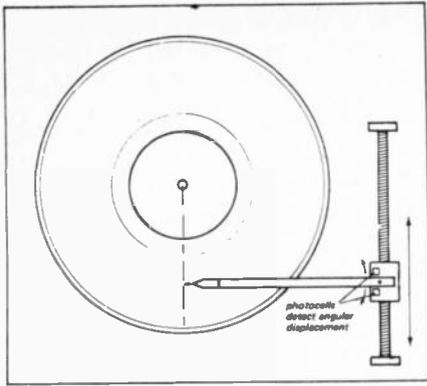
## STOP PRESS! ETI DIGITAL CLOCK KIT PROJECT 521

**\$69-00**  
**POST \$1**



Complete kit incl. case etc. P.C. board  
\$2.90 post 20c. STC GNP-7 \$4.75 post  
30c.

SPECIAL OFFER NOT APPLIC.



*Fig. 1. Simplified drawing of Beogram 4000 shows how tone arm is free to pivot in horizontal plane. Photocells detect angular displacement and servo mechanism then drives complete arm assembly longitudinally to maintain the arm tangentially to record groove. (For simplicity the sensing arm and assembly guide rails have been deleted).*



# BEOGRAM 4000 TURNTABLE

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

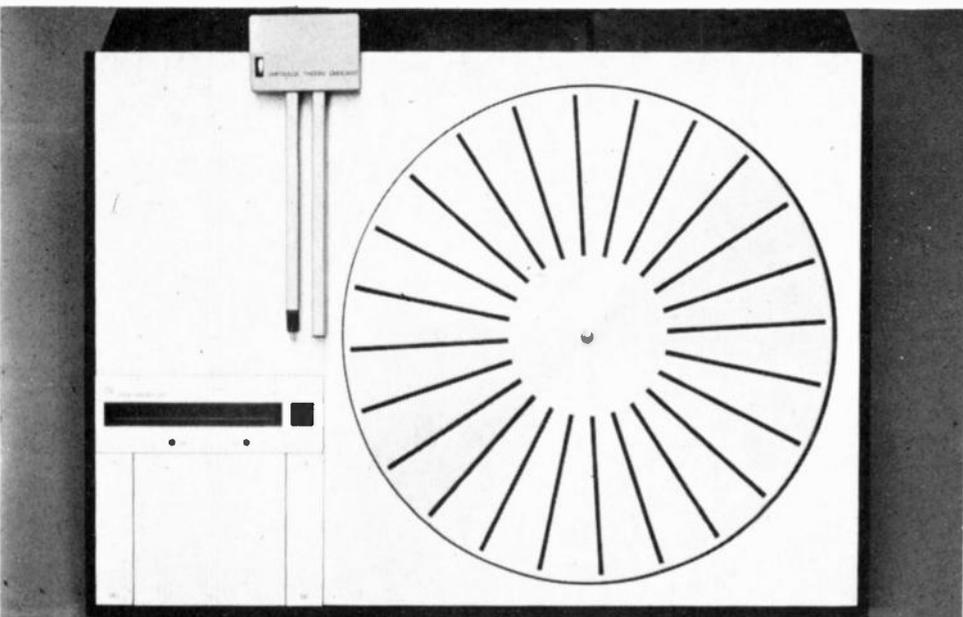
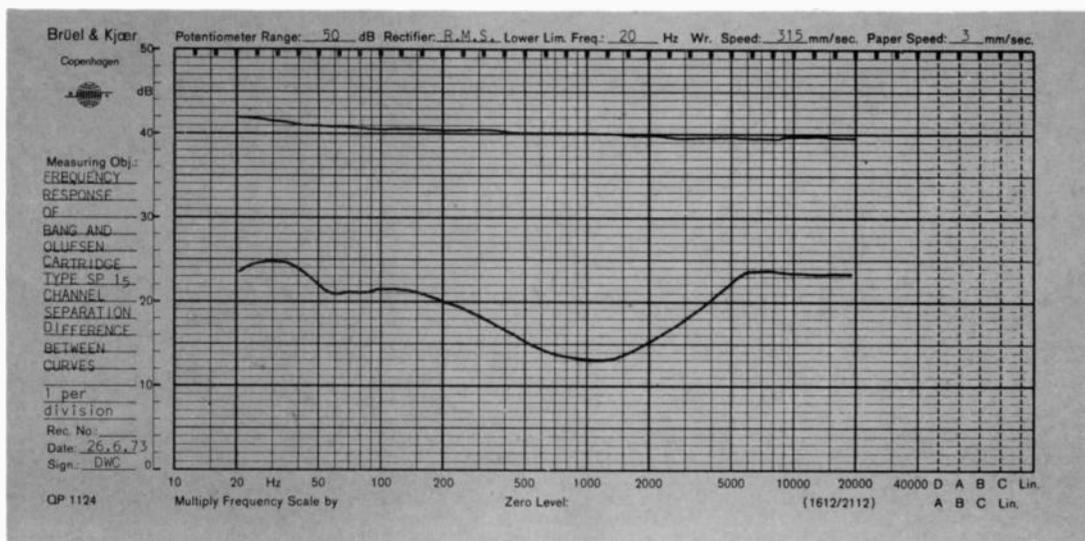
THE BEOGRAM 4000 reviewed in this article is as ahead of its time in terms of engineering, styling, and operating philosophy, as in the field of motor engineering was the ID series Citroen.

The most obvious difference between this and other turntables is the tangential arm which ensures that the pickup moves in a straight line across the full playing width of the record, thus ensuring that the stylus tracks the record groove at the same angle as that

of the original recording cutter. This avoids distortion that is otherwise introduced due to the stylus tracking the record groove at a continually changing angle.

The tangential tone arm, plus a second 'sensing' arm, is cantilevered out from a slide which in turn is positively located but free to move longitudinally along a pair of guide rails. The complete slide assembly is driven up and down these rails, via worm gearing, by a small servomotor.

This brilliant example of Scandinavian design combines unique appearance with state of the art technology.



The tone arm is pivoted in both vertical and horizontal planes. The horizontal angle is monitored by a small lamp and shutter assembly in conjunction with a pair of light sensitive cells, such that as the tone arm deviates slightly to the left or right as the stylus advances across the record, a change in the light sensitive cells drives the tone arm assembly to the left or right as is required, seeking always to maintain the arm tangentially to the record groove, and never allowing the error in tracking angle to exceed  $0.04^\circ$ . This unusual system eliminates all the problems inherent in previous attempts to produce a linear tracking tone arm. There is negligible sideways resistance and because of this there is no noticeable difference between left and right-hand channels. Also it will accurately track an eccentric record

even to the extent of driving in reverse if necessary.

The turntable platter has a reflective metal surface on which are mounted a number of radial black plastic 'spokes'. A small lamp and photo-cell housed in the tip of the sensing arm (this is the arm to the left of the tone arm) detects the presence (or otherwise) of a record on the revolving platter. If a record is on the platter, the light reflected back to the photo-cell will be fairly steady, but if the platter is uncovered, the reflected light from the polished metal turntable will be regularly interrupted by the black radial spokes, hence a chopped dc voltage will be generated by the photo-cell.

When the turntable is switched on, and the record playing sequence initiated, the sensing arm and the tone arm move steadily along their guide

rails until the sensing arm is over the edge of the record. If no pulse signal (from the spokes) is received, the sensor assumes that a 12" record is on the turntable. At this point the tracking sensor motor is de-energised and the tone arm automatically lowered. If a 10" record on the platter then the sensing arm would continue to track inward until the edge of the record was detected and at that point the tone arm would be lowered as previously described.

Should a 7" record be resting on the turntable then the arm would automatically track across to the 7" position, and, apart from lowering the arm, the mechanism would cause the platter drive motor to switch to 45 rpm. A manually operated '33 rpm' overriding facility is provided for those 7" records that must be played at that speed. If there is no record on the platter at all, the sensor detects the moving spokes as the arm tracks across the platter, until, when the centre is reached, the arm is returned automatically to the rest position.

Manual over-ride controls are provided to enable the user to lower the tone arm on to any required part of the record. A calibrated scale assists the user to select any desired track — these manual controls are interlocked with the spoke sensing circuitry ensuring that the arm can only be lowered if a disc is on the platter.

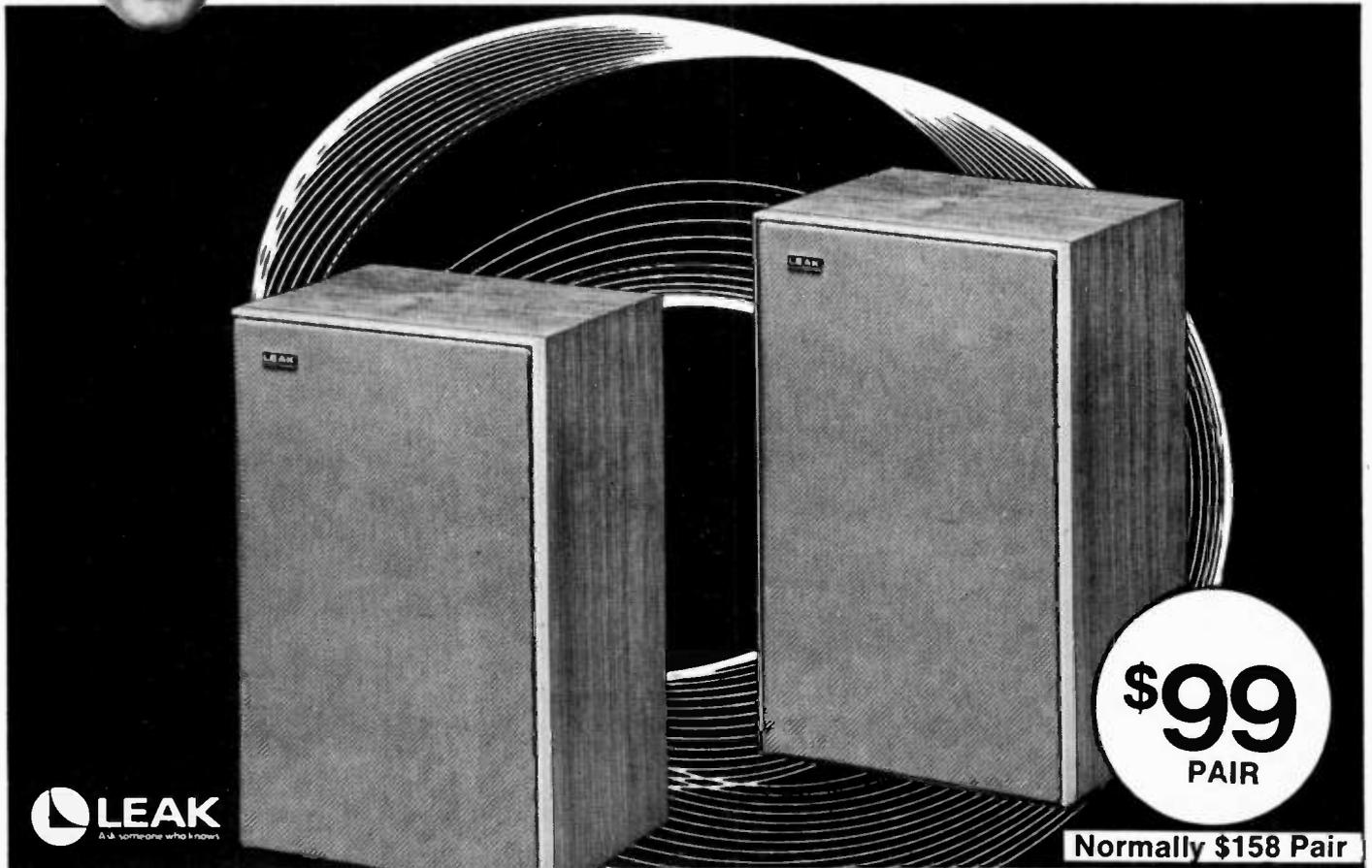
The raising and lowering arrangement for the tone arm operates electropneumatically and incorporates an electromagnetic to overcome the spring loaded mechanism.

The advantage of this electropneumatic system is that should the power be removed from the turntable the arm will immediately rise, thereby protecting the record and the needle against possible damage should power be reconnected.

The Beogram 4000 is not only



No one but "Mr. Hi Fi" could bring you value like this!



**LEAK**  
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Normally \$158 Pair

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For the second time in as many months Jack Stein makes history with another scoop buy. This month you're being offered superb Leak 150 Speaker Systems for only \$99 pair. These Leak loud-speakers deliver pure clean sound that you must hear to believe it's possible at this price.

- Impedance: 8 ohms normal
- BASS—170mm Sandwich Unit
- MIDRANGE—66mm midrange/treble
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- Plus a 3 year warranty

# Jack Stein Audio

275 Clarence Street (Town Hall end) Sydney 2000. Phone: 29-6315

# BEOGRAM 4000 TURNTABLE

unusual in its method of operation, it is also a very fine example of modern industrial design, it is extraordinarily sleek — approximately half the height of nearly every other turntable on the market. The actual unit itself is a mere two inches high and the tinted perspex cover adds a further two inches.

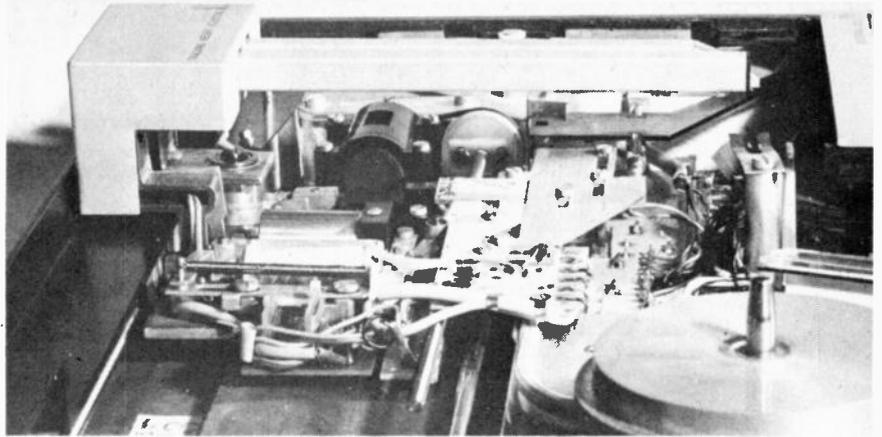
The finish is exceptional. It consists of a black tapered base approximately one inch thick surmounted by an oil timbered surround also one inch thick. The top panel is manufactured from brushed aluminium in six sections, each neatly interlocking into the one next to it.

The platter, located on the left-hand side of the control panel, is also brushed aluminium on which are located the radial rubber spokes described above.

The turntable, tone and sensing arm assemblies are supported on a die-cast frame which is completely separate from the rest of the unit. This frame is supported on three horizontal springs and provides isolation to vibration in both the horizontal and vertical planes. The resonance frequency of this sprung assembly is approximately 4.5 Hz.

The control panel is divided into four sections, the rearmost of these is approximately one inch wide. The turntable speed checking strobe light is at the left hand end of this section, and a calibrated scale showing the position of the stylus on the record is across the remainder. Just below the scale are two red slotted adjustment buttons for 33 and 45 rpm speed control. These little red buttons illuminate to indicate the speed that has been selected.

The remainder of the panel is divided, from left to right into a 3/4"



wide strip, a 3" wide strip and another 3/4" wide strip.

The left hand panel is labelled 33 at the front and 45 at the back. If the '33' end of this panel is pressed, the turntable will rotate but the tone and sensing arm assembly will not move across the record. This facility is provided so that a dust remover may be used on the record, prior to playing.

The centre panel has four arrows, one at the centre of each side. Pressing the panel at the appropriate place causes the tone arm to be lifted or lowered, or the arm driven to the left or right.

The right hand panel is labelled 'ON' at the front and 'OFF' at the rear and in most instances this is the only control that needs to be touched when one wishes to play a record. Pressing the panel at the 'ON' position immediately causes the turntable to rotate, the arm to track towards the centre and the automatic sensing and lowering process to take place as previously described.

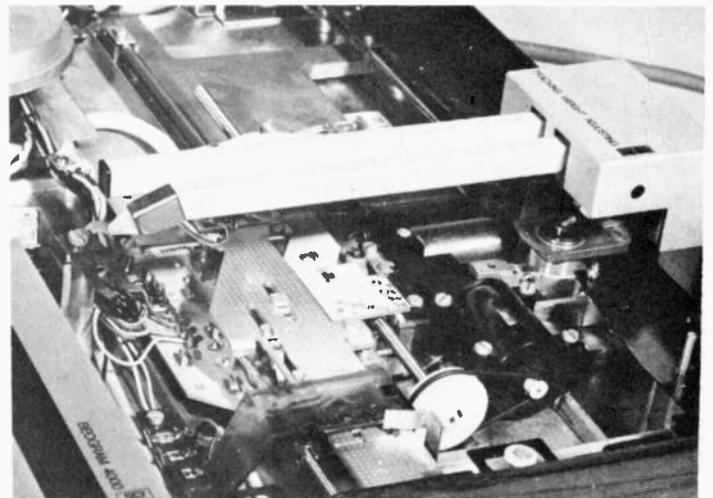
All the electronic circuitry is located below deck on six printed circuit boards. These consist of a power supply board, a motor speed control board, a small computer board (to use

B & O's terminology) that provides all the necessary interlocking between the lowering and raising modes of the tone arm, and two boards that contain the relay providing motor speed change control, and a pair of contacts that short the output from the cartridge until the tone arm is actually resting in the record groove — thus eliminating the obtrusive noise that one normally hears as the stylus drops onto the record and engages the groove. These boards are individually shaped so they fit into the available space below the turntable and the tone arm drive assemblies.

The cartridge is unusual for a number of reasons, firstly, because of its miniature size, and secondly, because the stylus is not replaceable. Rather, an exchange arrangement is involved whereby a damaged stylus may be exchanged for a new one at half price. Another unusual characteristic of the cartridge is the use of a naked diamond which is pressed into the stylus bar rather than the construction common to cheaper cartridges which generally use a diamond chip glued on to the stylus bar.

Each cartridge is supplied with an individual calibration graph. An interesting feature of the graph

*(Continued on page 72)*



# Some

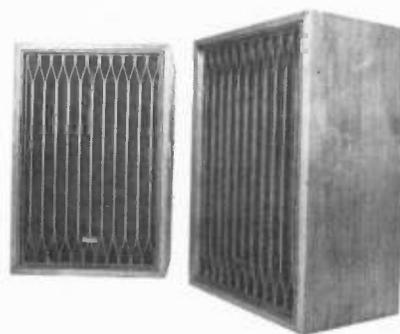
# ...they all



(Above) KLX-5 Speakers



KL-2090 Speakers



KL-7090  
Speakers

**KLX-5 COMPACT SPEAKER SYSTEM.** Superb performance with maximum input of 15 watts. Faithful reproduction from 50 Hz to 20,000 Hz. Attractive walnut boxes have inclined back for better sound direction. Set up on wall, in bookshelf or any handy spot.

**KL-2090 2-WAY 2-SPEAKER SYSTEM.** A compact size speaker system with a clear and elegant tone. Remarkable bass response for its size is due to use of a comparatively small unit and a bass reflex system. Sensitivity 98 dB. Freq. response 55-20,000 Hz. Can be wall mounted vertically or horizontally (as in the rear use for 4-channel). Attractive modern grille.

**KL-3090 2-WAY SPEAKER SYSTEM.** Designed to have high output 100 dB sensitivity, with 8-inch free-edge woofer and cone-type tweeter. Max. input 25 W with freq. response 45 Hz to 20,000 Hz. Attractive walnut finish and metal grille.

**KL-4090 3-WAY 4-SPEAKER SYSTEM.** Two cone-type tweeters, one cone-type mid range and one 12" woofer, with damped pipe duct, provide this system with both refined treble and real bass sound. Max. input 50 watts. Range 35 Hz to 20,000 Hz. A 3-step tone selector for clear, normal or soft. Sensitivity 101 dB.

**KL-5090 4-WAY 5-SPEAKER SYSTEM.** Five speakers, reproducing natural hi-fi sound over 30 Hz to 22,000 Hz, include 1 1/4" metal cone-type super tweeter and 12" free-edge-type woofer. Sensitivity 102 dB with max. input 70 watts, 3-step tone selector.

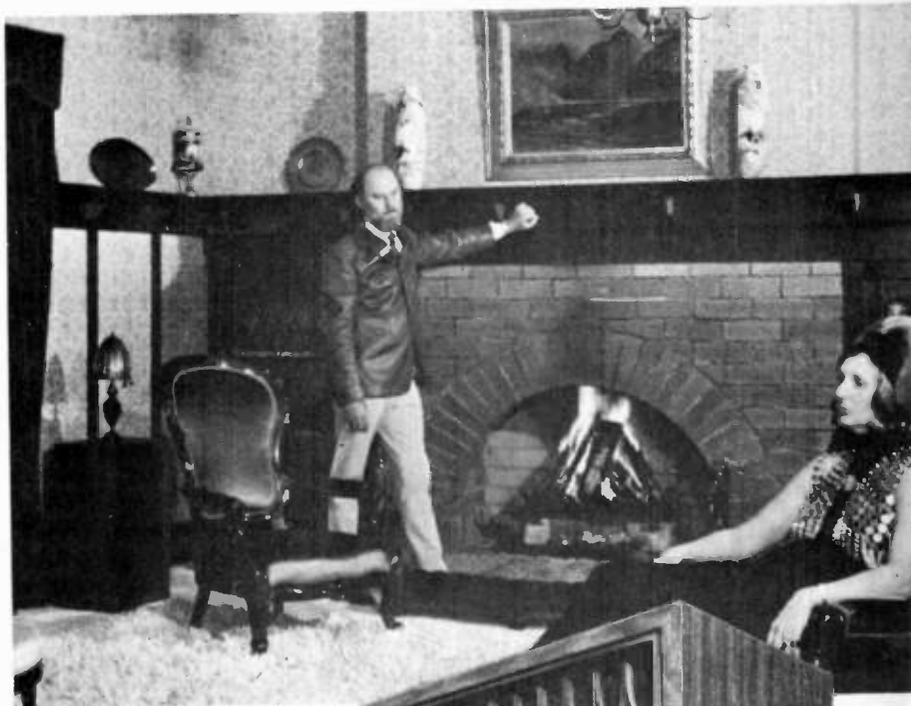
**KL-7090 5-WAY 6-SPEAKER SYSTEM.** You must listen to this speaker system to appreciate its fidelity and ability to reproduce ANY passages free from distortion. Freq. response 25 Hz to 22,000 Hz with metal cone super tweeter adding every minute nuance on the high frequencies over 10,000 Hz. Max. input 80 watts. Acoustic suspension eliminates distortion and dullness. A luxurious reproducer.

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direct sound downwards. The ultimate is reached with the KL-777—a speaker system sensitive enough to deliver the slightest nuance . . . and the most explosive bass tone impact. In the Kenwood range there is a speaker system to suit everyone—and every room—in elegant looks and enthralling hi-fi sound.



**KL-777 4-WAY 6-SPEAKER SYSTEM.** To reproduce in clear distortion-free sound anything from the earth-shaking basso profundo of a pipe organ to the delicate overtones of a violin or the sharp sound of cymbals. Three-step tone selector for sound to suit your room. Max. input 100 watts. Acoustic suspension enclosure. Freq. response 25-22,000 Hz. Front grille of handsome "bow line" design enhances even the best furnished interior.

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TAS.: Lawrence & Hanson Pty. Ltd., 34 Brisbane St., Hobart 7000.  
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*KL-777  
Speakers*

# BEOGRAM 4000 TURNTABLE

supplied is a resonance peak around 18 kHz. This peak is not in fact a fault or characteristic of the cartridge but rather is characteristic of the Bruel and Kjaer test record on which the calibration is performed. Surprisingly few testing authorities seem to be aware of this phenomenon.

The performance of the cartridge was very good in some respects and average in others. The frequency response was exceptionally smooth with no noticeable resonance in the audible range. The manufacturer's claim that the cartridge has useful response up to 45 kHz makes it suitable for discrete four-channel records if used with a suitable decoding unit.

The performance of the tone arm was very good, firstly in terms of operational simplicity and secondly in terms of excellent clarity. This was most noticeable on the AR

demonstration record, band 5, side 2. Towards the end there is a quick succession of notes played on the flamenco guitar, and it was pleasing to hear the clarity with which these notes were produced. With some cartridges these notes tend to blur due to mistracking. Although the cartridge trackability was not quite as good as the very best that we have encountered, its frequency response and the advantage gained with the tangential tracking system provided very good performance.

Some mistracking was noticed at very high levels on such instruments as bells, triangles and harpsicords, but this slight mistracking is more than compensated for by the exceptional clarity and crispness of all type of program material, whether orchestral or electronically generated. Particularly noticeable was the added depth, which on some records resulted in notes being heard that we had never noticed before — presumably due to masking because of tracking angle error, particularly near the centre of the record.

The measured performance was in accordance with the manufacturer's test data in nearly all respects, the only difference being a slightly higher wow figure. This is almost certainly due to differences in measuring equipment used by ourselves and the manufacturers — our equipment measuring right down to dc.

Hum was measured at a almost unbelievable low of 61dB. The combined hum and rumble figure of 50 dB (A) is predominantly rumble, possibly from the drive system; the figure is still totally acceptable.

The speed adjustment is very easy to use and provides a change of approximately  $\pm 2\%$ .

Despite its apparent complexity, the Beogram 4000 is by far the simplest unit to use that we have ever encountered. Its almost totally automatic operation and inbuilt protection against misuse means that it may safely be used by young children.

It has a number of exceptional features including the tangential arm motion which puts it way ahead of its class in engineering design. ●



## MEASURED PERFORMANCE OF BEOGRAM 4000 WITH BANG & OLUFSEN SP15 CARTRIDGE SERIAL NOS: 61446 & 0002699

**Frequency Response:**  
20Hz to 20kHz  $\pm 1$ dB

**Channel Separation at 1kHz:**  
27dB

**Channel Difference:**  
0.2dB

**Sensitivity:**  
(Re 1kHz at 5 cm/sec)  
3.1mV

**Speed Accuracy:**  
Accurately Variable  $\pm 2\%$

**Hum & Rumble:**  
50dB (A)

**Wow & Flutter:**  
0.15% rms.

**Dimensions:**  
10 x 49 x 38 cm.

**Weight:**  
12 kg.

## HITEC Electronics

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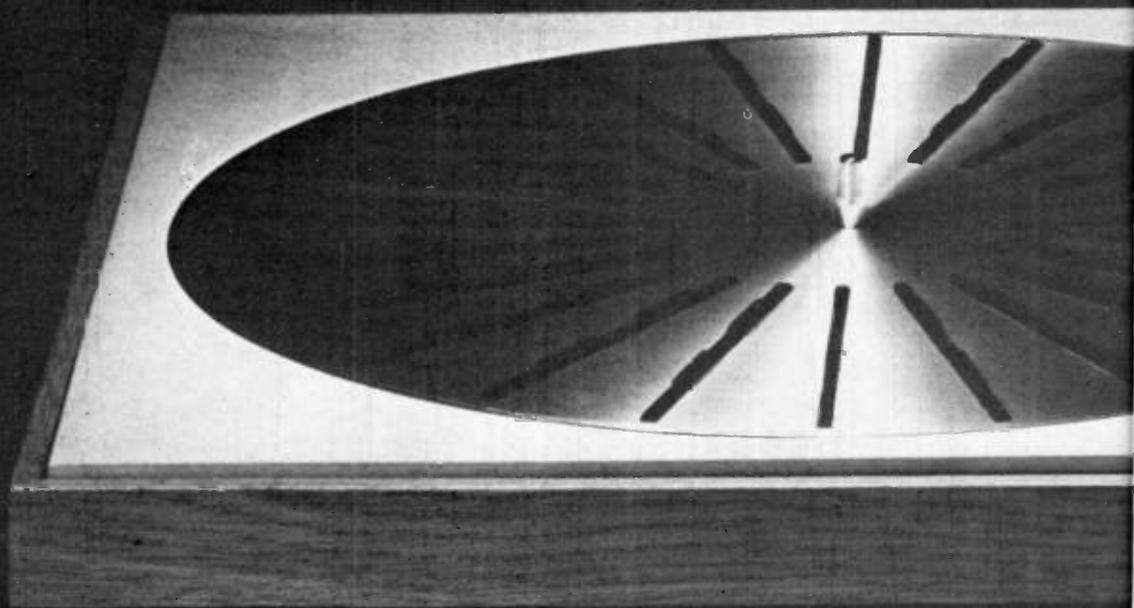
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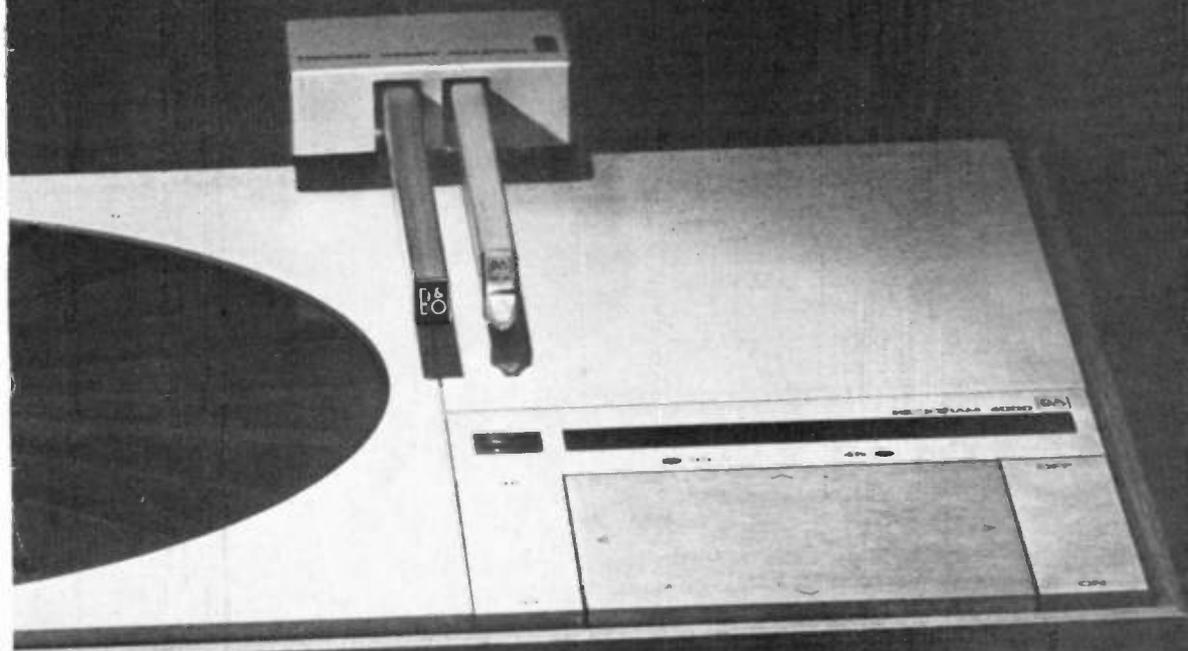


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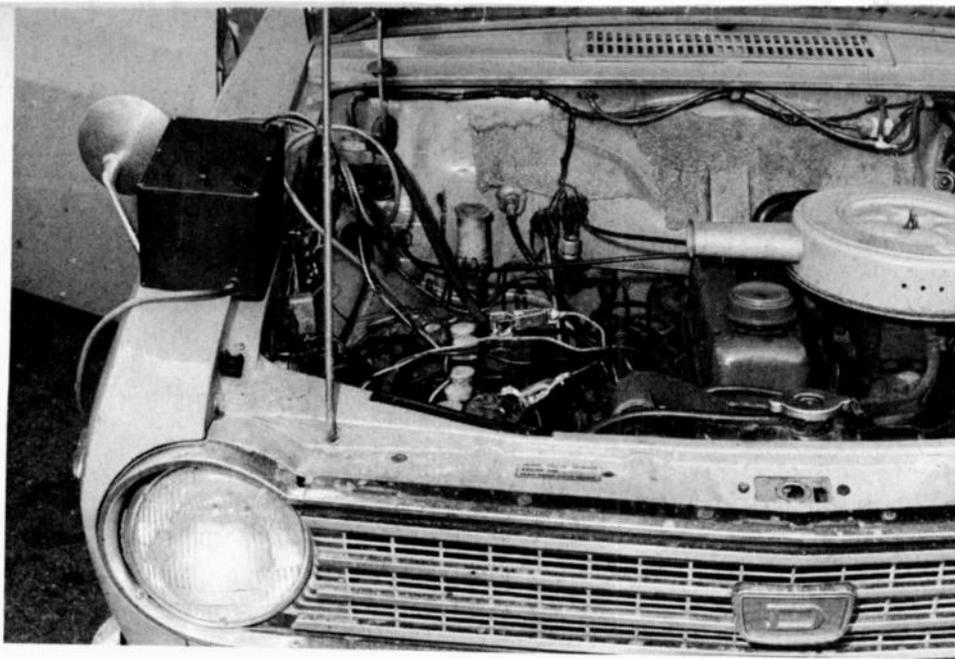
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the turntable.  
of music reproduction.

Fi, Leslie Leonard; South Australia - Sound Spectrum; Queensland - Brisbane Agencies.



**NOTE**

This battery charger described in this article has been designed specifically for charging 12 volt lead acid batteries. Six volt batteries may be charged but there will be no automatic voltage cutoff. Six volt batteries should therefore not be permanently connected to the charger.

# International 309 battery charger

This battery charger is fully protected against ALL fault conditions.

AT first sight there would seem few circuits simpler to design than a battery charger.

But this is not so – to the extent that during our preliminary research we could not find a single unit that offered the protection against misuse that a charger really does need.

To be fully protected a charger must be able to:—

1. Operate into a short circuit.
2. Not be damaged by, or attempt to charge, a reverse connected battery.
3. Operate into a totally flat battery.
4. Be regulated for both current and voltage.
5. Be capable of floating a fully charged battery for extended periods.

In the International 309 charger all these conditions have been met.

Both current and voltage regulation are provided – initially the unit will charge at its maximum current limit of four amps – then, as the battery voltage rises, the charger changes automatically to a voltage limiting mode (maximum 14 volts).

In the voltage regulator mode of operation the current will be in the form of pulses with a relatively long time between them and the LED will noticeably flicker if the current falls to

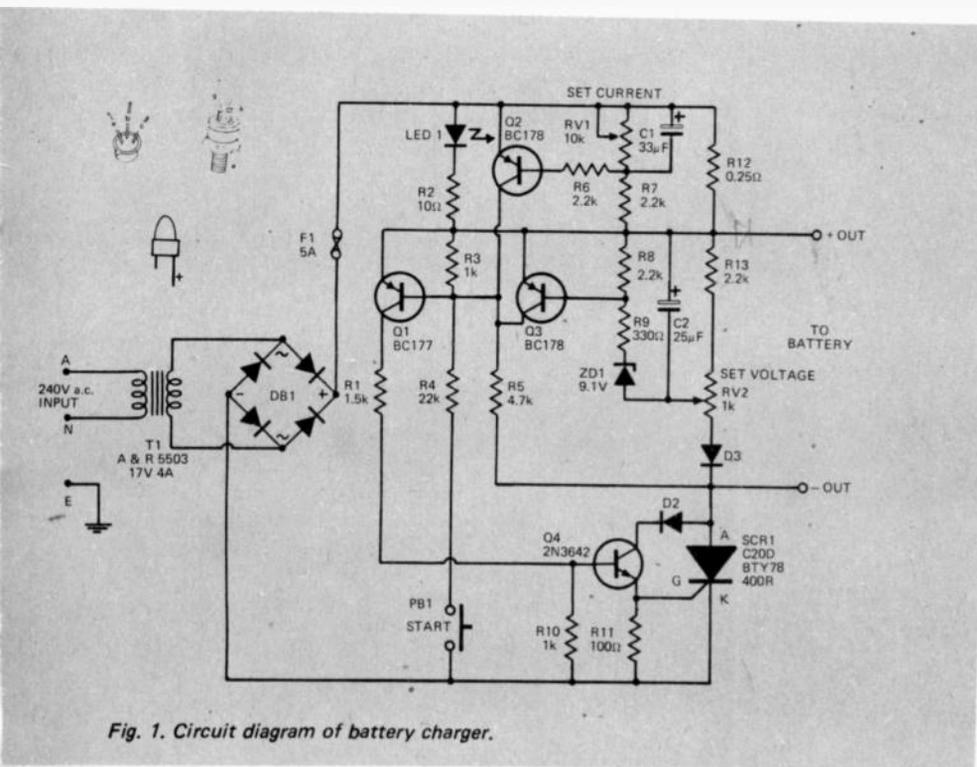


Fig. 1. Circuit diagram of battery charger.

## SPECIFICATION

### Charging Current

Within battery voltage range 1V to 14V 4 amps.

### Cutoff Voltage

14 volts

### Starting

Automatic self start range 4-14 volts  
Push button start 0-4 volts

### Protection

Constant current charging of 4A for all battery voltages from 1V to 13.5V.  
Protected against reversed battery.  
Protected against reversed battery with start button pressed.

### Charge Indication

Illumination of LED indicates charging.  
Flicking of LED indicates charge current has fallen to less than 1 amp.

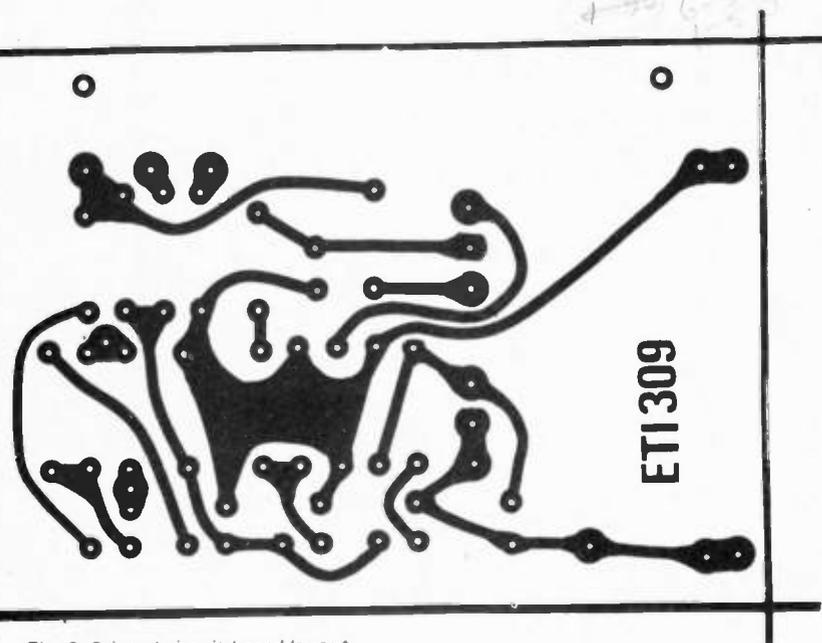
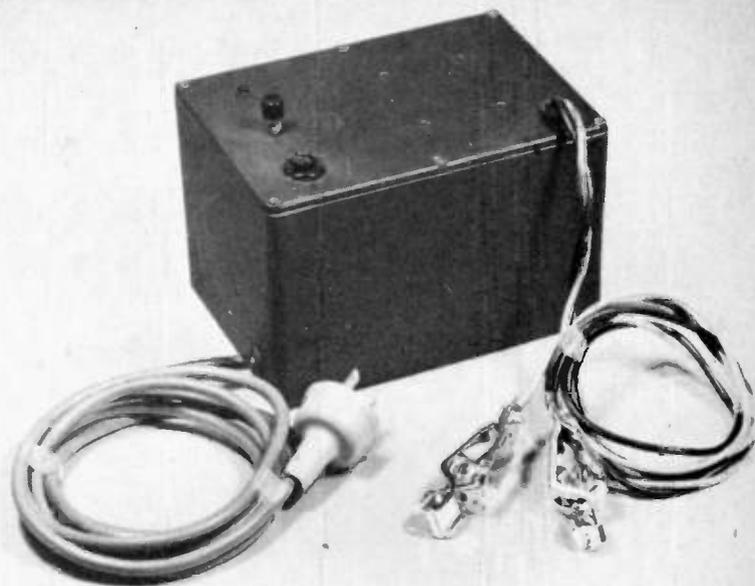


Fig. 2. Printed circuit board layout.

## HOW IT WORKS

The battery charger is basically a switching regulator limiting the output voltage to 14 volts and the output current to four amps. Thus there are two modes of regulation, current and voltage, the changeover between these two modes being quite sharp. An increase of 0.1 volt above 14 volts causes the output current to drop from four amps to zero.

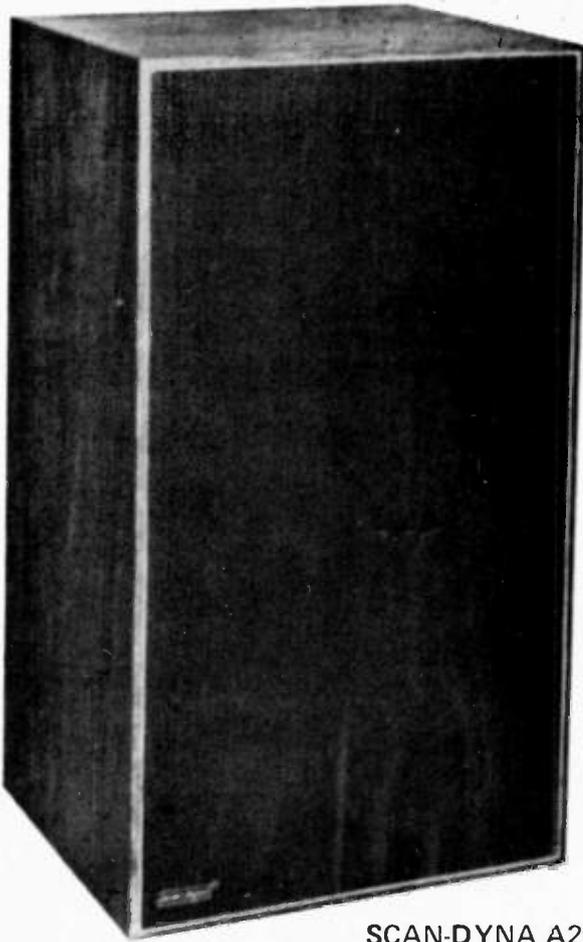
The 17 volt secondary of transformer T1 is bridge rectified by diode bridge DB1 to provide pulsating dc to the regulator. The main control element is SCR1 the gating sensitivity of which is increased by transistor Q4. A current of 2.0 mA through R1 is sufficient to turn Q4 and SCR1 on.

When a battery is connected with correct polarity across the output terminals, current will flow through R5 and the base emitter junction of Q1 turning Q1 on. This produces current in R1 sufficient to turn on Q4 and hence SCR1. The current flowing through SCR1 is sensed by R12, and if this current exceeds four amps average, Q2 turns on and is held on for a short time by virtue of the charge on C1. Hence the turn on of SCR1 on the next half-cycle is delayed thus reducing the average current. This control action ensures that the current stabilizes at four amps.

When the battery reaches 14 volts, transistor Q3 will turn on, the turn-on point being set by RV2. This again prevents SCR1 from turning on until later by by-passing the base current of Q1. Thus the current falls until the voltage across the battery stabilizes at 14 volts.



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P. & M. Supplies, Launceston, TAs. Bel Canto Audio, Hobart, TAS.

# International 309 battery charger

one amp or less. On batteries of 30 amp hour rating or less which are in good condition this flickering of the LED indicates the fully charged condition. On older batteries, or those of greater than 30 AH capacity, the float current may never drop below one amp and no flickering will be seen.

In applications where it is required, batteries may be 'floated' continuously across the charger without damage to charger or battery.

The unit is normally self-starting (into batteries that are already charged to four volts or over). For totally flat batteries — or those charged to less than four volts — a starting button is provided to initiate the charging cycle; after an initial couple of seconds the battery voltage will have risen sufficiently to maintain operation.

The charger will not start if a battery is connected to it with reversed polarity — even if the start button is pressed. Nor will the charger be damaged if the output leads are accidentally shorted together — however if the start button is pressed whilst the leads are shorted, the protection fuse will blow.

This last condition is most unlikely to occur and it is solely to protect against this eventuality that the fuse has been incorporated. A blown fuse should therefore be a rare occurrence.

(Continued on page 80)

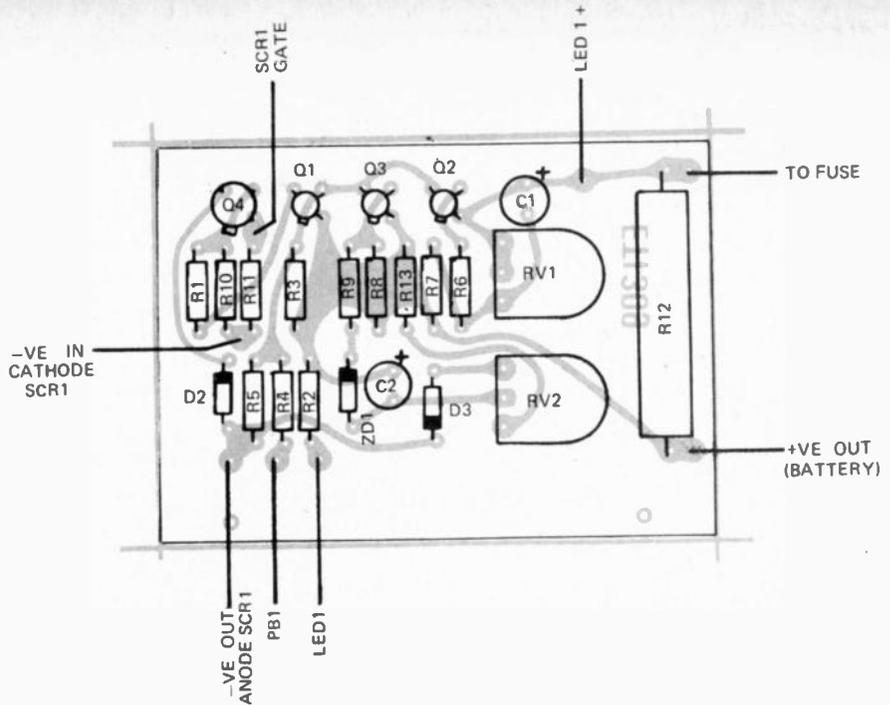
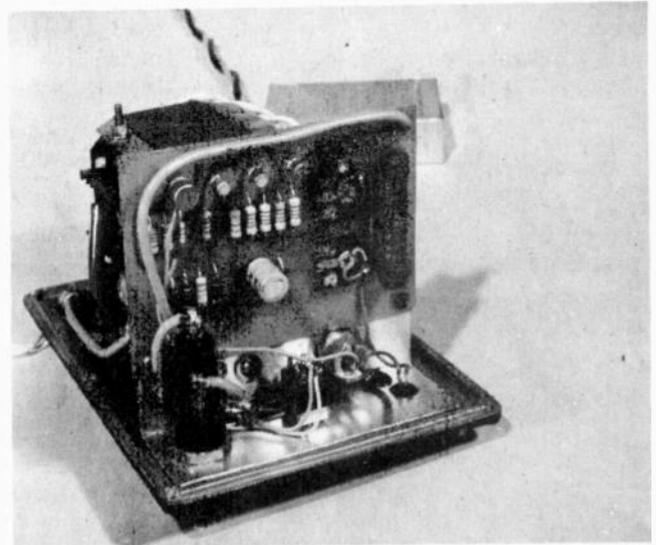


Fig. 3. Component overlay.



| PARTS LIST |  |          |  |
|------------|--|----------|--|
| R1         | Resistor   | 1.5 k    | 5% ½ watt                              |
| R2         | "  | 10 ohm   | " "                                    |
| R3         | "  | 1 k      | " "                                    |
| R4         | "  | 22 k     | " "                                    |
| R5         | "  | 4.7 k    | " "                                    |
| R6         | "  | 2.2 k    | " "                                    |
| R7         | "  | 2.2 k    | " "                                    |
| R8         | "  | 2.2 k    | " "                                    |
| R9         | "  | 330 ohm  | " "                                    |
| R10        | "  | 1 k      | " "                                    |
| R11        | "  | 100 ohm  | " "                                    |
| R12        | "  | 0.25 ohm | 5% 15W (or 2 0.47 ohm 10W in parallel) |
| R13        | "  | 2.2 k    | " ½ watt                               |
| RV1        | Large trimpot                                    | 10 k     |  |
| RV2        | Large trimpot                                    | 1 k      |  |
| C1         | Capacitor  | 33µF     | 6.3 volt electrolytic                  |
| C2         | "  | 25µF     | 25 volt electrolytic                   |
| Q1         | Transistor                                       | BC177    | or similar                             |
| Q2         | "  | BC178    | "                                      |
| Q3         | "  | BC178    | "                                      |
| Q4         | "  | 2N3642   | "                                      |
| SCR1       | C20D, BTY78-400R or similar                      |          |  |
| D2, D3     | Diode EM401 or similar                           |          |  |
| DB1        | Diode bridge PA40 or similar                     |          |  |
| ZD1        | Zener 9.1V, BZY88C9V1                            |          |  |
| LED 1      | Light emitting diode NSL5023 or similar          |          |  |
| T1         | Transformer 17 volt at 4A, A & R 5503 or similar |          |  |
| PCB        | ET1 309.   |          |  |

Die-cast box 4¼ x 6¼ x 4", metal bracket, 3 core flex, two grommet mains terminal block, fuse holder, 5A fuse, single pole push button (push to make).

2  
5  
15  
2

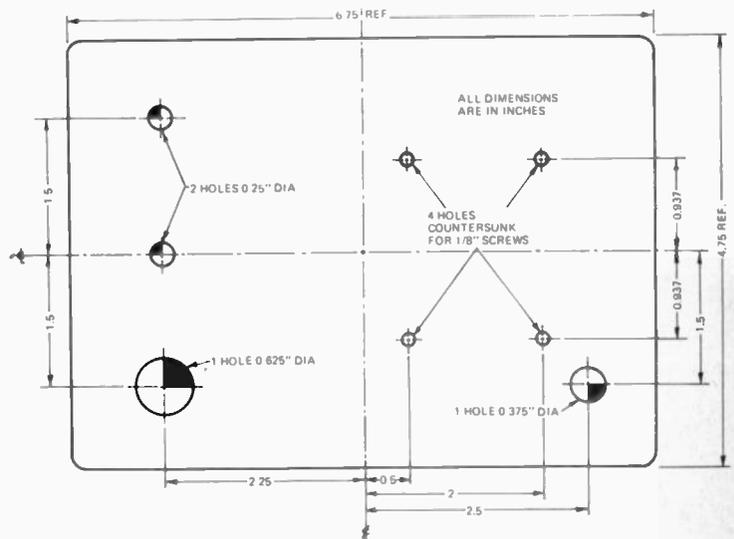


Fig. 4. Drilling details for lid of die-cast box.

# International 309 battery charger

## CONSTRUCTION

We built our unit into a diecast box  $4\frac{1}{2}'' \times 6\frac{3}{4}'' \times 4''$ , all the components being mounted on the lid, drilling details for which are provided in Fig. 4.

Most of the components are mounted on a fibre-glass printed circuit board.

Assemble all components to the printed circuit board in accordance with the component overlay, making sure that all diodes and electrolytic capacitors are correctly orientated.

The transformer should be mounted onto the lid using countersunk screws making sure that the 240 volt input leads are away from the lid. The printed circuit board mounting bracket is secured to the front panel, such that it passes through the bracket, but is screwed directly to the front panel. The hole through the bracket provides clearance for the light emitting diode.

The diode bridge is mounted on the transformer side of the bracket and the SCR on the opposite side. The SCR must be insulated from its heat sink by mica or similar insulating

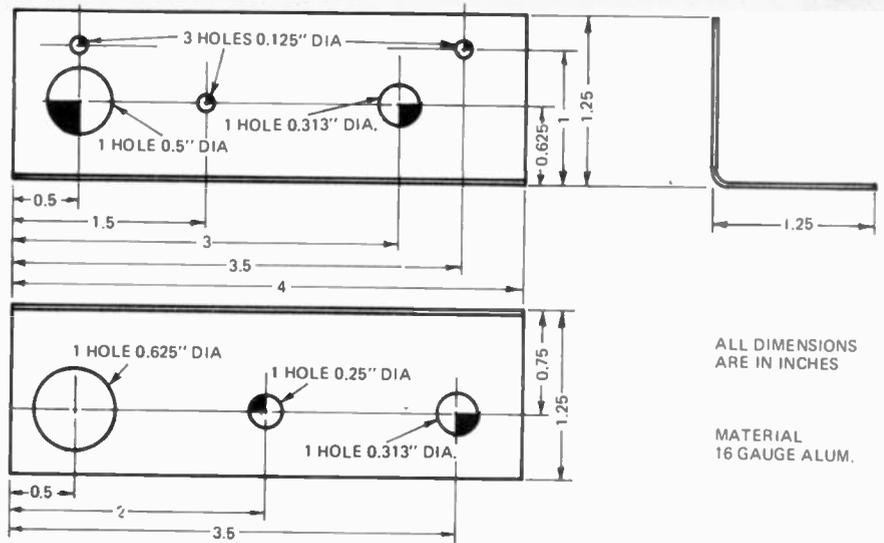


Fig. 5. Mounting bracket for printed circuit board.

washers. These should preferably be smeared with silicon grease to aid heat transference. The printed circuit board is then mounted to the bracket and connected as shown on the overlay and circuit diagrams.

For all four amp wiring use 40/0076 (preferably) and 23/0076 as an absolute minimum.

## ADJUSTMENT

**Current** — Using an ammeter (10 amp range) in series with a flat battery,

adjust RV1 for a four amp charge current. A four or five amp meter range may be used providing the meter does not have internal diode protection.

Alternately the voltage across R12 may be adjusted (using RV1) to one volt whilst charging a flat battery. Use a 2.5 volt or higher meter range.

**Voltage** — When the battery is fully charged the current will fall. When it has fallen to 2 amps, adjust RV2 for 14 volts across the battery.

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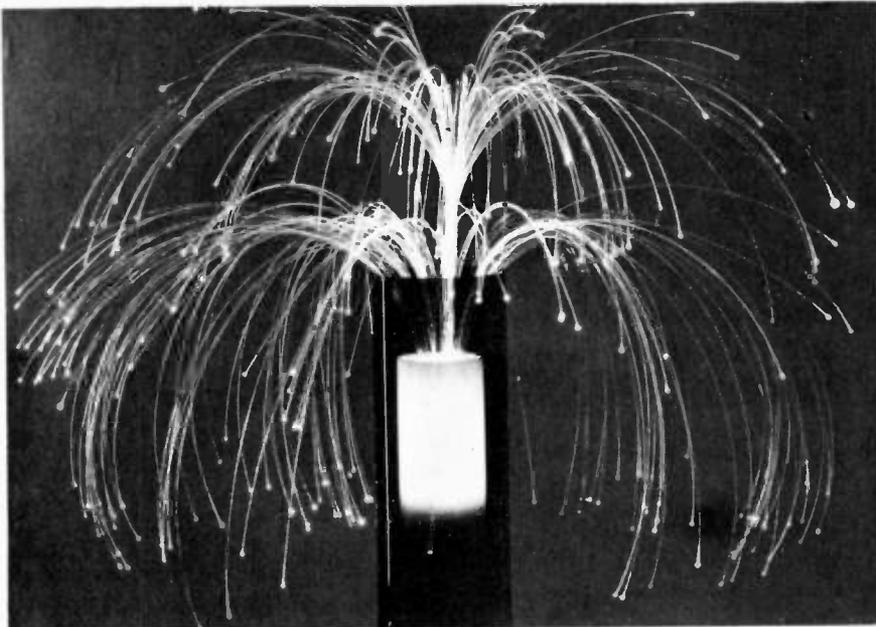
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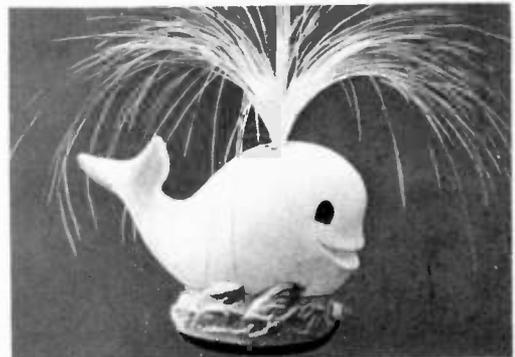
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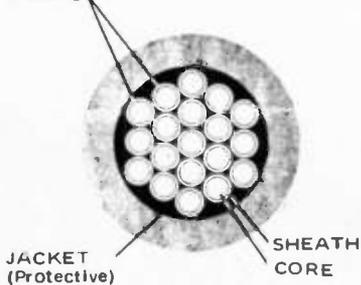
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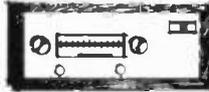
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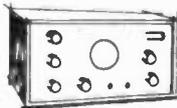
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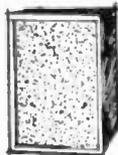
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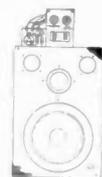
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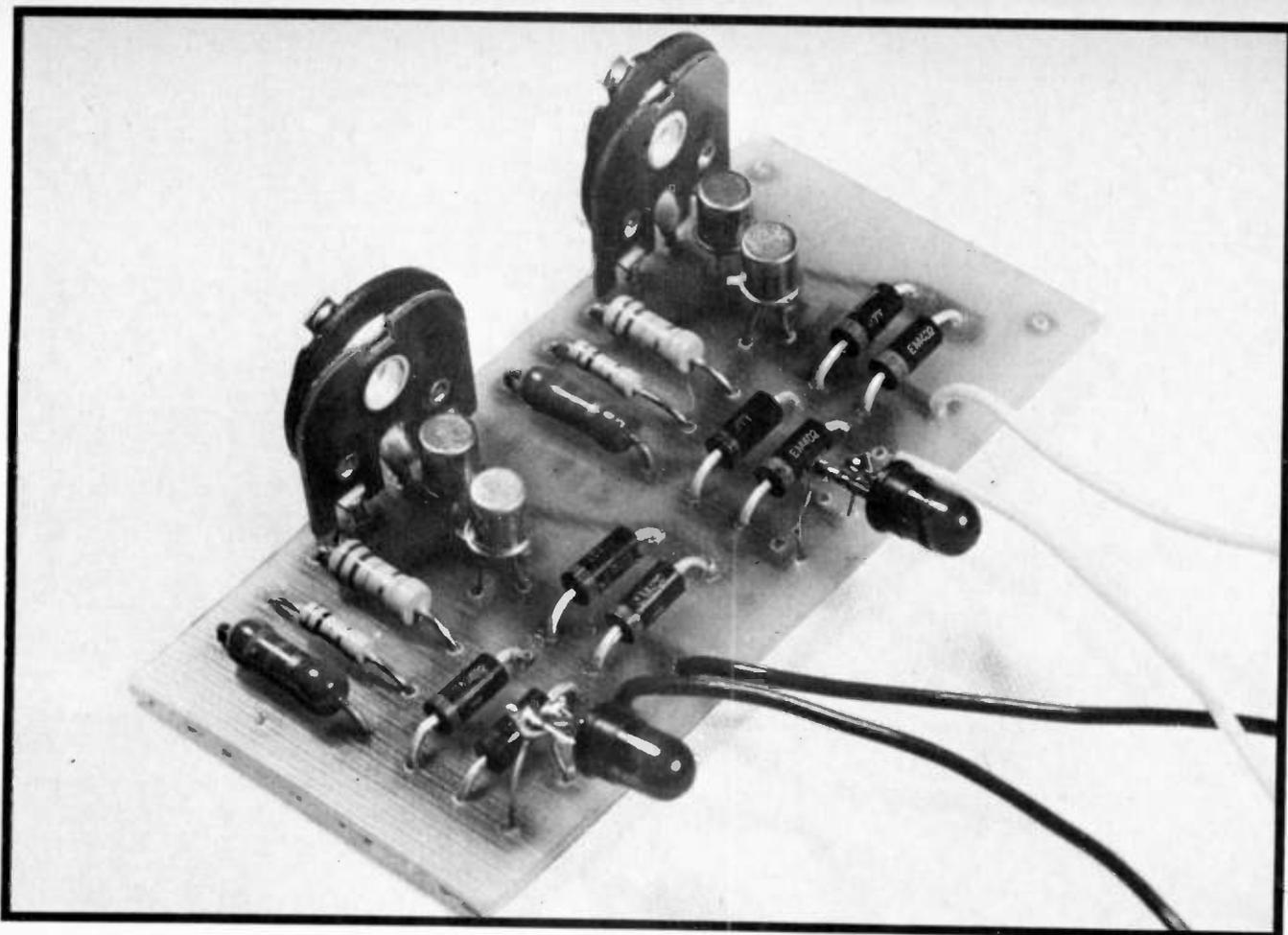
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**ETI** PROJECT 417

# THE OVER-LED

Is your power amplifier clipping? This simple monitor lets you know.

TABLE 1

| RMS watts<br>per channel | SPEAKER IMPEDANCE |      |     |      |     |     |
|--------------------------|-------------------|------|-----|------|-----|-----|
|                          | 4Ω                |      | 8Ω  |      | 16Ω |     |
|                          | R1                | R3   | R1  | R3   | R1  | R3  |
| 5                        | 68                | 5.6k | 82  | 8.2k | 120 | 12k |
| 10                       | 82                | 8.2k | 120 | 10k  | 180 | 18k |
| 15                       | 100               | 10k  | 150 | 15k  | 220 | 22k |
| 20                       | 120               | 12k  | 180 | 18k  | 240 | 24k |
| 25                       | 150               | 15k  | 220 | 22k  | 270 | 27k |
| 35                       | 180               | 18k  | 240 | 24k  | 330 | 33k |
| 50                       | 220               | 22k  | 270 | 27k  | 390 | 39k |
| 75                       | 240               | 24k  | 330 | 33k  | 470 | 47k |
| 100                      | 270               | 27k  | 390 | 39k  | 560 | 56k |

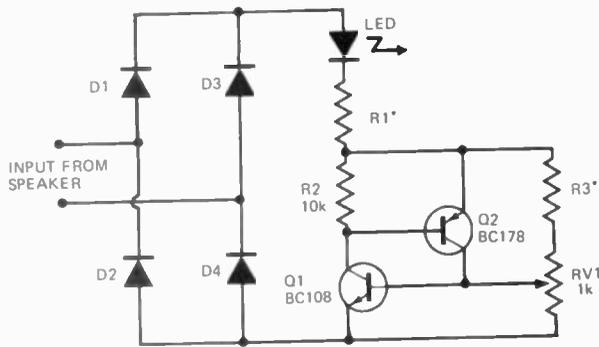
MANY people are aware of distortion when they turn up the volume control on their hi-fi equipment — but are usually unaware of the cause.

Nine times out of ten this distortion is caused by 'clipping'. That is, the amplifier does not have enough reserve power to handle the peak music transients at the required volume.

During such peaks, the amplifier is driven into an overload condition and as a result the music peaks are 'clipped'. This results in harsh sounding reproduction.

This simple device, which may be built into your existing amplifier, or separately located, flashes a warning light if the power level at which clipping occurs is exceeded.

Two completely independent circuits are provided so that each channel of a stereo system may be monitored separately.



\*SEE TABLE 1 FOR VALUES  
ONE CHANNEL ONLY SHOWN

Fig. 1. Circuit diagram of overload detector. One channel only shown.

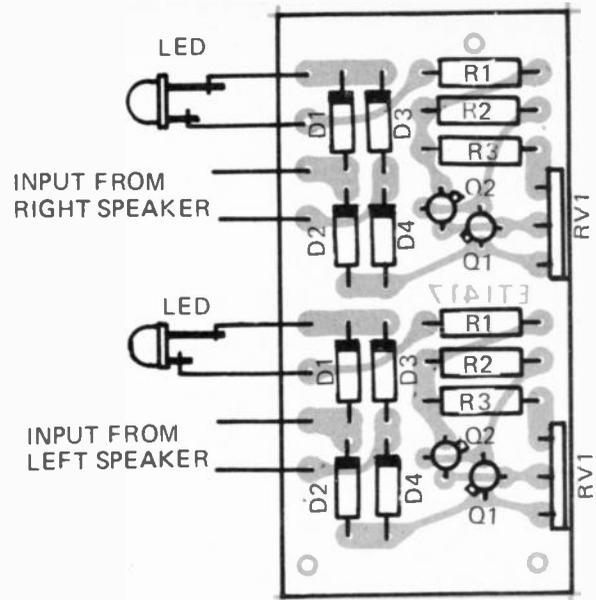


Fig. 2. Component overlay.

### HOW IT WORKS

The output of each power-amplifier channel is monitored at the speaker terminals. The output is bridge rectified by D1-D4 so that both positive and negative transients may be detected.

Transistors Q1 and Q2 (together) are equivalent to a sensitive gate SCR (silicon controlled rectifier). If the voltage at the base of Q2 is more than about 0.6 volts above its emitter, Q1 and Q2 will each turn hard on and latch on, until the current through them drops to zero.

When transistors Q1 and Q2 are on, the current flowing through them also flows through the LED causing it to illuminate. Resistor R1 limits the peak current through the LED to about 100 mA. The range of calibration potentiometer RV1 is set by resistor R3. The values of R1 and R3 are provided in Table 1 for various amplifier power ratings and speaker impedances. These values are not critical. If your amplifier has a power rating other than that specified, the nearest values will do.

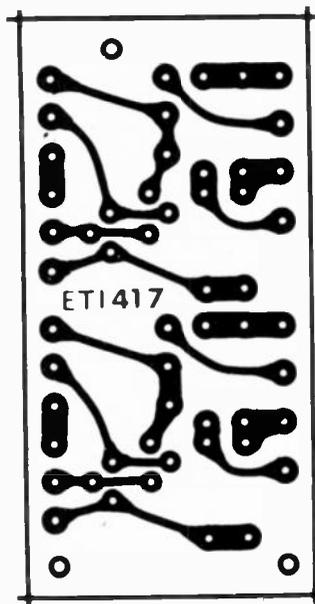


Fig. 3. Printed circuit board (full size).

### PARTS LIST

One set required for each channel.

|          |            |                   |
|----------|------------|-------------------|
| R1       | resistor   | as Table 1        |
| R2       | "          | 10k 5% 1/2 watt   |
| R3       | "          | as Table 1        |
| Q1       | transistor | BC108 or similar  |
| Q2       | "          | BC178 or similar. |
| D1 to D4 | Diode      | EM401 or similar  |

LED light emitting diode FLV110, MV5025 or HP4403 etc.

PCB ET1 417 (1 only required — each board has provision for two channels)

### CONSTRUCTION

Mount all components on to the printed circuit board in accordance with the component overlay. Make sure that all diodes are correctly orientated, in particular the LED's. The LED's will not be damaged by reverse polarity but will not operate in that mode.

Whether the unit is mounted inside the amplifier or external to it in a small box will be a matter for the individual constructor. The printed circuit board may be mounted in any suitable position within the amplifier and leads extended to front-panel mounted LEDs if required.

Polarity of the leads to the amplifier output terminals is immaterial but make sure that the leads of separate channels are not mixed. This is best avoided by twisting each pair of leads to each channel.

### CALIBRATION

There are several ways of calibrating the unit.

By far the best way is to connect an audio oscillator to the input of the amplifier (both channels driven at the same time), then, with the amplifier volume control at a low setting, adjust the oscillator to provide a 1 kHz sine-wave.

Set both trim potentiometers (RV1) so that their wipers are nearest R3.

Now increase the amplifier volume until clipping occurs. This is very easily identified as a sudden harshness of tone. Do not leave the volume control at this setting for more than a second or two, as apart from the pounding you are giving to your ears, some amplifiers will not tolerate a sine-wave input at clipping level for extended periods without damage.

Once the clipping point has been established, turn the volume down again, and then quickly turn up to the clipping point momentarily, meanwhile adjusting the trimming potentiometers RV1 until a point is reached where the light emitting diodes just come on.

Repeat the procedure a few times — finally arriving at a setting at which the LED's come on just before the clipping point.

If you do not have access to an oscillator, the device can be set by playing a test record that contains a sine-wave tone — or failing this — by playing a record of a solo instrument such as a flute. A recording of the human voice is also very effective. In such cases the same calibration procedure described above should be followed.

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\* **mag-net-ite** (mag'nē-tīt) *n.* A massive, granular, isometric, black iron oxide, Fe<sub>3</sub>O<sub>4</sub>; lodestone; an important ore of iron. [**<MAG-NET + -ITE>** = **magnēt-ic** (-it'ik) *adj.* The Collins dictionary

Magnetite is the first magnetic substance recorded in history — Lodestone. Because TDK was founded in 1935 by a group of engineers who developed a new iron oxide compound ferrite, TDK research has now been able to develop an entirely new recording material from Magnetite which produces the best recorded signal on tape possible today. TDK have named this new tape Extra Dynamic as it is manufactured specifically for the Audiophile who requires reel-to-reel performance from a cassette recorder.

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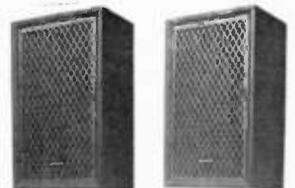
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# Professional Recording Equipment

Everything bigger and/or better at Association of Professional Recording Studio's recent exhibition — Terry Mendoza reports

THE Connaught Rooms in London's West End was the venue for one of the most comprehensive displays possible of garagantuan 'consumer' electronics — the sixth annual exhibition of the association of professional recording studios.

The message was everything bigger and better than before. The nerve centre of all recording studios is the mixing desk so these were present in abundance, ranging at one end of the scale from the Swiss Stellarox AMI 48 — a location (battery) mixer with five channel, prefade listen and full equalisation facilities, to a 59 — 26-channel Neve console (needing a bank of engineers to operate it?).

Alice (Stancoil), presented the AM range of mixers with a number of ingenious features including a pin matrix panel for signal routing (this two inch square board renders the three foot square jack-field obsolete), and a linear column of LED's giving graphic indication of the relative levels of the stereo output.

The neatest mixing console was the Swiss made Studer transportable 089.

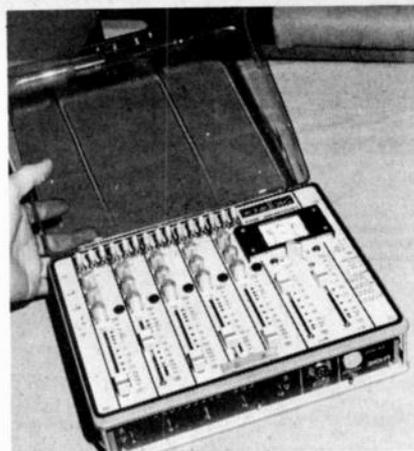
The Stellavox SQ7 made its debut at the exhibition. This beautifully engineered tape machine is the first professional location battery portable capable of quadrophonic work with its four parallel tracks — Stellavox for some reason prefer the term 'quadrosonic'.

Another neat package on the Stellavox stand was a speed change unit for their recorder permitting switched standard speeds with the choice of a continuously-variable speed change — an important facility for special effects, and to enable a recording artist to sing in a musical scale for which his vocal chords were really not designed! On the other side of the coin to this variable pitch device, Bauch were displaying the Lexicon Varispeech 1A which, equipped with conventional type

cassettes, can vary the speed of reproduced delivery while keeping the speech at the same pitch. It is based on digital sampling technique and to my ears, the result has a rather rasping warble but it does work!

Bauch were displaying highly varied studio ancillary equipment including the EMT 440 electronic delay unit using (high speed this time) digital sampling, a signal can be delayed a few hundred milliseconds. The output is fed to the EMT 240 gold foil via a mechanical transducer and a similar transducer picks the signal off the other end, including the all-important mechanical signal reflections. The delay is needed to give a slight separation between the signal and its reverberation which prevents the signal becoming 'swimmy'.

Computerised mixing was shown for the first time by Allison Automated Processes of New York, in a nutshell the positions of the linear faders are digitally recorded on to unused tracks of the multi-track recorder. This information can be updated and over-ridden as necessary permitting one



Stellavox SQ7 quadrasonic portable recorder.

engineer to carry out a mix down from 32 tracks to two chord stereo without going prematurely bald in the process!

On the musical side the American Tonus ARP 2600 electronic music synthesiser and its junior stable mate the ARP Odyssey were operational and visitors who were not bewildered by the profuse display of knobs and dials could listen to their keyboard attempts via headphones. Incidentally the ARP Odyssey is one of the first synthesisers to permit more than one note to be played at a time — if more than one key is depressed the second key control voltage is logically routed to cover another oscillator.

Dolby, the noise reduction people, were present in force, showing a new 324 broadcast unit which carries out Dolby B processing. This is intended for high quality FM stereo radio stations. Also on the stand was a rather larger box containing the electronics for a 24-channel Dolby, a processor/de-processor for studios in possession of 24-channel recorders such as the Scotch machine mentioned above. ●



ARP Odyssey 2600 Music Synthesizer.



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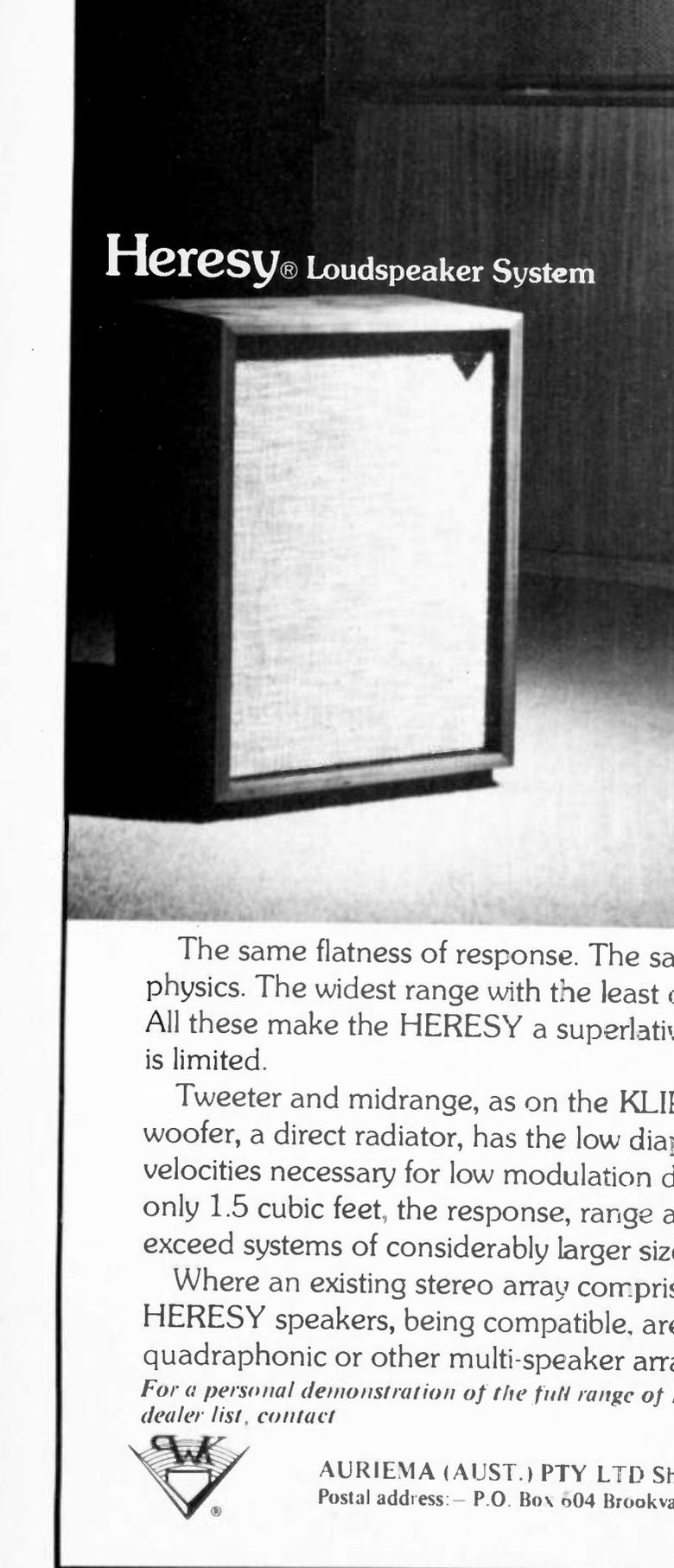
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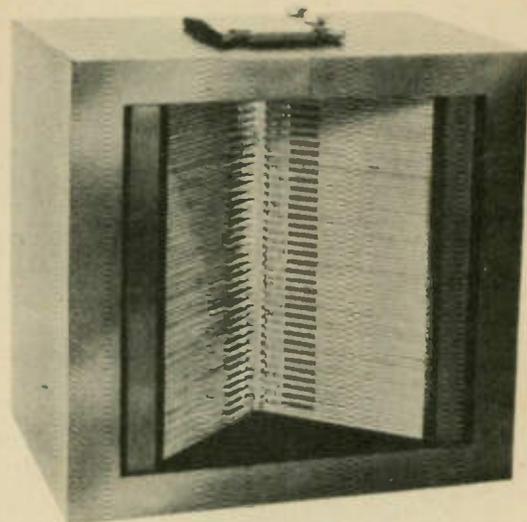
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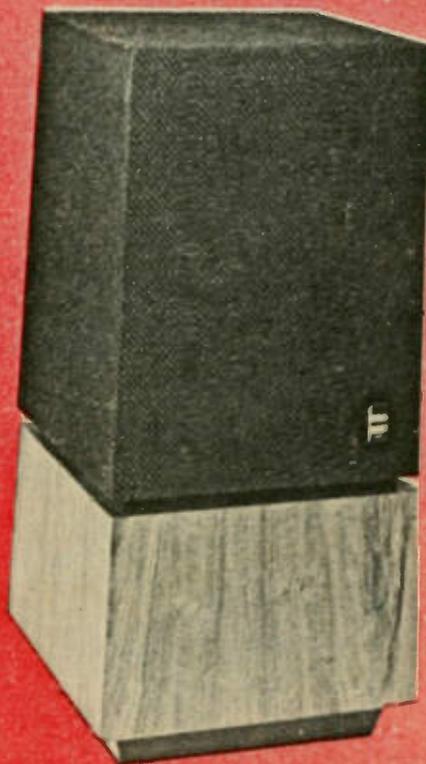
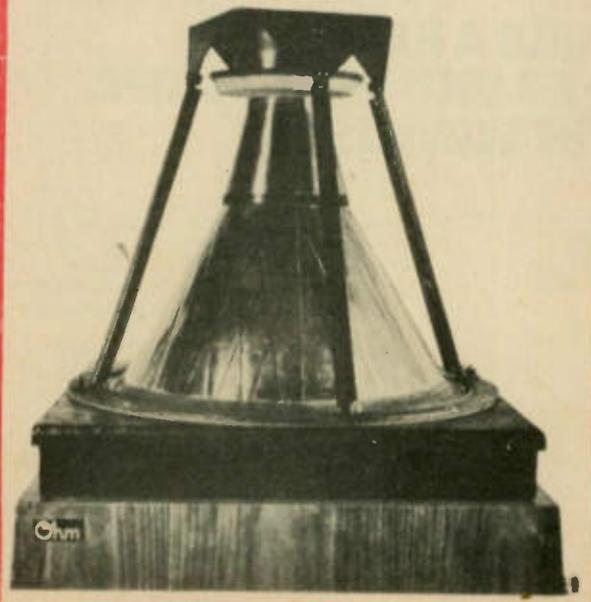
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*Heil Air Motion Transformer handles mid-range and treble in conjunction with conventional woofer — the manufacturers, ESS, are believed to be actively developing a bass version of the Heil unit.*

*Ohm A unit covers full frequency range using single conical driver.*



# LOUDSPEAKERS

## -an explosion of new designs

by Irving M. Fried

Some of the most revolutionary innovations in years are hitting the market in 1973. Here's how and why they work.

THIS year, as every other year, will find old and respected manufacturers and brand new companies alike presenting their "new" "improved" or "breakthrough" loudspeakers to the general public. Once again, you will be asked to accept each system as "the speaker of the future," one that "makes all others obsolete." Just as surely many new models will, like so many previous "break-throughs," sink quietly into oblivion. The number of enduring advances in the art of loudspeakers is very small.

But from time to time, manufacturers do manage a significant advance in basic design principles, largely by using new materials and technologies. And 1973 is such a time. I believe that some of the new loudspeakers described below will endure and find their market niches — but possibly not in the positions their proponents envisage.

Every twenty years or so a wave of fruitful innovation overtakes the loudspeaker industry. The last such broad advance was back in the middle 1950's when the first air-suspension systems and the first successful electrostatic, ribbon, and ionic drivers appeared.

I'd like to begin this survey of some of the more interesting new loudspeakers with those systems whose basic driver principles are the main subject of interest. I'll try, whenever possible and for the sake of the record, to mention past products that bear a resemblance. Manufacturers' claims for their products always are difficult to assess until the products themselves can be evaluated fully, and a certain extravagance is to be expected in someone who has worked hard on what he considers to be a successful design. The many quotes, some of which come from product literature, rather than directly from engineers and company executives, are to be understood in this light.

The most radically different new loudspeaker is the Ohm A. Invented and patented by the late Lincoln Walsh, famous in high fidelity history for his Brook all-triode amplifier, it has no direct antecedents in the art (though some claim the Hegeman tweeters of the fifties worked on the same principles). The Ohm A driver looks like an inverted funnel, the large end of which is fastened to an infinite baffle box. The funnel, or cone, is made of copper and titanium, forming a composite cone of rather large size and heavy mass. The theory of operation is, for the bass below 200 Hz, that of mass loading; and, for the midrange and treble, high-velocity wave-train propagation down the cone, with radial propagation of all frequencies of musical interest.

The Ohm A has been publicly demonstrated and is in limited production. It is very inefficient, but when driven by amplifiers of sufficient power seems to give a good account of itself — according to many auditioners. Traditionally the British metal-cone speaker designs of the past (G.E.C., Jordan-Watts, and Jordan) have been lauded for their clarity, while drawing some complaints of a metallic edge to high-frequency sounds. None has been precisely of the Ohm A shape, of course, and it will be interesting to see what the final evaluations of the Ohm A will be.

Very similar in design and built under the same basic Walsh patents — but intended only for treble propagation — is the Infinity Wave Transmission Line tweeter, which is used in the new Infinity Holosonic Monitor. Replacing the electrostatic drivers that have characterized the company's deluxe offerings, the tweeter also resembles a funnel, but with the large diameter upward. This cone is made of plastic with a thin aluminum skin — a laminate that, it is stated, will support a sound transmission speed of 11 000 feet per

second (about ten times that of sound in air). A voice coil at the cone apex "plucks" it, causing it to emit waves orthogonally: i.e., in circles, spreading outward from the cone surface. The design objective is the simulation of that Grail of speaker theory, the perfect pulsating sphere.

As incorporated into the Monitor of Infinity, the tweeter is intended to handle up to 200 watts of program input and is said to display a flat impedance characteristic to 100 kHz. The designer says it can be driven at living-room level with a 25-watt amplifier — transistorized or tubed.

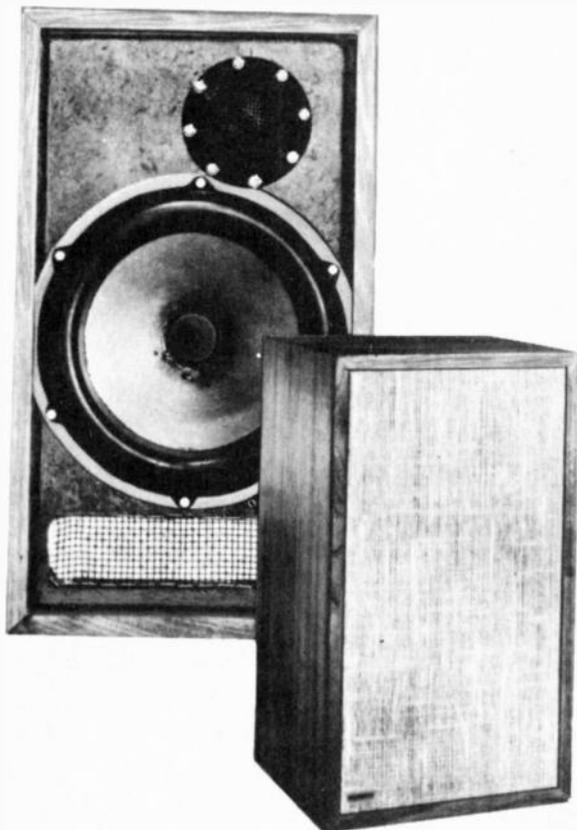
ESS (formerly Electrostatic Sound Systems), also known heretofore for expensive "hybrid" (electrostatic and dynamic) designs, now presents the Heil Air Motion Transformer as "the loudspeaker of the future". Invented by Oskar Heil, the unit is a midrange and treble driver whose corrugated plastic diaphragm (with imprinted voice coil, called a "conduction cortex") folds on itself, reducing and expanding the volume of the "multiple interfacing cavities" presented by the magnet's vaned pole pieces and projecting sound outward with an "almost perfect transfer of kinetic energy." Dr. Heil further claims near-instantaneous acceleration of the diaphragm, very low distortion, and omnidirectional dispersion in the horizontal plane since sound is "squeezed" out from both front and back of the driver.

First demonstrations of the Heil unit have led to marked disagreements among those present, which always seems to happen with dramatically unconventional loudspeakers. Part of the problem, it appears, is that the first design to be offered publicly has a new enclosure shape, a truncated pyramid, in which response below 500 Hz is handled by a decidedly conventional ducted woofer. More advanced bass systems are projected for future use with the Heil.

Needless to say, the Heil unit will be endlessly discussed and described. Among other things it claims to be "the first new principle of sound propagation in fifty years." Various aspects of the design suggest past

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THE HI-FI NEWSLETTER (P.O. Box 539, Hialeah, Fla. 33011)



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THE STEREOPHILE (Box 49, Elwyn, Pa. 19063)

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# LOUDSPEAKERS

products such as the Kelly Ribbons of the fifties, the compression-throat tweeters of the twenties, the perennial acoustic lens, and so on — all of which principles seem to be amalgamated in the Heil.

Another company claiming to make obsolete all electrostatics is Audio Research, famous for its all-tubed amplifiers. The Magneplanar loudspeaker is offered as a replacement for free-standing, full-range electrostatic loudspeakers, intended to solve their inherent problems (particularly the need for a power supply) and to improve their quality and performance.

The Magneplanar stands six feet tall, four feet wide, and *one inch* thick! Each speaker is hinged twice like a folding screen, forming three panels that are set up in zigzag fashion: two with woofers, the other with the tweeter. Each woofer or tweeter diaphragm is made of thin Mylar (as in electrostatics), to which are glued closely spaced vertical wires. The diaphragm is stretched over a frame; bar magnets are attached to the same frame and inter-leaved with the wires, which make up the voice coil. A crossover operates at 3 200 Hz, though there is provision for using two amplifiers if desired.

The Magneplanar bears a strong family resemblance to the short-lived Ge-Go Orthophase from France a few years back, though in modern dress. It sounds like no other loudspeaker, and is thus (again, as with the Heil) the center of brisk debate. One valid criticism is acknowledged by the manufacturer: its lack of extreme bass. A new add-on flat-panel subwoofer now is available.

Another flat loudspeaker is the Fisher Sound Panel. (this speaker is built, under licence, in Australia by Philips and was reviewed in our July 1973 issue.) While not claimed to be state-of-the-art, the unit is offered as an alternative to bookshelf loudspeakers. A single flat slab of acoustic polymer has two voice coils fastened to it. Because of the panel's physical design and the placement of the two coils, one acts as a woofer and the other as a tweeter. Sound is produced equally from front and rear.

More mundanely, several manufacturers claim to have developed improved woofers, with better "attack", power handling, and distortion characteristics. Infinity's new woofer (in its Monitor, already discussed) uses what is described as a patented magnetic system that permits it to handle 200 watts of continuous power without damage — including the demagnetization that conventional woofers can suffer with superpower

amplifiers.

Also mentioned are ported-dustcap woofers (Onkyo), copper caps over magnetic poles (Sony, Pioneer), huge magnetic systems (SAE), and laminated magnets (LDL). None of these, properly speaking, is a new idea, though some appear to have been patentably innovative in their present forms. Two points are interesting here, however. First, the emphasis on unconventional refinements in magnetic structures surely represents a step forward from the insistence on sheer magnet mass that characterized loudspeaker advertising only a few years ago. Second, manufacturers are now agreeing that woofers as well as tweeters need improving. To recoin a phrase: A woofer and a tweeter do not a speaker make — meaning that as one art advances so must the other, and that the advances must be co-ordinated.

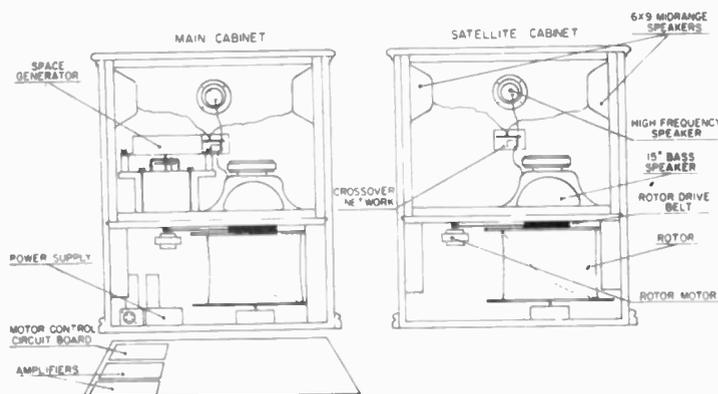
Other new loudspeakers, rather than presenting new drive principles as such, seem primarily to be concerned with the way in which the energy at the driver is presented to the air in the room — and hence to the ears of the listener. Some of the systems we have discussed — the Ohm A and the Heil Air Motion Transformer for example — adopt unusual means to this end, of course; and there are others.

Leslie, heretofore known for its electric-organ speakers, has a new design for home use, including its own built-in amplifier. A baffle in the woofer system of these speakers slowly rotates, "sweeping" the room. Built into the electronics is a phase-shifting system: as a unit the baffle and phase shifter is intended to subdue standing waves in the listening room. The phase shifter, which can be turned off, also is intended to produce quasi-quadraphonic spatial effects when a pair of Leslies are used in the back of the room, supplementing a conventional pair of the front.

Several new companies have combinations of small drivers, generally in omni or reflecting arrays

— each product with its own special claims and virtues, though some readers doubtless will see the interest in this type of design as a reflection of the phenomenal success the Bose 901 system has enjoyed. Design Acoustics uses small drivers on multiple intersecting planes, operating above a conventional woofer which faces vertically. Epicure Products has its various "tower" loudspeakers. APL (Applied Physics Laboratories) uses sixteen full-range drivers, each one "individually equalized" for optimum performance. The Array 12 employs eleven 4½-inch drivers, each with its own "special network" — to smooth the midrange, claimed by Array to be rough in all comparable multidriver systems. The eleven drivers are in a ducted enclosure; a high crossover feeds a single tweeter described as a polycarbonate dome. LDL, whose novel magnet system was mentioned earlier says its multiple-driver array may be used without an equalizer.

In complete contrast to all the above is a fascinating new approach demonstrated last September at the New York High Fidelity Music Show. It is the product of a new group headed by Saul Marantz (founder of Marantz, which now is owned by Superscope). The unit is called the Jon Dahlquist loudspeaker after its designer, and it should be available this year. The Jon Dahlquist Phase Array speaker is planar. (The first samples looked like the Quad electrostatic). It is not, however, a dipole (or doublet), radiating front and rear; Dahlquist strongly rejects such concepts. Rather he states that the flat shape is a device to avoid the diffraction distortions common to conventional enclosure loudspeakers. Mounted on the flat baffle are five dynamic speakers, each chosen for a special range of frequencies. These are joined by a complex crossover network, which equalizes their on-axis response with special compensation for on-axis time-delay distortions. The purpose of all this is to keep all phase



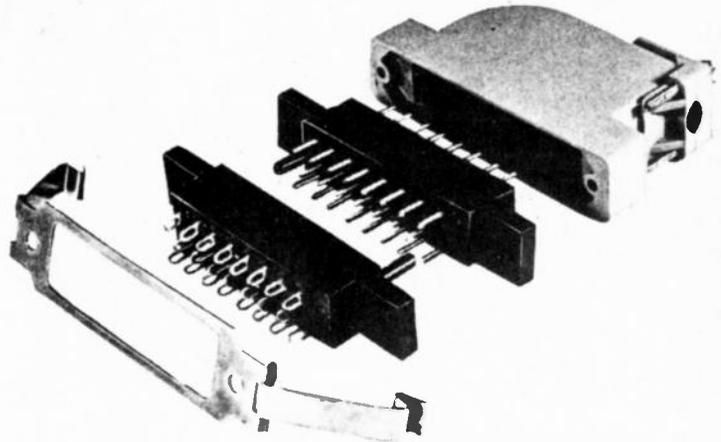
Woofer system of the Leslie Plus 2 enclosure. The driver faces downwards into a revolving baffle that 'sweeps' the room. System is similar to that used in electronic organs.

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# LOUDSPEAKERS

relationships coherent — that is, in step with each other at all frequencies — just as they would be in radiating from a live source.

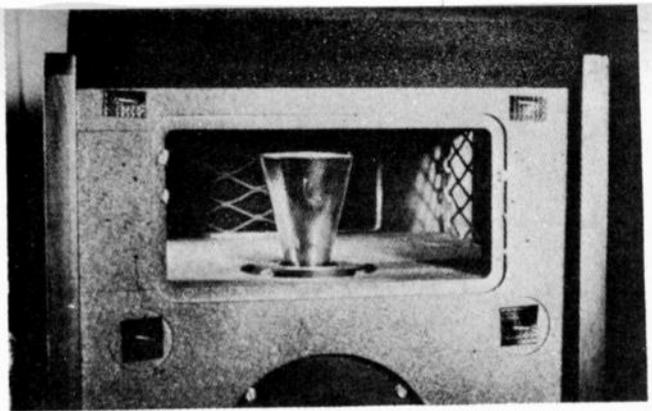
Dahlquist believes that a good loudspeaker should only operate on the frontal hemisphere, and never backward; that good dispersion forward is a virtue; but that it is better to have poor dispersion than to let any signals be reflected. Indeed, the design concept of the loudspeaker is to keep from "wasting energy" in either directions and to keep from confusing the stereo image. Mr. Dahlquist, it might be noted, speaks from a vast background of research and development on other kinds of loudspeakers — and sound like a spokesman for the English (BBC) school of speaker research, or the corresponding French (ORTF) school. His ideas and his patented speaker represent a divergence from the prevailing US school of wide, or even omnidirectional, dispersion. The design is a refreshing restudying of the principles of sound propagation and of the relationship of the speaker to the room and to the listener. I suspect that the Dahlquist will have a lasting effect on speaker design.

Despite some evidence of a trend away from electrostatics, two speakers have come out with that ever-glamorous drive in new formats, each claiming to correct all the problems of its predecessors.

The Crown International Auralinear is a hybrid. It has paralleled electrostatic cells used for the full range above 350 Hz, with dynamic woofers in acoustic-suspension enclosures used below that frequency. The cells stand free in the room, radiating from both front and back. Electronic protection circuits are built into the crossovers. Crown claims that the Auralinear represents enormous advances over the "timorous, touchy, and crackling old electrostatics." All the virtues are there, with a new ruggedness and ability to reproduce at very high levels.

The Dayton-Wright (named not for two men but one, Mike Dayton-Wright), from Canada, is a free-standing full-range electrostatic, claimed to cover the full range of sound with "electrostatic quality" in all frequency bands. Each speaker has eight electrostatic cells mounted in two ranks, one above the other, and with provision for coupling the cells in various ways, depending on the configuration that best suits the room's acoustics. Normally, each cell is used full range. The driver assembly is encased in a plastic bag filled with a nonconductive gas. Designer Dayton-Wright claims to have solved

*The Infinity tweeter is related to the Ohm A's operating principles though cone orientation is reversed. It is combined with transmission — line bass driver.*



problems "inherent in other electrostatics" — lack of efficiency, nonlinearity, inability to handle extreme dynamic range — by eliminating insulating sheathing in the drivers in favor of the nonconductive gas so that the speaker can take high signal voltages and produce long excursions without arcing and thus be low in distortion and high in output. He also says his design eliminates the phase distortion of crossovers and keeps wave fronts from the various elements coherent.

While Crown and Dayton-Wright have developed interesting (and expensive) new designs, some manufacturers are trying to get better performance from less floor space — an important practical consideration, particularly in quadraphonics. Noteworthy are the JBL sound columns and the EPI Microtower, two adaptations of the tuned columns that date back to high fidelity's earliest days. The results are excellent in terms of cost and space and show how much one can improve on old designs with modern materials and know-how.

The search for more realistic bass reproduction in speakers take several forms; most manufacturers are offering "new approaches" of varying complexity and cost. Perhaps most noteworthy are the various transmission-line loudspeakers turning up in the deluxe sector of the market.

The transmission-line concept is not new; old hands will remember the acoustical labyrinths of the late thirties and early fifties. A decade or so ago the British revived the idea of enclosing a driver in a long tube leading from the back of the driver. According to its proponents, the principle can be used wherever the criterion is more *natural* bass propagation, or wherever it is more *accurate* midrange or bass propagation. Thus some manufacturers have adopted transmission lines for both bass and midrange, justifying the complexity and expense by the more accurate reproduction made possible by high-quality drive systems. Properly executed, the technique provides a dead acoustic environment for the driver, killing reflections back to it from the enclosure and sound feed through enclosure walls. In addition, bass lines can be tuned like organ

pipes, lowering the free-air resonance of a driver (to get deeper fundamentals in the bass) and smoothing the impedance characteristics of the loudspeaker (thus making more efficient the transfer of power from the amplifier).

All of these virtues contribute to the transient performance claimed by transmission-line advocates. There are some vices, however, lowered overall efficiency and susceptibility to subsonic disturbances being the most important. But the designers have been busy, and a number of successful transmission-line systems are available from Infinity Systems, ESS, Radford Music and Sound, and IMF. The configurations vary of course from model to model.

A related idea, again from England, is the active-line loudspeaker. The transmission lines we have been discussing are passive — i.e., driven from one end only. In the new IMF ALS-40 loudspeaker the bass line is driven conventionally at the top end, and driven at its "port" end by a subsonic-resonance woofer through a complex phase-shifting network. The design team at IMF makes the following claims for the active-line principle: that it reduces cabinet size for equivalent performance; that it increases efficiency and power-handling capacity (i.e., acoustic power into the room); and that it eliminates subsonic problems.

Certainly no one has repealed the laws of physics, though speaker designers are wont to accuse each other of claiming to do so. All that can be said about the current state of the loudspeaker art is that some manufacturers are succeeding in making sonic advances, by a better understanding and application of the laws of physics, acoustics, and psychoacoustics. In short the art is not standing pat even though the laws within which it operates are. We are seeing more and more fresh design ideas; and some of them are, I think, better solutions to the eternal quest for the ideal loudspeaker. At the worst, there is a rebirth of excitement in loudspeaker design, and the purchaser this year is given some real choices. But the verdicts on today's new designs is of course that of the market place. ●



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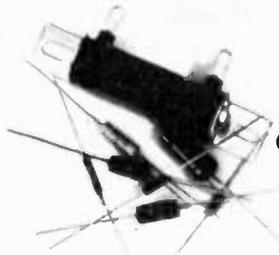
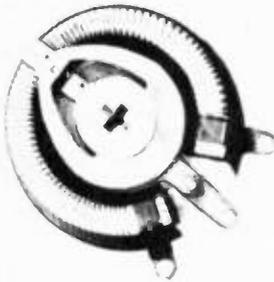
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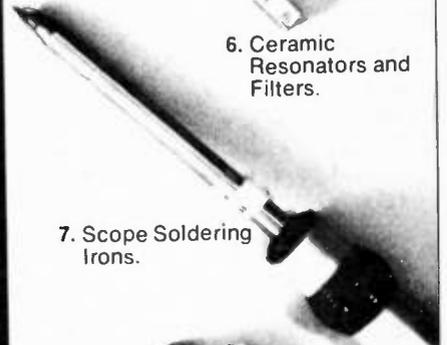
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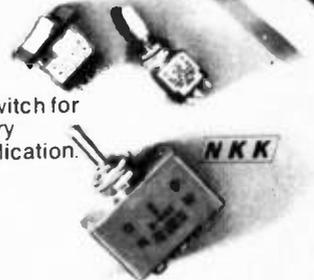
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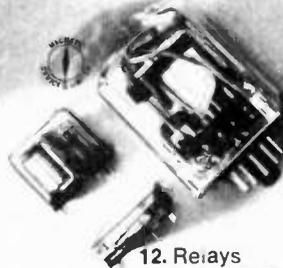
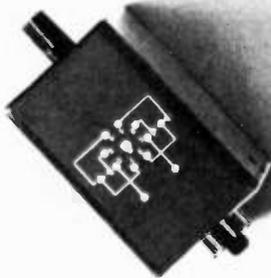
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# SENSORS ON

A new, regular monthly feature by 'Talus'

## The marvel of nature's mechanical systems

ONE aspect of instrumentation that fascinates me is miniaturization of sensors. We think our achievements related to the manufacture of tiny microcircuits tops everything — hundreds or even thousands of active elements on a chip about a millimetre across. But really, this is just the *start* of what is possible, as a look at Mother Nature's mechanical ingenuity shows.

The development of a discipline usually passes through two distinct stages. First comes the static understanding where the behaviour of the device to a stimulus is studied after all time variations have died down to the steady-state. The next stage of sophistication is to tackle the dynamic behaviour — how it responds during the transients. The latter is, by far, the more difficult to study.

From the mechanical construction point of view the integrated circuit is a mere static device. Some integrated circuits do use elements that mechanically resonate to simulate an effect but these are normally used only in the steady-state oscillatory mode. We are, therefore, still in the elementary stage of mechanical miniaturization.

Let us take a brief look at nature's achievements. Scanning electron-microscope pictures reveal the tremendous intricacy, delicacy and perfection of nature's mechanical machines. The body of a tiny insect, for instance, abounds with feedback-controlled mechanical devices incorporating actuators, sensors, signals and fine mechanics. Even our best watch technology falls far short of really copying nature's achievements.

For example, the jaw of one species of Australian ant is 300  $\mu\text{m}$  across. The controlled movement mandibles are of the same length. Upon the mandible are teeth and tactile sensors 30  $\mu\text{m}$  in length. The leg, wing and proboscis structures of a mosquito are equally as excellent.

It is interesting to look back through history on the theme of copying Nature's mechanics. It was once highly

fashionable (in the 18th and 19th centuries) for craftsmen to model and attempt to reproduce Nature's creatures with the same detail — they didn't try such small subjects as fleas and ants very often — ducks were the most popular subjects. One duck made by Rechenstiener in 1847 had over 400 moving parts in each wing. These Androids (as artificial animals are called) were so well made that it is said they resembled the real thing with remarkable fidelity. There are also the amazing clocks that depict scenes of historical import with moving figurines which act out a drama. Although few survive today, those that do show the incredible hand-skills and design ability people once had. Works of art of those periods also reveal their patience and skill — carved altars (of huge size) clustered with thousands of figures, silverware, paintings, sculpture, interior decorative schemes and, of course, the extreme embellishment of instruments.

Although it is largely true that the craft content often exceeded

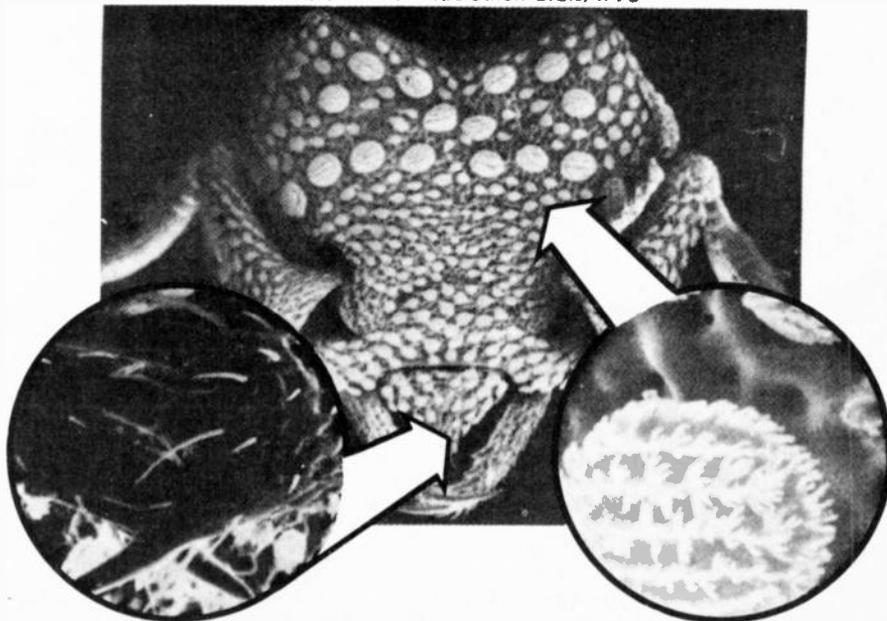
performance content in those early times, the same skills are an essential ingredient for the successful design of the sophisticated instruments and sensors needed by today's technology. It is a case of obtaining the right mix of ingredients. Sadly though, it seems we are fast losing many of our bygone virtues. We are forever preoccupied with haste of achievement, with love of the impermanent. Everything new is right, everything old is wrong. Bigger is better, faster is cleverer and so on.

### THE NEED FOR MICROSENSORS AND ACTUATORS

There is a need for microscopic sensors and actuators. Only the other day I received a letter in which the correspondent discussed the requirement for tiny pressure sensors that can be placed in the pore of a leaf — without altering the pore's function.

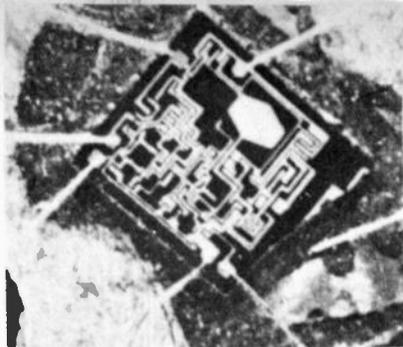
At present we generally investigate small things with mammoth equipments. We use an electron-microscope to "see atomic

Head of Ant (*Rhopalothox Orbis*) x 75



Teeth on mandibles x 300

Cephalic hairs x 600



T05 operational amplifier x 20. Whose still winning at miniaturisation?

size objects. The volume of the subject is  $10^{-27}m^3$  — the instrument is  $10m^3$  in size.

Many designers of today are engaged in sensor and control developmental projects where miniature dynamic techniques are essential. Prosthesis — the manufacture of artificial limbs — comes to mind. It is now possible to reproduce the external appearance and texture of skin and other human materials with tremendous similarity — the static case again — but when it comes to engineering their dynamical insides to produce lifelike movements, the skills need much improvement. Here is a need for reliable, sensitive, miniature sensors, small but powerful actuators to replace muscles and small, yet large capacity, power supplies.

In the study of nature, we need small sensors to research processes such as growth, colour formation, photosynthesis. Most of our knowledge has been gained the hard way using indirect procedures — the structure of the DNA molecule (the code of biological similarities) was untangled using X-ray diffraction patterns, not direct viewing of the helical molecule.

When we are able to build a mechanical device with the complexity of, say, a chart recorder, a record changer or a mechanical desk calculator in the volume of a millimetre cubed, we will be starting to rival Nature at the game. We have a long way to go from the transition from a static microcircuit to a mechanically active device.

What is the smallest man-made sensor of any kind, static or dynamic? Thin film and hot wire anemometers have been made the size of pinheads, thermocouples similarly are small. If you can offer ideas on what is the smallest sensor why not write in to me? (Letters, to our contributor should be sent to "Talus" c/- Electronics Today International).

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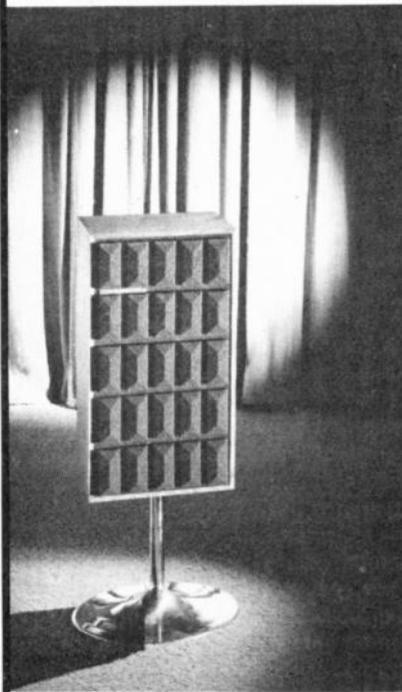
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14 1/2" W x 11 1/2" D. Nominal  
Impedance: 8 ohms.

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# SOLID STATE TIMER

Time delays from milliseconds to several months can be achieved using this new IC.

OVER the last two decades, methods of producing time delays have advanced from the purely mechanical and thermal devices to electronic devices incorporating transistors, etc. Early electronic timers utilised the charge time of a capacitor slowly charged through a timing resistor; when the voltage across the capacitor reached a certain level an electronic switch was operated and this provided the output.

Early timer designs were limited due

to leakage currents in transistors and timing capacitors. These limitations placed an upper limit on achievable time delays of around 60 seconds.

More recently there has been a move towards the use of unijunction transistors (PUT), along with better quality capacitors. It is now possible to buy capacitors with leakage currents in the region of a tenth of a micro-amp. The increase in the use of wet slug tantalum capacitors has caused their price to be considerably reduced over the past few years. These capacitors can be readily purchased with leakage currents well under a micro-amp. Using a wet slug tantalum capacitor as a timing element and a PUT as the voltage sensing element, it is possible to produce timers with time delays up to approximately 30 minutes or so. But the maximum time range obtainable is still limited by the leakage currents of the PUT and of the timing capacitor.

There is also a technical problem involved in the calibration of time ranges on long time delay units. This is because readily available potentiometers of high resistance values (1 megohm or so) have a typical tolerance of  $\pm 10\%$ , and timing capacitors can only be readily obtained with an absolute tolerance of  $\pm 5\%$  or so. If any degree of accuracy is required on an electronic timer it is therefore necessary either to select components to a high order of accuracy or to arrange for a calibration procedure. The former of these two propositions is not generally found practicable and the latter is therefore

used. In order to calibrate a timer it is necessary to allow it to time out, measure the time delay and adjust the calibration potentiometer as required. This procedure must be repeated until the time delay is of sufficient accuracy. When time ranges of minutes are involved this calibration procedure either requires expensive test equipment or a long laborious test procedure.

These problems appear to have been overcome by a new form of electronic timer developed in Britain by the Electrical Remote Control Company Limited, in conjunction with Ferranti. The two companies have jointly developed a 14 lead dual-in-line timing integrated circuit, designated the LR171E. This integrated circuit can operate from supplies of six to 440 volts ac or dc, producing many timing functions and time delays from five milliseconds to over three months depending upon the selected values of a few external components. The unit is also designed to provide an analog output capable of driving a meter directly, the voltage being proportional to the elapsed time. The latest advances in LSI (Large Scale Integrated) circuits made this device possible by bringing together bi-polar switching speeds and linear circuit capabilities, coupled with MOS complexities.

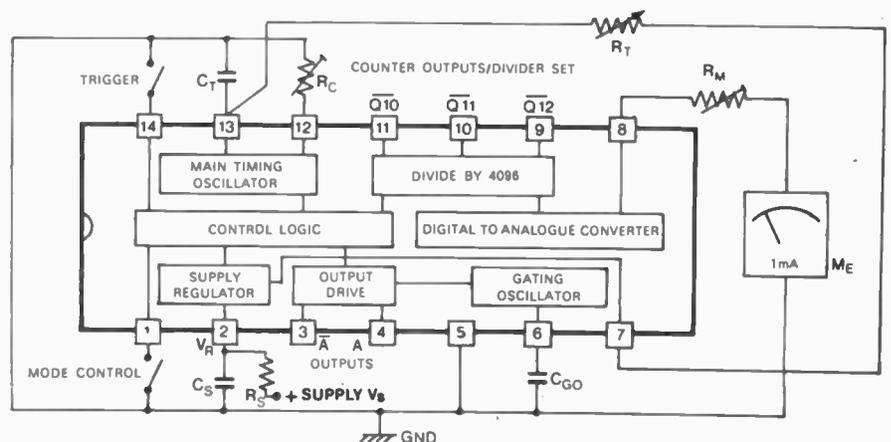
## GENERAL DESCRIPTION

An integral operational amplifier is used to form a relaxation oscillator, the period of which is determined by an externally connected capacitor and

TABLE 1

| Time Period | $R_T$ (ohms) | $C_T$ (farads) | Oscillator Period (seconds) |
|-------------|--------------|----------------|-----------------------------|
| 100 mS      | 10K          | 2 2n           | 24 42 $\mu$                 |
| 1 sec       | 10K          | 22 n           | 244 2 $\mu$                 |
| 1 sec       | 100K         | 2 2n           | 244 2 $\mu$                 |
| 10 secs     | 100K         | 22 n           | 2 442m                      |
| 10 secs     | 1M           | 2 2n           | 2 442m                      |
| 30 secs     | 100K         | 68 n           | 7 326m                      |
| 30 secs     | 1M           | 68 n           | 7 326m                      |
| 1 min       | 100K         | 0 15 $\mu$     | 14 65 m                     |
| 1 min       | 1M           | 15 n           | 14 65 m                     |
| 5 mins      | 1M           | 68 n           | 73 26 m                     |
| 10 mins     | 1M           | 0 15 $\mu$     | 14 65 m                     |
| 20 mins     | 1M           | 0 33 $\mu$     | 293 m                       |
| 30 mins     | 1M           | 0 47 $\mu$     | 439 6 m                     |
| 1 hour      | 1M           | 1 $\mu$        | 879 1 m                     |
| 2 hours     | 1M           | 1 5 $\mu$      | 1 758                       |
| 5 hours     | 1M           | 4 7 $\mu$      | 4 396                       |
| 24 hours    | 1M           | 22 $\mu$       | 21 1                        |
| 5 days      | 1M           | 100 $\mu$      | 105 5                       |
| 1 week      | 1M           | 160 $\mu$      | 147 7                       |
| 4 weeks     | 1M           | 560 $\mu$      | 590 8                       |

Table 1. This table shows the values of timing capacitor and resistor required for delays over the range 100 mS to 4 weeks.



Block schematic drawing shows the IC in a typical timing application. Time delay is determined by  $C_T$  and  $R_T$  (see Table 1). The meter ( $M_E$ ) indicates total elapsed time.

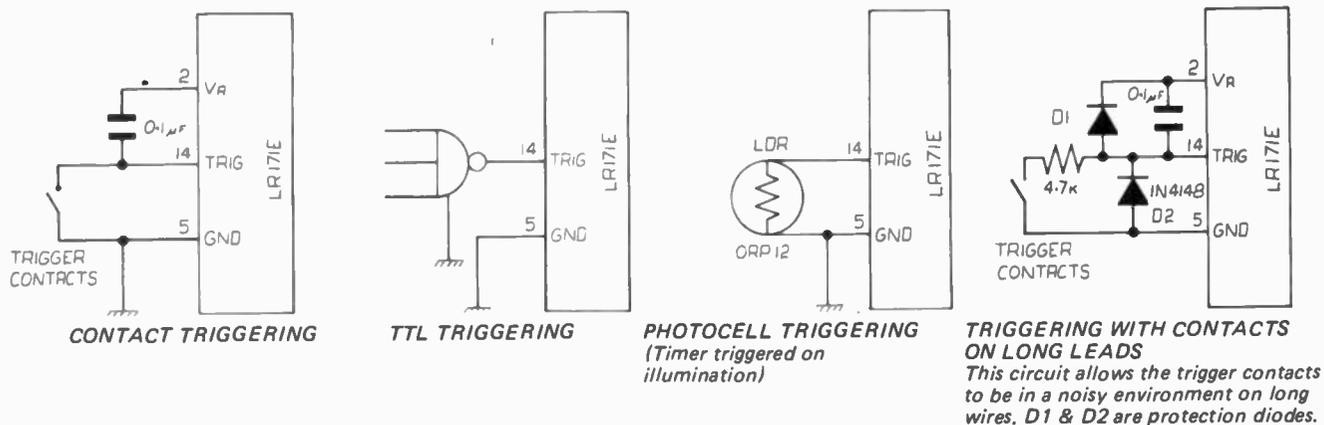


Fig. 2. The trigger input to the IC (pin 14) may be either through contacts or from an electronic source. Since the IC has an internal Schmidt trigger and pull-up resistor, the connection of a capacitor can satisfactorily prevent mis-triggering due to contact bounce.

an adjustable timing resistor. In addition, for calibration purposes, the frequency of the oscillator can be adjusted by an external trimming potentiometer.

Pulses from the oscillator are fed via the control logic to a chain of 12 binary dividers. When the IC is timing, the dividers count up the pulses. When the count reaches 4095 (binary 1111111111) this state is detected by the control circuitry which stops the timing.

The IC incorporates its own power supply regulators to enable the chip to run from unstabilised supplies. The shunt regulator holds  $V_R = 4.7V$  nom for the output circuitry and a series regulator gives 2.5V to supply the internal logic and oscillator etc. A reset circuit operates when the supply voltage is below 3.6 volts. Thus when the IC is first switched on, the divider chain and control logic are all automatically reset.

An output signal from the integrated circuit can either drive up to 20mA dc

into the gate of an SCR, or up to 20mA pulses  $10\mu S$  wide into the gate of a triac. The positive and negative pulses are obtained by passing a 1kHz rectangular wave through a capacitor to the gate of the triac.

Contained within the logic of the integrated circuit is a digital to analog converter. This converter gives an output voltage which is proportional to the count obtained on the timer counter chain. This output swings from 0 to 1 volt nominal and can drive a 1mA meter. The meter reads 0 to 100% of elapsed time. Using this technique the meter always read zero to full scale regardless of the actual set time, thereby achieving the highest possible accuracy.

The selective grounding of three pins on the integrated circuit can reduce the division ratio by 1/8, 1/4, 3/8, 1/2, 5/8, 3/4, 7/8. These same pins carry the outputs from the last three dividers, allowing the integrated circuit to be used directly as a scanner or multiplexer with a prefixed scan time.

Time delays achieved are mainly limited by the external components. The integrated circuit oscillator has a maximum speed of around 100kHz; allowing the minimum division ratio of approximately  $5 \times 10^2$  this gives a minimum time delay of 5mS. The maximum CR constant that can be practically and economically obtained from the oscillator is around 60 minutes, producing a time period of approximately  $1 \text{ hour} \times 4 \times 10^3 = 4000$  hours. If longer time periods are required or smaller values of CR are needed to achieve better stability, then two integrated circuits can be operated in series to give an overall division ratio of 16 773 120. The timing resistor can be any value in the range 5k to 1 Megohm. There is virtually no limit on the values of timing capacitor than can be used to operate the oscillator circuit.

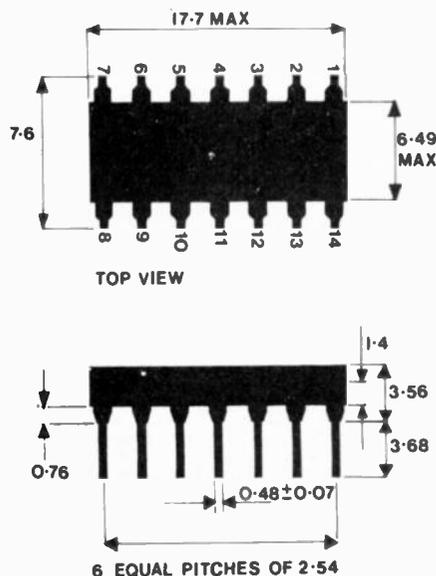
Using a typical set of components the integrated circuit timer will produce subsequent timing periods to an accuracy of  $\pm 0.015\%$ . The IC has an ambient operating temperature range of  $-10$  to  $+85^\circ C$  and will operate over an input current range of eight to 30mA. Timing varies by only 0.1% mA change in supply current. The variation in time due to variation in temperature is largely due to the type and value of timing capacitor and resistor used, the integrated circuit temperature coefficient being typically only  $-0.15\%/^\circ C$ .

The reset time required is dependent upon the power supply capacitor. This can be arranged to discharge and effect reset in 50mS if needed. If a larger value of capacitor is used then longer reset times can be obtained. It should be noted that for very fast reset times under unusual transient conditions, special precautions have to be taken. If the integrated circuit is driven from a low voltage dc power source then no reset due to input fluctuations will take place unless the supply voltage falls below a nominal 3.6 volts.

The dc power supply regulator built into the integrated circuit is designed to withstand transients of 1kV continuous when operating from a 240Vac supply via a series resistor and diode.

The manufacturers of this IC (Elremco Ltd) are currently seeking representation in Australia. Interested companies should contact Elremco directly, mentioning this magazine. Elremco's address is Electric Remote Control Company Ltd, P.O. Box 10, Bush Fair, Harlow, Essex England. Telephone Harlow 24285.

#### OVERALL DIMENSIONS in millimeters



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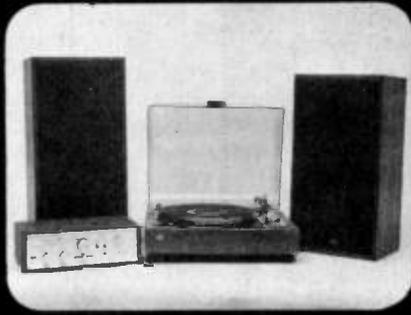
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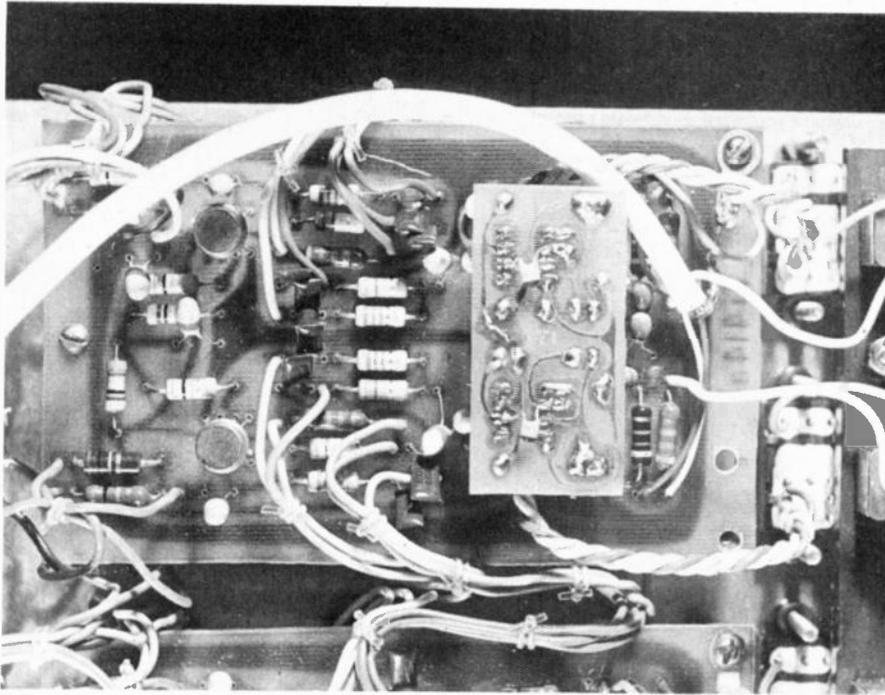
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# Master Mixer modification

This simple two IC board replaces the LM381 dual preamplifier which is currently unobtainable.



The replacement board is mounted, component side down, as shown. A small wooden block spaces this board from the main board. Note that C1 and C3 mounted on the copper side of the board.

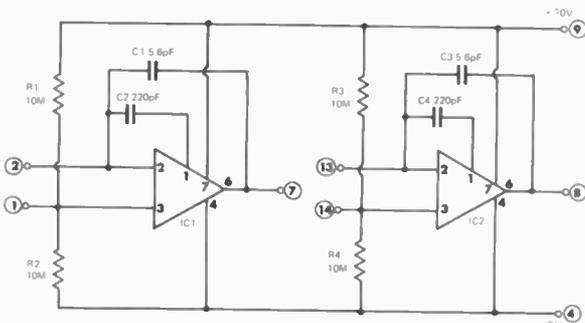


Fig. 1. Circuit diagram of the replacement unit. The ICs are National LM301.

## HOW IT WORKS

Except for biasing, the operation of the LM301 is identical to one half of the LM381 (LM381 is a dual amplifier).

The LM381 is designed for operation from a single-ended power supply whereas the LM301 requires a dual power supply. The LM301 therefore requires resistors to split the power rail by providing an artificial centre tap (R, R2 and R3, R4).

The 390 kohm biasing resistors for the LM381, R7 and R8, are therefore no longer used and must be removed from the main board.

A 5.6 pF capacitor is connected

across pin 6 to pin 2 of each IC, as feedback, to reduce the high frequency gain beyond 20kHz, thus reducing high frequency noise. With this capacitor in use the gain when set to maximum drops 3 dB at 20 kHz. At lower gain levels the response is flat to well beyond 20 kHz.

Frequency compensation is applied to each amplifier by means of the 220 pF capacitor connected between pins 1 and 2. This mode of compensation is known as "Feed forward" and is used to extend the frequency response of the LM301 which would otherwise be 3 dB at 1 kHz and maximum gain.

## PARTS LIST

- IC1 integrated circuit LM301 (mini-DIP pack preferred)
- IC2 integrated circuit LM301 (mini-DIP pack preferred)
- R1 resistor 10M ¼ or ½ watt 5%.
- R2 resistor 10M ¼ or ½ watt 5%.
- R3 resistor 10M ¼ or ½ watt 5%.
- R4 resistor 10M ¼ or ½ watt 5%.
- C1 capacitor 5.6pF ceramic
- C2 capacitor 220pF ceramic
- C3 capacitor 5.6pF ceramic
- C4 capacitor 220pF ceramic
- PC board ETI 414d

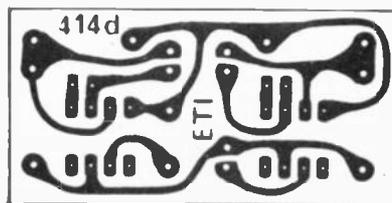


Fig. 2. Foil pattern of printed circuit board shown full size.

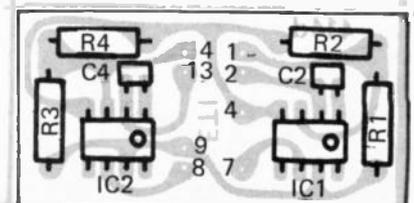


Fig. 3. Component overlay

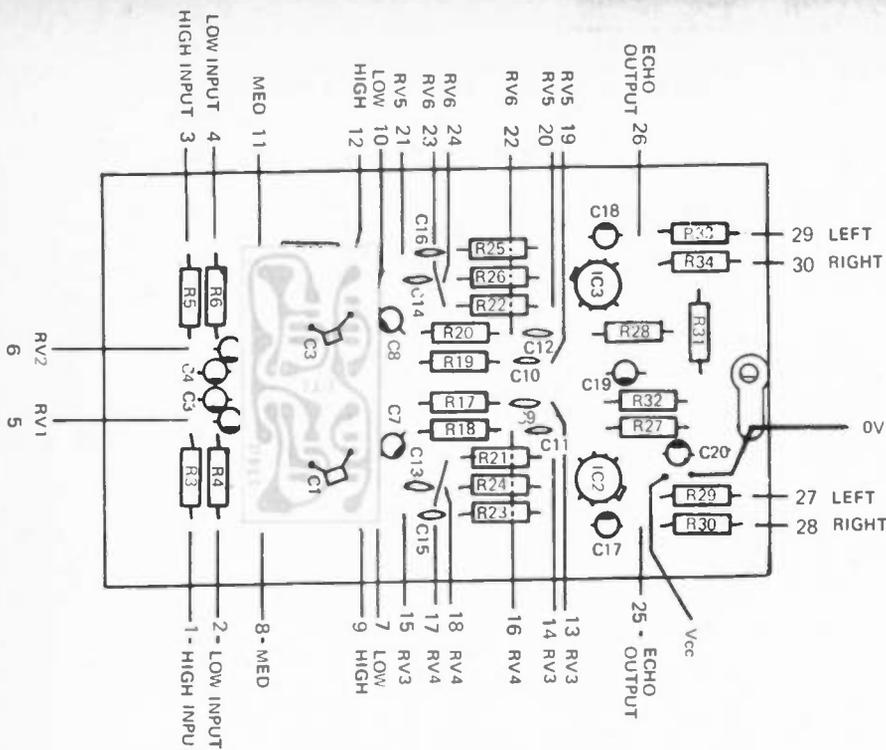


Fig. 4. Position of the printed circuit board with respect to the preamplifier board. Note the positioning of C1 and C3.

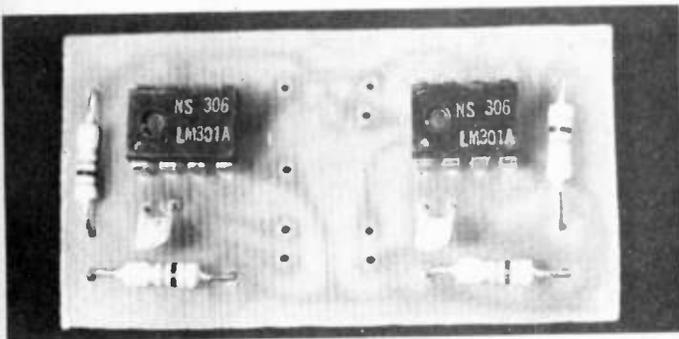


Fig. 5. The completed PC board is connected by means of wire links from the remaining holes to the LM381 socket on the preamplifier board.

dB gain at 10 kHz). We have established however that the LM301, when used with feed-forward compensation, does provide the necessary stability and frequency response over the required gain range.

The LM301 is not primarily a low-noise amplifier however, and the noise level of the mixer will be 10 to 15 dB worse than with the LM381. This however will not be a problem for normal live work. It may however, (but not necessarily) be a problem when the unit is used for recording.

As the noise performance of the original unit was very good indeed, 10 to 15 dB degrading is not as serious as it might at first seem, and for normal live work, will cause no problems. The increased noise level may (but not necessarily) be a problem when the unit is used for recording purposes in studios with low ambient levels.

Apart from the noise increase, this modification will not degrade the performance in any way. Both gain and frequency response will remain as specified, and the mixer will operate satisfactorily for all but the most exacting applications.

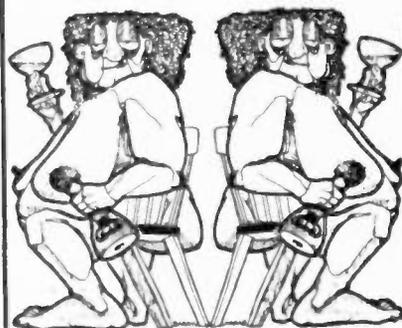
### CONSTRUCTION

Mount the components onto the printed circuit board as shown in Figs. 3 and 5. Ensure that the IC's are correctly orientated. The dot or notch on the IC should be to the left when the board is orientated as shown in the photograph. Note that capacitors C1 and C3 are mounted on the copper side of the board as shown in Fig. 4 and the photograph.

Remove existing R7 and R8 from the preamplifier board (390 kohm) and using a small wooden block as a spacer (1/2" x 1/4" x 3/4") position the small board over the LM381 socket in the preamplifier board as shown in the photograph and in Fig. 4.

Small straight pieces of tinned-copper may be used (eg., ends of resistors previously cut off) to join the two boards together. Note that the small printed circuit board is designed as a pin-for-pin replacement for the LM381 but pins 3, 5, 6, 10, 11 and 12 are not used. Thus the pieces of wire are passed through the holes in the small board to the corresponding hole in the LM381 position. Solder the wire to the copper pads on both boards and trim the excess wire.

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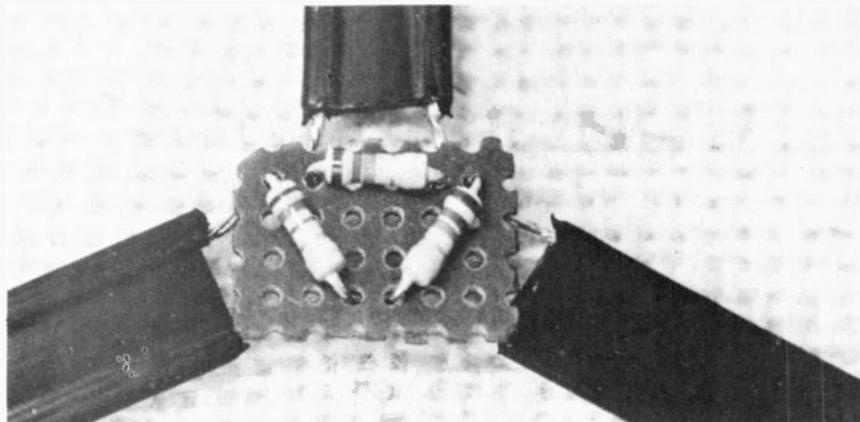
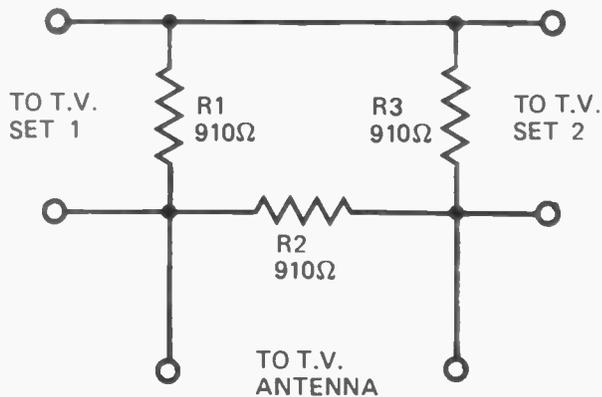
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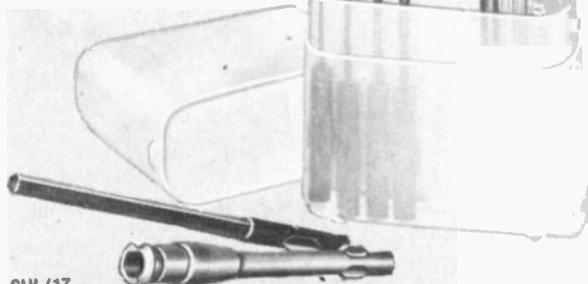
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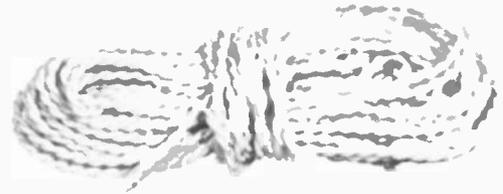
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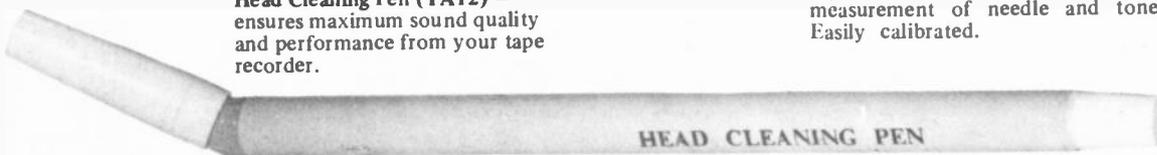


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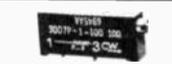


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## WIREWOUND

### ADJUSTMENT POTENTIOMETERS

|       | Description                       | Dimensions<br>H x W x L | Terminals | Res.<br>Tol.<br>(%) | Power<br>(Watt)<br>at 70°C | Max.<br>Temp.<br>°C | Nom.<br>Adj.<br>Turns | Humi-<br>dity<br>Mil Spec | Standard<br>Resist-<br>ances Ω     |
|--|-----------------------------------|-------------------------|-----------|---------------------|----------------------------|---------------------|-----------------------|---------------------------|------------------------------------|
|  200  | Low Cost TRIMPOT Potentiometer    | .32 x .26 x 1.25        | P         | ±10                 | 0.5                        | 105                 | 25                    | Steady State              | 10-10K<br>20K & 25K<br>50K<br>100K |
|  224  | High Temperature                  | .32 x .19 x 1.25        | P         | ±5                  | 1.0                        | 175                 | 22                    | Yes                       | 10-10K<br>20K & 25K<br>50K<br>100K |
|  3007 | Commercial E-Z-TRIM Potentiometer | .31 x .16 x .75         | P         | ±10                 | 1.0 at 40°C                | 125                 | 20                    | Steady State              | 10-25K                             |
|  3067 | Commercial E-Z-TRIM Potentiometer | .36 x .28 x 1.0         | P         | ±10                 | 0.5 at 25°C                | 85                  | 15                    | No                        | 50-20K                             |

## CERMET

### ADJUSTMENT POTENTIOMETERS

|  |  |                                      |        |     |              |     |      |     |                          |
|--|--|--------------------------------------|--------|-----|--------------|-----|------|-----|--------------------------|
|  3006  | Commercial TRIMPOT Potentiometer         | .25 x .19 x .75                      | P      | ±10 | 0.75         | 125 | 15   | Yes | 10-2 Meg.                |
|  3009 | Commercial E-Z-TRIM Potentiometer        | .35 x .19 x .75                      | P      | ±10 | 0.75 at 25°C | 125 | 20   | Yes | 10-2 Meg.                |
|  3282 | Humidity Proof PALIRIUM Cermet Element   | .20 x .375 x .375                    | L      | ±10 | 0.5 at 85°C  | 175 | 25   | Yes | 10-1 Meg.                |
|  3329 | High Performance PALIRIUM Cermet Element | .250 dia. x 180<br>.245 x .29 x .375 | H<br>W | ±20 | 0.5 at 85°C  | 150 | 240° | Yes | 10-1 Meg.<br>10-1 Meg.   |
|  3389 | Single-Turn Commercial                   | .24 x .394 x .36<br>.36 x .394 x .24 | P      | ±20 | 0.5          | 125 | 280° | Yes | 100-2 Meg.<br>100-2 Meg. |

## RESISTON CARBON

### ADJUSTMENT POTENTIOMETERS

|  |                                   |                 |   |     |              |    |    |    |            |
|--|-----------------------------------|-----------------|---|-----|--------------|----|----|----|------------|
|  3068 | Commercial E-Z-TRIM Potentiometer | .36 x .28 x 1.0 | P | ±20 | 0.20 at 25°C | 85 | 15 | No | 20K-1 Meg. |
|--|-----------------------------------|-----------------|---|-----|--------------|----|----|----|------------|

## VARIABLE RESISTORS

|   |                                 |  |
|---|---------------------------------|--|
|  3359P | 3/8" Single-Turn Cermet Element | Standard Resistance Range ..... 100 to 2,000,000 ohms<br>Power Rating ..... 1/2 watt at 70°C, 1/4 watt at 40°C<br>Humidity ..... Less than 1% change in total resistance after 500 hours |
| 3359W   | 3/8" Single-Turn Cermet Element | Resistance Change After Solvent Bath in<br>FREON T.F. or Trichloroethane ..... Less than 1%<br>Operating Temperature Range ..... -65°C to +125°C   |

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TE 8125/173

# AMATEUR RADIO

Roger Harrison VK2ZTB



# THE STATE OF THE ART

## Updating transmitter and receiver circuit techniques.

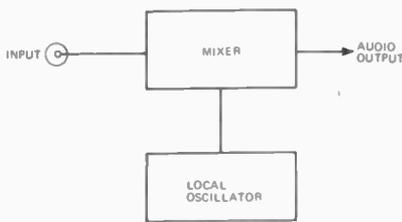


Fig. 1.

THIS month this column is slightly unusual in that I will describe a number of new thoughts, possibly advances (?), on receiver and transmitter techniques. I believe that there are already a number of amateurs experimenting along the lines described below. If you have been experimenting with any of these techniques I would appreciate hearing from you.

### DIRECT CONVERSION RECEIVERS

While the principle of direct conversion reception of modulated RF signals is not new — first appearing in the 1930's as the homodyne and synchrodyne receivers — the development and application of the principle to modern techniques has been quite rapid in the past few years. The direct demodulation of SSB suppressed carrier and DSB suppressed carrier transmissions necessitates a more complex approach than that shown in Fig. 1 for efficient utilisation of the characteristics of SSBSC and DSBSC. The commonly used product detector in every SSB receiver is, of course, a simple example of a direct conversion receiver. The input frequency is, in this case, fixed, and the receiver BFO performs the function of the local oscillator. There would be few amateurs indeed who do not possess and use a direct conversion receiver in that case, albeit as portion of another receiver!

Figure 2 shows a simple practical system for a direct conversion receiver.

However, to effectively demodulate AM and DSBSC signals, phase locking is necessary to avoid phase distortion and attendant loss of intelligibility. The RF filters are included to minimise cross modulation, and the two RF amplifiers provide pre-mixer gain and AGC control. The audio low pass filter sets the receiver bandwidth.

A better system is shown in Fig. 3. This system can demodulate SSBSC, DSBSC, or AM (being a double sideband signal with carrier). RF and AF phasing is used to cancel one sideband of the incoming signal, making it a truly single sideband receiver. Upper or lower sideband is selected by reversing the phasing of either the RF or audio signal. Lower sideband is selected when the upper channel has the RF and audio sections in the same phase, and upper sideband is selected when they are out of phase. It is necessary to maintain accurate phasing of the signals and to have well matched gain in the two audio channels before the summing amplifier.

With many useful types of ICs appearing almost monthly on the market, the task of constructing a receiver from the block diagrams given

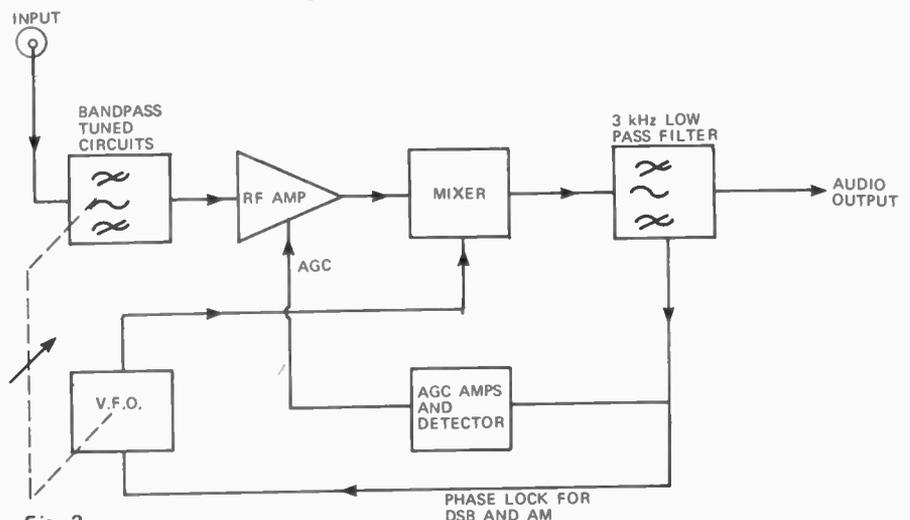


Fig. 2.

should not prove too difficult. The "building blocks" of mixers, RF amplifiers, AGC amps/detectors, summing amplifiers are readily available. Standard, well-established techniques can be used to make the necessary additions for a complete receiver.

### SSB TRANSMITTERS AND ENVELOPE PROCESSING

The RF envelope of an SSB signal does not resemble the audio waveform producing it. Thus, audio clipping/limiting or compression are not very useful in increasing the average-to-peak power ratio of an SSB transmitter. These techniques certainly can improve "talk power" of an SSB transmitter, but the improvement is marginal at best and often results in distortion through maladjustment. Audio AGC derived by a peak detector from the RF envelope is a better system but cannot match the improvement provided by ALC, or RF compression, and RF clipping.

Figure 4 shows an SSB transmitter employing clipping and ALC. The clipping is applied to the SSB signal itself and then filtered to remove the resultant harmonics at 2f, 3f, etc, and

then passed through an automatic level control amplifier prior to mixing with the VFO to produce the final transmitting frequency. ALC control voltage is obtained from the final linear amplifier.

The above system needs careful adjustment but yields good results. Naturally, the final linear amplifiers must be rated sufficiently to withstand the increased average power. The audio input level and the clipping level must be adjusted for best received quality or best signal-to-noise ratio.

This system can be modified such that the resultant SSB (?) can be passed through a class C amplifier. Naturally there is some attendant distortion, generally quoted as "slight"; the receiver could also be expected to add some distortion in this case. The clipper is replaced by a Schmitt trigger, and 12 dB/octave pre-emphasis above 1 kHz is applied to the audio. The peak power thus equals the mean power during speech. As this is a fully-clipped system, the ALC is not necessary.

For further reading, issues of The Proceedings of the IREE (Aust.), Wireless World, Radio Communication (RSGB journal), etc for the past three years have some suitable source material.

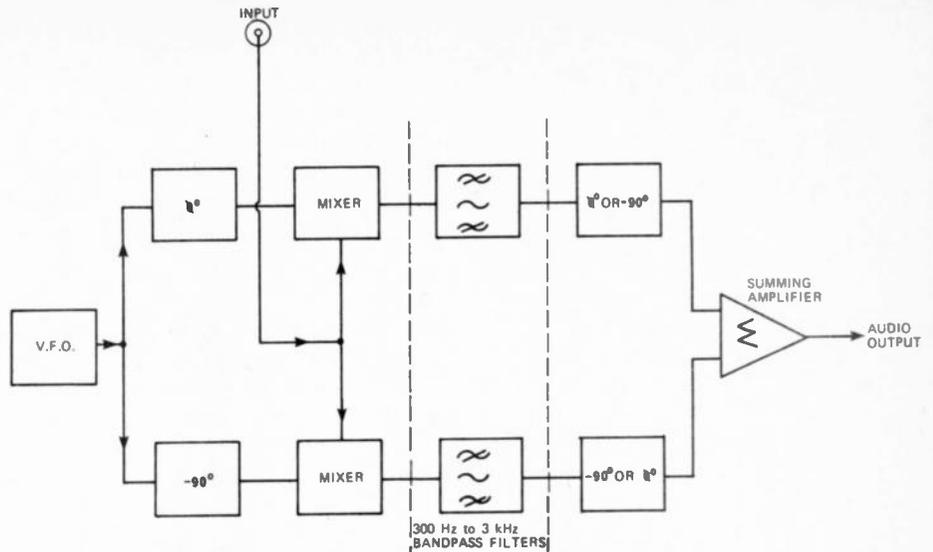


Fig. 3.

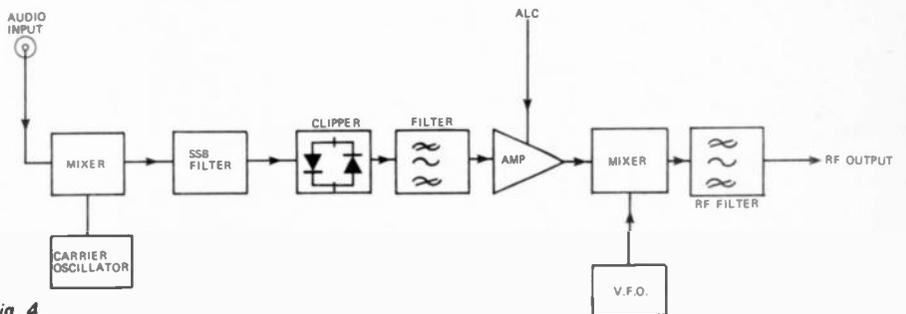
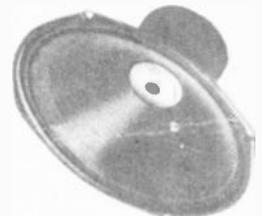


Fig. 4.



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| Model No. | Nominal Cone Diameter | Magnet Weight (Oz.) | Voice Coil Diameter | Application Typical  | Speaker Resonance (Hz) | Response Range (Hz) | Nominal Sensitivity Level* (decibels) | Power Rating Maximum RMS Watts | Suggested Retail Price \$ |
|-----------|-----------------------|---------------------|---------------------|----------------------|------------------------|---------------------|---------------------------------------|--------------------------------|---------------------------|
| 12C10L    | 12"                   | 10.                 | 1"                  | Lead guitar or organ | 75-95                  | 70-7,000            | 100                                   | 25                             | 21                        |
| 12E18L    | 12"                   | 18.                 | 1½"                 | Lead guitar or organ | 80-100                 | 80-7,000            | 100                                   | 60                             | 38                        |
| 12E18B    | 12"                   | 18.                 | 1½"                 | Bass guitar          | 45-65                  | 50-4,000            | 98                                    | 60                             | 38                        |
| 15E28L    | 15"                   | 28.                 | 1½"                 | Lead guitar or organ | 70-90                  | 70-8,000            | 102                                   | 60                             | 48                        |
| 15E28B    | 15"                   | 28.                 | 1½"                 | Bass guitar          | 35-55                  | 30-4,000            | 98                                    | 60                             | 48                        |
| 15G54L    | 15"                   | 54.                 | 2"                  | Lead guitar or organ | 70-90                  | 80-8,000            | 107                                   | 100                            | 70                        |
| 15G54B    | 15"                   | 54.                 | 2"                  | Bass guitar          | 30-50                  | 30-4,000            | 100                                   | 100                            | 70                        |
| 18G54B    | 18"                   | 54.                 | 2"                  | Bass guitar          | 30-50                  | 20-3,000            | 100                                   | 100                            | 94                        |

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# 5mV/cm

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**Sensitivity:** .6V to 6V/cm  
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**Horz. Amplifier:** DC to 1MHz  
**Sensitivity:** .6V to 6V/cm  
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The BFU-121 boasts perfect record tracing; quiet, constant speed, 4-pole synchronous motor; feather-touch cue-control lever; 12 months warranty and after sales service.

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**AUTO PLAY:** Flip the lever to auto and the turntable begins to rotate. Upon reaching the required rpm, the arm leaves its rest and gently lowers the stylus to the disc.  
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Manual and semi-auto models also available.

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N.T.: N.T. Musical & Electrical Wholesale Pty. Ltd., 54 Cavenagh St., Darwin

## NEW PLESSEY HI-FI SPEAKER KITS

Plessey Rola has introduced two new high fidelity cabinets in kit form, designated CK1 and CK2, the kits have been designed for optimum performance with the Plessey C80 woofer and two C3GX tweeters in the CK1, and the recently released C100 woofer and X30 tweeter combination in the CK2.

Extremely simple to assemble, the Plessey do-it-yourself kits represent a considerable saving over fully finished enclosures of similar performance. Anyone who can use a screwdriver should, Plessey say, complete two cabinets for a stereo system in just one afternoon's work.

The finished product is a high quality, high performance unit with a most attractive appearance.

The CK1 kit makes up a 1.8 cu.ft. cabinet. With the recommended Plessey speakers, frequency response is 44 Hz to 20 kHz and power handling capacity 20 watts rms. A 2.5 cu.ft. cabinet is produced from the CK2 kit. Fitted with the recommended speakers this system has a frequency response from 40 Hz to 30 kHz and 20 watts rms power handling. (Kits are available from Plessey Rola distributors and other leading hi-fi dealers. Further details from: Plessey Rola Pty. Limited, The Boulevard, Richmond, Victoria.)

## HI-FI FURNITURE

The SIMPLA-LUX range of to-it-yourself furniture can soon be seen in a new showroom at 504 King Georges Rd., Beverley Hills. The showroom will be opened by Mrs. Gwen Tinney who has been handling the furniture now for some two and a half years.

This furniture is extremely suitable for the hi-fi enthusiast as it enables him to arrange his equipment in any position he so desires.

Components come in cartons complete with instructions, the necessary hardware, and are finished ready for oiling and assembly.

## SANYO TO SELL WHARFDALE IN JAPAN

Sanyo Electric Co. have arranged to import Wharfdale hi-fi speaker systems for sale in Japan.

It is not clear whether the decision is due to a desire to market a quality UK product – or is due to the prevailing shortage of wood in Japan – imports have of course

also become cheaper since the revaluation of the Yen.

Initial order is believed to be for 12 000 units worth approximately A\$1.2 million.

## US CONSUMER ELECTRONICS SHOW 1973

*This special report by J. Bryan Stanton, Editor, High Fidelity Trade News.*

Although traditionally not a selling show, CES this year brought brisk business to many exhibitors, particularly the blank tape manufacturers. Typical was the comment of BASF executive Tom Dempsey, "The first three days of the show have been the best order-writing days we've ever had."

Product news was varied, with some new introductions still in the prototype stage. Most of the items brought out this year were improvements, refinements, or extensions of previous development rather than completely new categories.

Among trends noted at the exhibition were:

Four-channel amplifier – manufacturers coping with the current confusion by including circuitry to cope with all four-channel modes of operation.

Tape equipment – Dolby 8-track players from more than one supplier and an overall upgrading in cassette decks.

Speakers – new manufacturers, including Koss with an electrostatic line and smaller entries like Applied Physics Laboratory from Tennessee. New designs, including some colored plastic cabinets and wide use of foam grilles.

Car stereo – growth of in-dash models, plus some new four-channel units and an expansion of auto cassette. Optimism about the market as sales continue to grow by about 33% each year.

Television – new developments in color tuning and in-line tubes and promotional pricing on black-and-white sets. Expectation that soon all sets will be solid-state. Emphasis on portable rather than console color TV for autumn, plus increasing interest and new brands of small-screen sets of seven inches and under.

Concern over availability of supplies was voiced by some manufacturers, although none said they would not be able to deliver products because of shortages. Altec Lansing engineers reported quotes of as long as 20 weeks on deliveries of some products, and KLH and others said wood was the material hardest to obtain.

# big n true



'N not expensive. Pioneer's big new SA-6200 that offers you beautiful, true, Hi Fidelity stereo reproduction at a reasonable price. It features precise RIAA equalisation to  $\pm 0.5$ dB wide frequency response (15–80,000 Hz) and wide power band width (10–70,000 KHz), factors usually found in more expensive amps. Hear it perform now at all quality stereo dealers. The big, new, versatile and true SA-6200. From Pioneer. \$199 rec. retail.

Continuous Power Output, (Both Channels driven): 20 Hz to 20 KHz, 15W + 15W (8ohms).  
Harmonic Distortion: Less than 0.5% (continuous power output).  
Intermodulation Distortion: Less than 0.5% (continuous power output).  
Power Bandwidth: 10Hz to 70KHz (H.D. 0.5%)  
Frequency Response: 15Hz to 80KHz, + 0 – 1dB  
Damping Factor: More than 30 (1KHz, 8 ohms)  
Hum and Noise: More than 90 dB (Less than 1mV)

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**A new low-cost isolator.** At 5 MHz bandwidth, it's 25 times faster than any other isolator on the market. It has a high DC isolation voltage of 2500 volts, and a high common mode rejection of 10 volts at 2 MHz, making the 5082-4350 ideal for eliminating ground loops in digital or analog line receivers, floating power supply and feedback networks. Prices start at \$2.66 each in 100 quantities.

**A low-cost LED display.** Our numeric and hexadecimal displays have simplified your designs with on-board electronics, standard package configuration, and categorized light outputs. Best of all, the 5082-7300 numeric has a new low price of \$10.80 in 100 quantities.

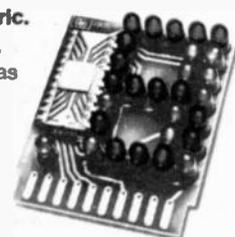
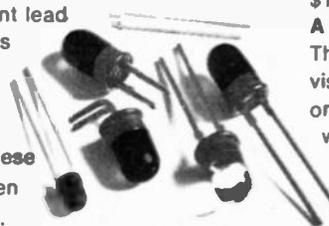
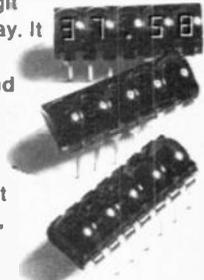
**A new 1.5" LED numeric.** This new LED display, visible from 60 feet, has on-board electronics, wide viewing angle, and is designed for edge mounting in a standard

PC board socket. Solid-state reliability makes the 5082-7500 ideal where dependability is important. The price is \$23.40 each in 100 quantities.

**Small character LED displays.** The 5082-7405 is a 5 digit end stackable display. It minimizes power consumption and offers ease of implementation with a standard 14 PIN DIP package. At only 7 mW per digit, this display is ideal for calculators, portable instruments and anywhere that low power and high brightness are important. The 5082-7405 is priced at \$2.97 per digit in 100 quantities.

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Computer Automation's CAPABLE computer-driven tester performs complete functional tests on logic cards, read-only-memories, LSI, MSI and IC components, and cable assemblies. Printed test reports may be generated for each test; or pass/fail indicator lamps may be used to yield high testing throughput.

The console combines operational simplicity with testing flexibility. The operator has pushbutton control over the testing modes — and can change CAPABLE'S activity at any time merely by pressing the system interrupt pushbuttons. He can select GO/NO-GO testing or operate

for fault isolation.

The tester system gives production technicians an exceptional capability for accurate, high-speed testing of digital logic modules in a production-line environment. It is claimed to provide the first available on-line capabilities for automatic fault isolation, automatic program generation and test program verification and to reduce production time by 80% and more.

Completeness of the test program is verified by forcing all possible functional faults of all IC components on a board.

Further details from: DC Electronics Pty. Ltd., 32 Smith Street, Collingwood, Vic. 3066.

connectors, the Avo Transistor Tester TT169 is battery-operated. Indicator lights on its front panel identify satisfactory and faulty components under test. The low operating voltage ensures that all types of electronic device can be tested safely even if the instrument is inadvertently mis-used.

Further details from: Electrical Equipment of Australia Ltd., 86 Liverpool Street, Sydney, NSW, 2000.

## FREQUENCY-TO-CURRENT CONVERTER MEASURES SPEED

A frequency-to-current converter has been developed in Britain by Lee-Dickens Ltd, principally to provide indication of the speed of rotating machinery. It can also be used for other applications, including flow indication in conjunction with a turbine flowmeter. The instrument can optionally be fitted with high- and low-speed alarms.

Input pulses can be provided by most types of magnetic or photoelectric transducers. If required, the manufacturers will supply suitable transducers. The ST200 produces a current output of 0.1 mA, 0-10 mA or 4-20 mA that is proportional to the frequency of the input signal, irrespective of wave shape or amplitude, within a range of from 50 mV to 20 V.

The basic unit operates from 110 V or 240 Vac supplies, but an optional inverter permits operation from 12 V, 24 V, or 48 Vdc while retaining isolation from the supply.

Further details from: GEC-Elliott Automation, 373 Horsley Road, Milperra, NSW, 2214

## FAST MEASUREMENTS OF SLOWER EVENTS

A new module for the Hewlett-Packard 5300 Measurement System makes fast measurements of low-frequency events with high resolution: e.g. it resolves RPM to 0.001 or frequency to 0.0001 Hz in less than 1 second. No gate times need be set, no adjustments made for triggering or frequency multiplication. And it has an events-per-minute mode to display such readings as RPM or beats per minute.

The new instrument, Hewlett-Packard Model 5307A, achieves speed with resolution, in measuring frequencies from 5 Hz to 2 MHz, by first making a period average measurement for one or more periods (counting its own internal 10 MHz clock), then calculating the corresponding frequency. To indicate the results in events-per-minute requires only the touch of a selector, to change the instrument's calculation.

Light in weight, small in size, and having a battery option, the HP 5300A equipped with a 5307A high-resolution module will speed measurements for many users — for utilities, which need quick, accurate measurements of line frequency and relay trip settings; for users and makers of mobile radio equipment to assure correct operation of tone-selective controls; for touch-tone telephone systems; in process control, to

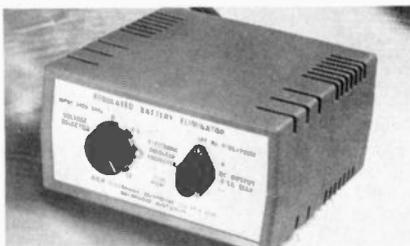


## BATTERY ELIMINATOR

A new Battery Eliminator, the model PS 203 has been introduced by A & R Electronic Equipment.

The unit is primarily designed as a regulated supply for bench testing of tape recorders, radios, amplifiers, record players and test equipment, etc, which normally operate from internal dry cells.

Output voltages of 4.5, 6, 7.5, 9 and 12 are available, by means of a front panel selector, at currents up to 0.5 amps. The ripple is less than 100 mV rms and the



regulation is better than 10% on the 12 volt range and 5% on all other ranges.

The eliminator is approved by all supply authorities and may be supplied in a double-insulated version to meet APO specifications 1053 and 1054.

Size 140 mm x 133 mm x 83 mm, weight 1 kilogram.

Further details from:

A & R Electronic Equipment Co. Pty. Ltd. 32 Lexton Road, Box Hill, Vic.

## SIMPLE INSTRUMENT FOR IN-SITU CIRCUIT TESTING

A lightweight instrument, small enough to be held in one hand and simple to use, has been designed for testing pnp and npn transistors, diodes and thyristors without removing them from the circuit.

The device, developed by AVO Ltd for simple go/no-go tests, speeds up routine testing procedures. Since components are checked in-situ, accidental damage is avoided to printed-circuit boards and other components. Testing is claimed to be easy — even on crowded printed-circuit boards.

Supplied with all necessary leads and

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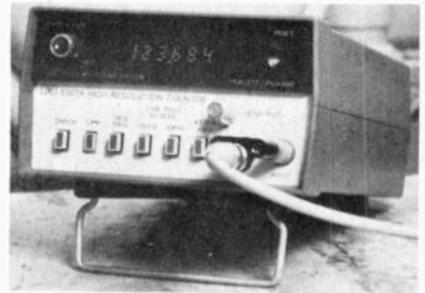
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deliver a fast-paced stream of accurate information on RPM, velocity and other frequency-related measurements; for any job of rapidly calibrating the frequency of audio and other LF signals.

With all its front-panel controls in "neutral", the 5307A is a fully auto-ranging, high-resolution counter with 10 millivolt sensitivity which will operate over its entire specified range without skilled attention. These controls, however, can give the instrument ability to count in situations which would otherwise be impossible. Low-pass filters, at 100 Hz or 10 kHz, may be switched in, to make counting possible in the presence of noise or other extraneous high-frequency signals. Sensitivity is controllable, to set the trigger level above noise levels at all frequencies. To avoid erroneous counting due to bounce, ringing and secondary wave peaks, common in mechanical devices, a hold-off inhibits triggering for an adjustable period of time after each main pulse. An input attenuator can cut down high-level signals with high-level noise to the point where the lower levels of noise will fall below the trigger setting, and accurate counting of the main signal becomes possible.

The basic HP Model 5300A Measurement System consists of a single six-digit display section to which any of several function-determining modules may be snapped. Among these is the new 5307A High-Resolution Counter. Others are 10 MHz, 50 MHz and 525 MHz units, a time interval module and a digital multimeter module. To any of these, a battery pack may be added, and also, if desired, a digital-to-analogue converter which produces analogue signals proportional to the meter's reading, suitable to drive strip-chart or X-Y Recorders. The battery pack and d/a converter are "snap-between" units which can be added to any functional pair of modules.

Further details from: Hewlett-Packard Australia Pty Ltd, Marcom Department, 22-26 Weir Street, Glen Iris, 3146, Vic.



### A NEW U.V. SPECTROPHOTOMETER WITH DIGITAL DISPLAY

An ultraviolet spectrophotometer, which presents results in digital form on a built-in illuminated display panel, has been introduced by Philips Scientific and Industrial Equipment Division. The new instrument, known as the SP 1700 is manufactured by Pye Unicam Limited, of Cambridge, and is compatible with Pye's existing range of ultraviolet analytical equipment. It will complement Pye Unicam's already successful SP 1800 spectrophotometer which uses a scale-and-pointer display. The numerical presentation of the SP 1700 provides

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improved linearity and increased accuracy of absorption measurements.

The display panel on the new unit shows results electronically as four large illuminated digits, a format which eliminates most of the reading errors that occur when checking data from quantitative analysis. Like the SP 1800, the SP 1700 can be set to provide either absorption measurements or concentration directly. Absorption results are displayed to two or three places of decimals, as required. For concentration measurements, the position of the decimal point is selected by the operator. Any particular result can be held on the digital display by the operation of a pushbutton switch. Another feature of the display is an 'over-range' symbol, which indicates an excess absorption, even if the value displayed by operation of the concentration control is within the instrument's limits.

Electrical outputs built into the SP 1700's circuits provide 0-10 mV for coupling to a recorder and 0-25 V for connection to a printer. Operation of the concentration control will give continuous scale expansion. The digital display circuit will also produce an output in BCD (binary coded digital) form for use with electronic data processing equipment. Photometric accuracy and reproducibility are  $\pm 1\%$  of the absorption reading or 0.002 A, whichever is the greater. The wavelength accuracy is within 5 nm over the whole range.

The method of display used in the SP 1800 spectrophotometer is a sensitive, highly linear scale, 14 cm long, which can be switched to any one of four absorption ranges as well as to an adjustable concentration range. A zero-shift switch and a continuous zero-control, together allow the most sensitive scales to be used at high absorption values. The overall range is the same as with the SP 1700, photometric accuracy and reproducibility being  $\pm 1\%$  of the full scale reading on all ranges. Signal outputs of 0-10 mV and 0-2.5 V are provided for recorders and printers, respectively.

### Optics and power supplies

Both the SP 1700 and the SP 1800 spectrophotometers are double-beam instruments with a static beam splitter and an Ebert f/10 diffraction grating

monochromator with a 25.4 cm focal length. Versions are available operating in the range 190-700 nm with a standard detector (SP 1700A, SP 1800B). The light sources provided are an air-cooled deuterium arc and a tungsten-filament lamp. Changes of lamps and filters, required for different wavelengths, are normally made automatically, but can be controlled by the operator, if desired.

A choice of power supplies is available with both instruments; either 110-120 V or 220-250 V can be specified, and either 50 or 60 Hz. Printed circuits (push-in type with test points) and solid-state electronics are used throughout.

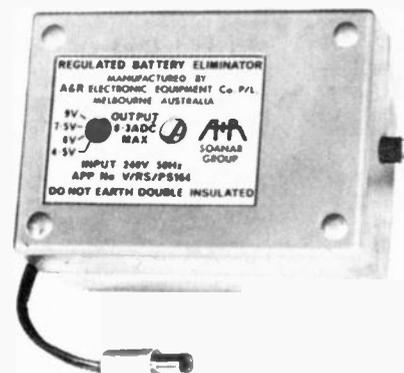
Philips have an SP 1700 operating in their Scientific Department's Applications Laboratory at 200 Goulburn Street, Sydney. This unit is available for demonstration and customer evaluation — by arrangement with Mr Ross Page at Philips (phone Sydney 20223).

### WHAT IS A SPECTROPHOTOMETER?

Spectrophotometers are analytical instruments which make use of the fact that different molecules absorb particular wavelengths of electromagnetic radiation. They consist basically of a source of light, a method of limiting the range of wavelengths in that light (the monochromator) and a means of measuring the amount of light which has passed through the sample (the detector). The beam of light from the source is split into two beams by an optical system (the beam splitter) which in this case is static, i.e. does not move, once set. One of the beams passes through the sample, the other through a known reference cell. The detector system then compares the beams and produces a 'difference' signal that is manipulated by the electronics circuitry before presentation.

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Multi Voltage 4.5, 6, 7.5, 9 V



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- Approved by Electric Supply Authorities.
- Double Insulated for extra safety.
- Ideal for 4.5, 6, 7.5, or 9V Transistor Radios, Tape Recorders, Small Transistorised Amplifiers and Test Equipment, etc.
- Filtered to ensure hum-free operation.
- Output selected by rotary switch, recessed to prevent accidental alteration

### Technical Specifications:

Input 220/240V 50Hz.  
Output 4.5, 6, 7.5 or 9V DC Regulated,  
Maximum Current 0.3 Amps.  
Regulation — less than 10%.  
Ripple — less than 0.25% RMS.  
Dimensions 3½ ins. x 2½ ins. x 2 ins.  
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### SCHLUMBERGER FREQUENCY COUNTERS

Additions to the Schlumberger frequency counter range are the FH 2524 and FH 2525 nine digit models measuring to 160 MHz and 520 MHz respectively.

The main operating modes of the counters include frequency measurement, period and period averaging, time interval and time interval averaging. The time interval mode features a "dead zone time" control inhibiting operation of the stop input by spurious trigger sources until a preset time has elapsed. Time interval resolution is 100 ns but can be increased to 10 ns using an external 100 MHz clock.

Six versions of each model are available offering varying crystal stabilities and optional programme control. The latter features complete remote operation of all functions including trigger threshold and is by 16 bit address. A further option available is a 520 MHz 10 mV sensitivity preamplifier plug-in.

Further details from: Schlumberger Instrumentation Australia Limited, P.O. Box 138, Kew, Vic. 3101.

### DIRECT READING COAXIAL FREQUENCY METER

The Model VMC 1 coaxial hybrid frequency meter, operating from 0.3 to 1 GHz, is the low frequency version of a family of three such instruments designed for the 0.3 to 12 GHz band of frequencies.

Each instrument is of the absorption type and utilises a mode change from coaxial to circular operation thus providing extra wide frequency coverage without spurious resonance. The multiturn helical dial/drive mechanism is directly calibrated in GHz and gives high resolution throughout. The FMC 1 calibration accuracy is  $\pm 1$  MHz and Type N connectors are fitted as standard.

The instruments are manufactured by — Flann Microwave Instruments Limited.

Further details from: Jacoby Mitchell Limited, Box 2009 P.O. North Parramatta, NSW 2151.

### SINEWAVE POWER SOURCE

NH Research have a general purpose power source which provides a wide range of ac power requirements.

Known as the Model 6120, the unit consists of two basic sections: the exciter and the power unit. The exciter unit has the oscillator and radio transformer mounted separately from the power amplifier and output transformers.

The instrument offers many design features, including circuitry that is claimed prevents damage to either the unit or any instruments under test. Silicon solid-state construction is used, with the exception of the power output stage.

Features of the unit include output up to 2000 VA over a frequency range from 10 Hz to 100 kHz. Output voltage is adjustable from 0 to 1600 volts and current available is up to 20 amps.

Further details from DC Electronics Pty. Ltd., 32 Smith Street, Collingwood, Vic. 3066.

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Unquestionably, the SU3000 from Technics is one of the most eyebrow-raising amplifiers on the market today.

Elegant in design. Generous in rich sound. Virtually free of noise and distortion. And whats more you wont find better value anywhere.

The SU3000 houses all the latest advances in audio amplification and has a full 28 watt (R.M.S.) output. Advanced direct coupled OCL circuitry allows this unit to boast of a frequency response of 10 – 50,000 Hz – 3dB.

The front panel boasts a complete set of controls. Bass, treble, balance, and high/low filters controls are just some. A special feature is the level control that allows you to fade in or out the microphone with that professional touch. Also featured is a two tape monitor circuit that permits simultaneous recording on two tape decks or dubbing from one tape onto the other.

The rear panel has a complete range of inputs and outputs.

So if you're still unconvinced what value this amplifier really is then just try one at your nearest Technics dealer.

There, allow your ears and pocket to do the testing.



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# What makes Amcron products UNIQUE?

People often ask us what makes Amcron products so different. To begin with, Amcron is a professional audio equipment manufacturer, although we also serve discriminating audiophiles. Then there are other unique differences which you may not be aware of.

Amcron craftsmen work to only one quality level. Models differ in size and features but not quality. Each is designed to be superior in overall performance in its price range. For example, no competitive amplifier, preamplifier or tape recorder can match Amcron's distortion levels. Amcron products are made only in America, by American craftsmen with 99% American parts.

Every Amcron is guaranteed to meet or exceed printed specifications.

Each active electronic component is tested before wiring, then each circuit board is tested after wiring, and finally the complete product is tested from every angle.

Every Amcron is accompanied by its individual hand-entered proof-of-performance report.

All this in-plant effort is backed up in the field by broad-service warranties. This is not to make the products "look good" in advertising, but because we feel committed to keeping every product serving its owner satisfactorily. Amplifiers and preamplifiers are covered by a three-year warranty on parts, labor and round-trip shipping. In addition, all warranties over continuous commercial usage, including broadcast use 18 hours a day, 7 days a week for years. This is extremely rare for hi fi products, but it confirms the fact that Amcron products are designed to the professional standards demanded by recording studios, research and design laboratories, professional musicians, etc.

Among the professional features which ensure the least possible deterioration are front panels of 3/16" aluminium plate, corrosion-protected metal parts, wear-proof control markings, silicon transistors, tantalum capacitors, and many other top-grade components selected for maximum life.

Amcron does not plan for product obsolescence. The design lifetime of a Amcron recorder is ten years or 65,000 hours, with three service overhauls. We have not yet found performance deterioration in any amplifier after six years in the field.

As one of the oldest audio manufacturers selling in the high fidelity market, we at Crown emphasize that our primary goal is not to make sales, but to serve our customers as we would want to be served, with factual advertising, genuine product value and courteous customer service. For us, this is a deeply satisfying way of doing business.

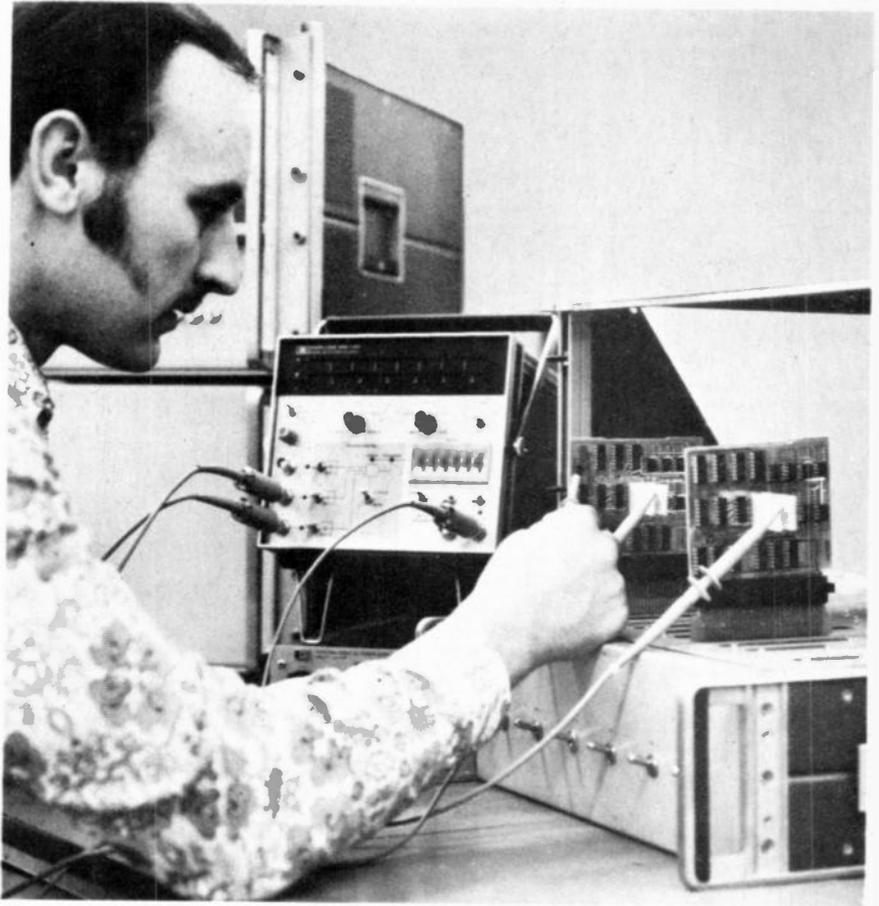
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## EQUIPMENT NEWS



### LOGIC STATES REVEALED

Any part of a data stream as fast as 10 megabits/sec can be captured, stored and displayed for quick interpretation by a new Logic Analyzer, Hewlett-Packard Model 5000A, on a new light-emitting diode matrix readout. On a row of 32 LED's it shows the logic states during any 32 successive clock intervals. Diodes are on for HIGH states, off for LOW, producing an instantly-understandable statement in data language.

The user can easily and quickly choose just which 32 bits in the stream are to be frozen for analysis. For example, should he want the sequence beginning at the 109 501st clock interval after a trigger, he simply dials in the number. The 32-bit display "window" can be moved in time to any part of the data stream; uniquely, the 5000A can also look *backward in time*, before the trigger, so as to show causes as well as effects.

Triggering is digital and may be from a signal at the instrument's A or B input or at the trigger input; or the trigger word can be any HIGH-LOW combination at two or three of these inputs. Thus a fault condition on more than one input could be made to trigger a display.

There are two rows of LED's in the display matrix. One use for these would be to compare data in two inputs continuously,

lighted diodes pinpointing any differences.

It's always easy to see what the instrument is doing. Front-panel LED annunciators tell all. An LED for each of the instrument's five signal inputs functions as a logic probe, to indicate logic states and pulse trains dynamically. If a probe isn't making contact, or an input isn't receiving pulses, these LEDs indicate the fault immediately. Two other LEDs announce arming and triggering.

The 5000A is compatible with all digital logic families, and will test circuits built from TTL, ECL, MOS, RTL, HTL, and even CMOS with no logic-level or loading problems. Its input logic threshold is variable over a range of  $\pm 1.4$  volts. Input impedances are  $1\text{ M}\Omega$  and  $25\text{ pF}$ ; they are compatible with standard divider probes, which will yield  $10\text{ M}\Omega$   $10\text{ pF}$ , and extend the threshold range to  $\pm 1.4$  volts.

Because the display is always divided digitally into clock cycles there is no need to devote a data channel to the clock waveform. The display shows logic state after logic state, in clock cycles, exactly the information needed for comparison with truth table timing diagrams. Dividing the information digitally into clock cycles also removes problems arising from jitter in the data stream.

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

# What's in a name

This month a great new brand of Hi-fi equipment is being launched onto the Australian market.

The giant Matsushita Electric Company of Japan—producers of the famous National brand Radios, Tape Recorders and high quality Hi-fi components—knew that their products had to be better than others on the market.

In the traditional Japanese manner these products had to be sold in Japan for some time before they were allowed to be exported.

Some eight years ago the brand "Technics" was released on the Japanese market and became Japan's top selling range of Hi-fi components. Released to export markets in 1973 "Technics" has already become an established leader in its field.

Today in Australia not just the brand is new—"Technics" is a new concept with new designs and features a totally new reality in offering the best value for money.

If you are considering a stereo system consider the benefits of buying "Technics"—products that developed with all the knowledge and know-how of Matsushita Electric, the people who first invented the Direct Drive turntable, the "Hot Pressed Ferrite" head for Tape Recorders, the "OTL-ICL" circuitry for Amplifiers.

So really it is not what's in a name, but what is behind it.

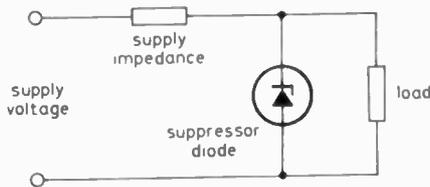
 **Technics**

## HIGH POWER SURGE SUPPRESSOR DIODES

Transient voltages are a commonplace problem with electronic equipment, and are a major cause of component failure and equipment malfunction. Designated the BZW70, BZW86, BZW91, BZW93 families, the new ELCOMA high-power surge-suppressing diodes are capable of dissipating high powers for short periods (to 60 kW for 100  $\mu$ sec) and provide a simple and effective method for the suppression of transient voltages.

Under normal operating conditions the diode, which has a clearly-defined reverse break-down voltage, is non-conducting and therefore dissipates no power. During the transient over-voltage, the diode conducts and limits the load voltage to a safe value. Although the current through the diode is high during a transient, the average power level is low and no heat-sink is required.

Further details from Elcoma, 67-71 Mars Road, Lane Cove, 2066.



## PLUG-IN SOLID STATE RELAY

NS Electronics have increased their range of solid state/hybrid relays by the addition of a plug-in relay. Fully encapsulated with a standard 8 pin octal base, the relays have a

switching capability of 6 amps up to 240 Vac.

The relay design permits easy chassis layout and also gives compatibility with electromechanical relays.

The plug-in relays may be used in place of electromechanical relays where inductive or capacitive loads are switched, and life expectancy considerably in excess of electromechanical relays is required.

Control is by a 5, 12 or 24 volt dc supply with a current drain of approximately 10mA.

Further details from: NS Electronics Pty. Ltd., Cnr Stud Rd & Mountain H'Way, Bayswater, Vic. 3153.

## PIN DIODES FOR UHF/VHF SWITCHES AND ATTENUATORS

A new low-capacitance, planar-passivated silicon PIN diode is announced by Hewlett-Packard. Called the HP 5082-2077 PIN Diode, the device is designed for RF switching, modulating and automatic gain control applications. It is intended for use in RF duplexers, antenna switching matrixes, digital phase shifter, analog phase shifters, electronically-tuned filters and variable RF attenuators.

Effective minority carrier lifetime is greater than 100 nanoseconds, resulting in low harmonic distortion in the frequency range 100 to 1000 MHz. Dynamic range is from 1 ohm to 10 000 ohms; reverse bias capacitance is less than 0.3 picofarads. CW power switching capability is 2.5 watts.

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



## LEAD SOCKET CARRIER ASSEMBLY

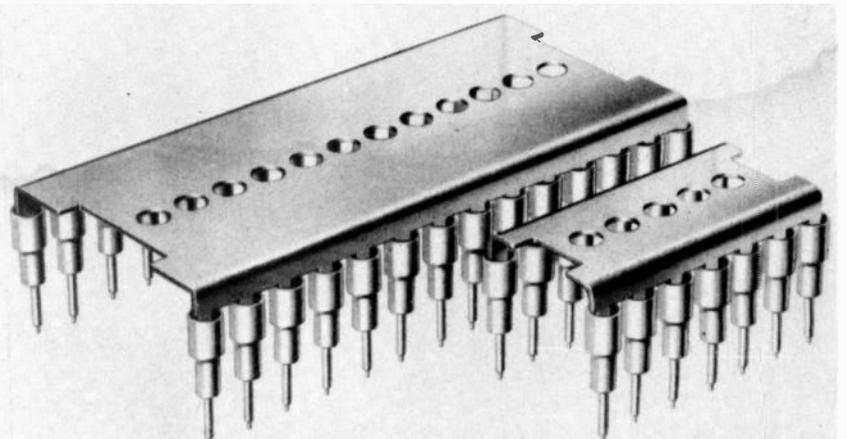
A new lead socket carrier assembly designed for loading lead sockets into P.C. boards are been introduced by Augat Inc.

The steel disposable carriers enable faster placement of sockets into the board, eliminating individual socket loading.

Designed to accept tapered entry machined socket assemblies, the new carriers consist of 14 D.I.P. patterns and up.

Contacts for machined sockets are made of beryllium copper, gold over nickel plated. Sleeves are made of brass, gold over nickel plated. Lead socket and soldered connections are entirely visible for inspection and repairs on both sides of board. Elimination of the insulator provides better circulation of air under the IC's.

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



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for, built-in (factory matched) Demodulator for CD-4 discrete records and decoders for those other types of 4 channel and your existing stereo material.

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Here's a summary of the six holidays. For more complete information, see Pan Am or your Pan Am travel agent, or send in the coupon.

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**The Executive.**

39 Days from \$1,588 visiting Honolulu, San Francisco, New Orleans, New York, London, Frankfurt, Zurich, Rome, Hong Kong.

**The European Special.**

38 Days from \$1,469 visiting Hong Kong, Tel Aviv, Rome, Paris, London, Frankfurt, Milan, Athens.

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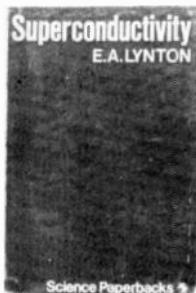
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# BOOK REVIEWS

REVIEWER: Brian Chapman



**SUPERCONDUCTIVITY** By E. A. Lynton. Published by Chapman and Hall Ltd. as a Science Paperback 1971. Soft covers. 219 pages 7¼" by 4¾". Australian price, hard cover \$5.85, soft cover \$3.75.

Superconductivity is one of those fundamental physical phenomena which have been known for many years, but only recently exploited.

In 1908 Kamerlingh Onnes was successful in liquefying helium for the first time and subsequent to this, in 1911, when measuring the resistance of a mercury sample as a function of temperature, found that at 4°K the resistance fell abruptly to a value which, as far as Onnes could tell, was zero. This phenomenon he named 'Superconductivity' and the temperature at which it occurred, the Critical Temperature.

The book under review surveys the entire field of progress in the study and implementation of superconductivity, and treats the subject to a depth adequate for undergraduates commencing intensive study in this field, or for those who wish to use superconductive devices in conjunction with other work.

The book is supported by a very extensive bibliography of some 25 pages which would seem to cover all that has ever been written on the subject — including that from Russian sources.

Superconductivity is assuming an ever growing importance in the creation of, and research into, very high magnetic fields, in the construction of cryogenic computer memories and in the measurement of extremely small potentials. No doubt future developments in this area will give rise to a technology which will have as much impact on our lives as the introduction of semiconductors.

The study of this new field will therefore be well repaid in the light of such future developments.

This book is one of the excellent, economically priced, Science Paperback series and is superconductive value for money. — B.C.



**A COURSE IN PROGRAMME IN FORTRAN IV** by V. J. Calderbank. Published by Chapman and Hall Ltd. 1972. Soft covers, 88 pages 8½" x 5½". Australian price — hard covers \$4.50, paperback \$2.65.

There is little doubt that FORTRAN IV is one of the most powerful and most used, high-level programming languages at present in use by engineers and scientists.

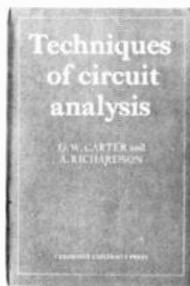
The aim of this book is to introduce Fortran IV programming in such a way that a beginner with only elementary knowledge of mathematics, and with the book in one hand and a computer in the other may learn to program.

Whilst on the whole it must be said that a good exposition of Fortran is given, it must also be said that what is meant by 'beginner' should be qualified somewhat. The term 'beginner' as applied in the aim of this book, is really relative. An engineer or scientist could readily learn Fortran programming with the aid of this book alone, but a schoolboy would not. Although everything necessary is provided, some familiarity with computers and logical construction of flow charts is really required and in this book these aspects are dismissed in the first four pages, pages 5 onwards being devoted solely to the characteristics of the Fortran language. It is felt that this is too big a step for the complete beginner to surmount.

Having made this criticism however it must also be said that anyone having the above mentioned pre-knowledge would find in this book everything necessary in order to learn the use of Fortran.

Plenty of exercises are given to which answers are provided in the back of the book. In addition some sample programs are provided which would be found very useful and two typical larger programs are completely described and listed in appendices. These are a least-squares curve fitting program, and a program for numerical integration by the Kutta-Merson method.

A useful book for undergraduates or engineers who require the aid of a little computational power but can't afford the time to attend a regular course. — B.C.



**TECHNIQUES OF CIRCUIT ANALYSIS** by G. W. Carter and A. Richardson. Published by Cambridge University Press 1972. Hard covers, 549 pages 9" x 6". Review copy supplied by publisher. Australian price \$15.60.

This text is primarily written for under-graduate students of electrical and electronic engineering.

As the title implies, it is a modern and comprehensive treatment of circuit-analysis techniques. The usual bias towards either power engineering or electronics has been avoided by the dual authorship. Thus the book is more comprehensive than most that deal with the same topic.

The treatment is essentially mathematical and uses Laplace Transforms, Matrix Algebra, Fourier Integrals and the Complex Plane. Each of these methods is fully developed and explained in the book such that reference to standard mathematics texts is not required.

Of particular interest are the sections on the analysis of distributed circuits and transmission lines under transient and steady-state conditions — subjects which cannot be found in many other texts.

For an essentially mathematical book, the text is unusually lucid and is supported by many worked examples and problem. — BC

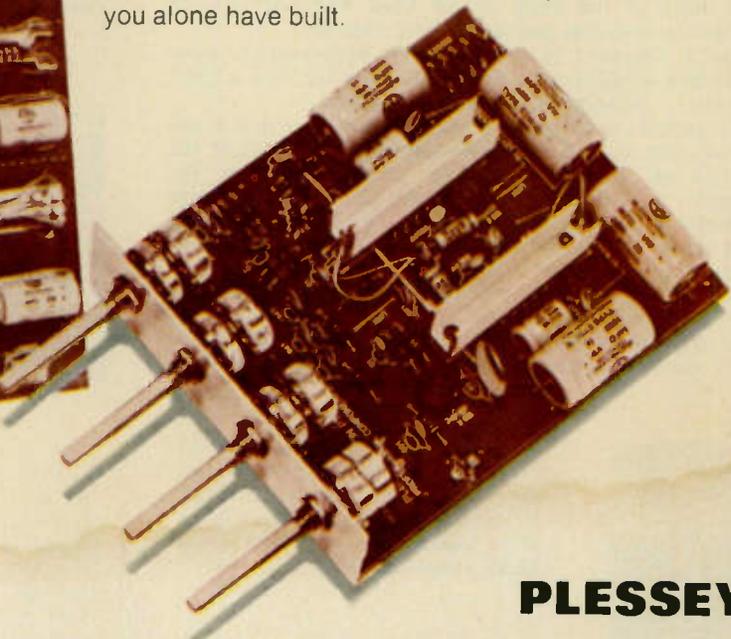
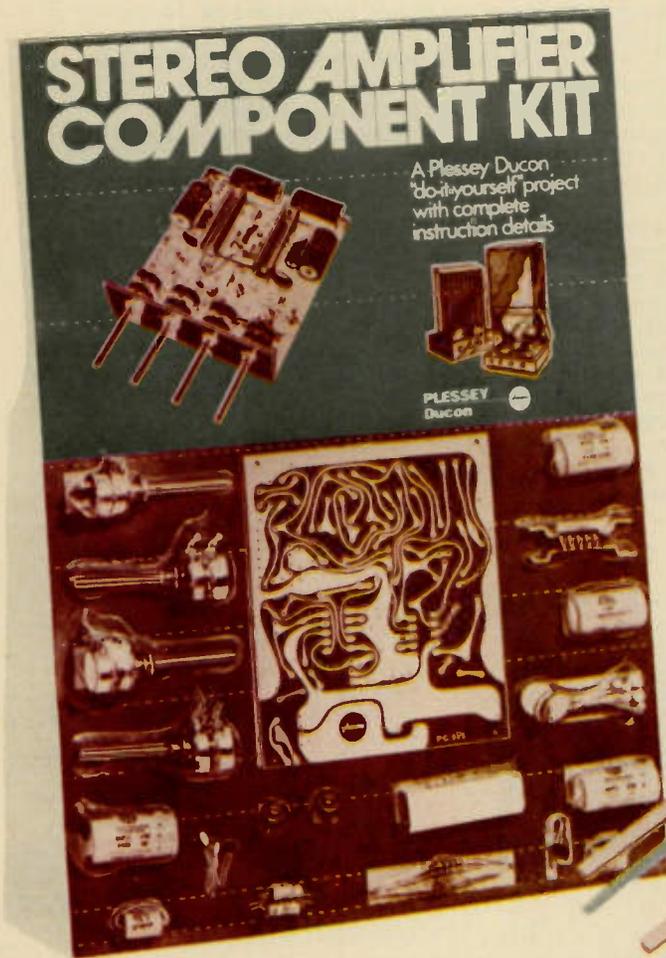
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**CRYOELECTRONICS** by W. P. Jolly.  
Published by the English University  
Press 1972. Soft covers, 88 pages 8½"  
by 5½". Australian price \$4.70.

Cryogenics is the term used to describe the study of temperatures in the region where the so-called 'permanent' gases liquefy, that is, the region from something over 100° K down to absolute zero. (Oxygen boils at 90 K).

Research in this area has increased continually since hydrogen was first liquefied in 1898. Early research was motivated only by scientific curiosity but from about 1940 onwards engineers became interested in using cryogenic techniques to reduce noise in electronic systems. One of the most outstanding examples of this usage is the cryogenic maser. Operation of a maser at cryogenic temperatures allows amplification of extremely weak signals such as those encountered in space communications which would otherwise be swamped by receiver front-end noise.

The technology of cryogenics as applied to electronic systems has now become known as Cryoelectronics and this covers the more specific fields of electrical conductors, insulators and semi-conductors at low temperatures, superconductors, superconducting magnets, machines and the techniques of producing low temperatures.

This then is what the book under review is all about. The treatment is essentially non-mathematical, concise and straightforward. The book may be read in a few days and is designed as an introductory text for those with a scientific background wishing to obtain an understanding of this new technology.

Adequate references are provided to allow those wishing to pursue the subject further to do so. — BC.

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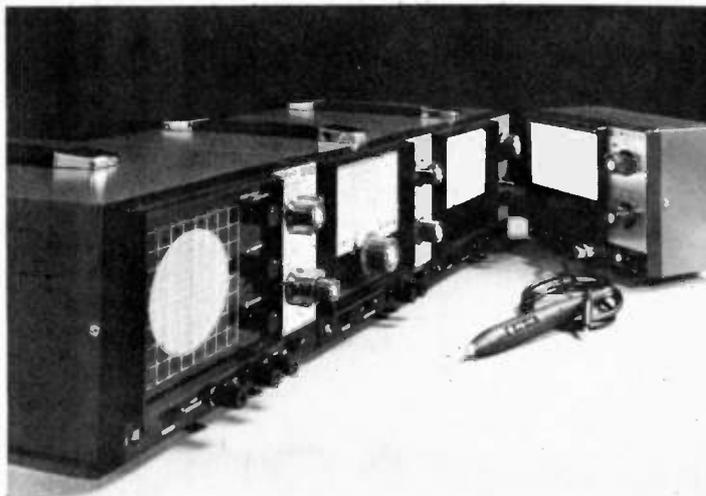


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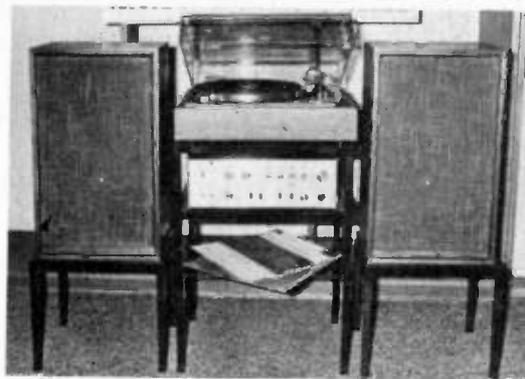
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**SCHUBERT: Sonata in A (Op. posth.) (D. 959); German Dances D. 790. Alfred Brendel (piano). Philips 6500 284 6.20).**

It is curious that a man of Schubert's talents is still largely known by a few, endlessly rehashed pieces – a few of the songs, the Unfinished Symphony, the Impromptu and the Trout Quintet. And yet some of his finest works are hardly known – for example, his late masses and his piano sonatas. (It has been said that one doesn't know Schubert unless one knows his masses, but there are only two recordings of the A-flat available, and *none*, anywhere, of the great E-flat!). In particular, the last three of the piano sonatas are sadly neglected, for they are not so far removed from the finest of Beethoven's. The present sonata is the second of these three, and the second record in the set of complete sonatas which Alfred Brendel is recording for Philips.

It is only in the last three sonatas that Schubert leaves behind the Viennese sound which is characteristic of his earlier works and which in its own way makes them less great. Schubert was not much of an innovator, and much of the lurking originality of the earlier piano works is tempered by an attempt to emulate the much-admired Beethoven, who really *did* take everyone by surprise. The Waldstein and Appassionata sonatas (from his middle period) which had so much influence on Schubert were quite unlike anything ever heard before, and uncharacteristic of anything except Beethoven being unpredictable.

But what has happened in these last three sonatas? There is of course the wonderful lyric quality which is better known in his songs; in fact much of the piano sonatas is eminently singable. There are the common two-against-three patterns; the sudden pauses, real cliff-hangers, but now we have pure, synthesized, Schubert. The insistent, assertive few bars at the beginning of this A major could have been written by no-one else, not even Beethoven. The sudden interspersions of what were once Viennese fairy-floss are still there, as they are in that very conventionally constructed Trout Quintet, but now he pushes them through a

progression of fantastic modulations – and with what effect! Running into one another in rapid succession – a dash of hope here, a touch of the pathetically abject there, somewhere else a modulation as remote as the distant world it takes us into. How unlike the last movement of Beethoven's Op.111 piano sonata, built solely on C major and its related minor, and constructed from there around the interval of the seventh – nothing could be more simple.

In this elusive roaming over so many emotions, it looks forward to the impressionists, and there is more than just a touch of the Chopinesque in it (particularly the Scherzo). It strikes me that Brendel is the only pianist who has really attempted to point out its advances and signs of the future rather than its Beethovenian heritage. I can think of no-one else who can show this sonata as a build-up of images, and without losing its wonderful lyrical quality. As for his crescendi and decrescendi – again, he is the only pianist I know who can make the hair on my neck stand on end (in particular, in the 'Wanderer Fantasy', Philips 6500 285); but beware rather heavy surface hiss. Most importantly, he realizes the centrality of searching through the haze of sound-colour to reach the really profound Schubert; a new plane which has left the world far behind and in which is only a gentle and quite peaceful silence. He plays his Schubert as Schubert, and that is the highest praise I can think of. – T.R.B.

**MONTEVERDI: Il Ritorno d' Ulisse in Patria (Dramma in Musica). Penelope; Norma Lerer, Ulisse; Sven Olof Eliasson; Baker-Genovesi, Hansmann (sopranos), Esswood (counter-tenor). Anderko, Hansen, Equiluz, Rogers, Dickie (tenors); Muehle (contralto); Wyatt, vanEgmond, Simkowsky (basses); Vienna Concentus Musicus/Nicholas Harnoncourt. Telefunken Das Alte Werk SKB-T23/1-4 (\$24.80).**

If the price of this recording seems daunting on first sight, rest assured that one is receiving the quality one is paying for. To begin with, it is complete, unlike the only other currently available version on Turnabout (which happens to be unavailable in Australia), but the overall quality is remarkably fine.

The honours go to the minor characters, in particular, Rotraud Hansmann in her various parts, Margaret Baker-Genovesi and Nigel Rogers as the young lovers, and Murray Dickie as Irus. Penelope herself seem a rather moribund menopausal female except in the very last aria with her long-lost husband Ulysses, who throughout did not more than sing remarkably well. This matters rather less than in modern-day operas in which poor leading parts more-or-less means a poor production all told, for in Monteverdi as in no-one else it is the way the words are fitted to the music that is vitally important. Though of course the development of the story is important, Monteverdi concerned himself in his later operas with the texture – almost syllabic painting. It is as characteristic as his very angular and dry melodies which are so unmistakably a product of their time.

Occasionally the voices become obscured by the orchestra which always sounds much

closer than the actors, but on the whole the sound quality is remarkably fine. The sound effects such as thunder and the whizz of arrows are hair-raisingly realistic, and the orchestral balance does full justice to the instruments which are, of course, genuine period. The Concentus Musicus are too well known by now, both for their preceding Monteverdi issues and their monumental Bach Cantatas series, to need any further recommendation – they are naturally precise, refined and well schooled in the style of the period. Harnoncourt is also a noted musicologist and thoroughly researches all his music before it is performed – all of which adds up to a fine performance. It is a pity that the two lead singers do not see the development of the drama, and in particular Penelope's gradual realization that Ulysses has finally returned to her is dealt with very shallowly. But for sheer enjoyment of sound patterns, and for the complete offering (absolutely complete but for one chord, I believe) this set is not to be missed, especially by professed Monteverdians. – T.R.B.

**HAYDN: The Six String Quartets Op. 17. Tatral Quartet. Qualiton Stereo LPX11382-4 (three records, \$10.50). Distributed by Avan-Guard.**

As the first of three boxed sets of Haydn quartets put out by Qualiton, it is singularly impressive. To begin with, the packaging is exemplary: thick plastic sleeves which fold over, and heavy paper covers as well as the box. The notes also, (given in Hungarian, English, French, German and Russian) are very well translated. My only criticism is that the playing itself is patchy to begin with; in the first 1½ quartets there is occasional but disconcerting variance in pitch, and the group sounds generally uneasy (not helped by some surface distortion on the first side), but from there on the players seem to accustom to the studio, or whatever. Though their fast movements are their best, and some of those are magnificent, quite a few of the others are similarly, particularly those in Quartet No. 4.

By far the heaviest burden falls on the first violin; the quartets of the time (and indeed, much chamber music for other numbers of instruments) consisted of a main instrument and others which merely accompanied. Unlike Beethoven's quartets, in which at least the first and second violins are often indistinguishable from one another, sometimes the viola as well (unless the stereo balance is placed very carefully), at no point in Haydn's quartets does the first violin become confused with any other part.

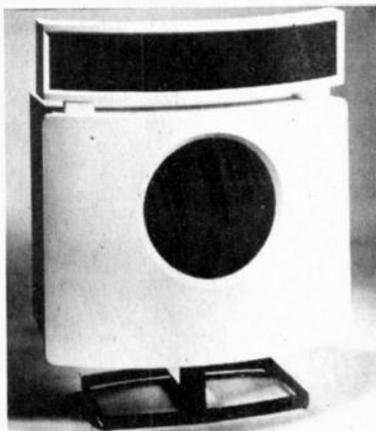
When Beethoven published his six quartets Op. 18 there was loud criticism; all four parts had equal status, and this just simply wasn't *done*. No wonder the Great Fugue Op. 133 was greeted with such stupefaction, for all else aside, a fugue requires all voices to be of equal status by definition. What is remarkable about these quartets of Haydn's is that they had only just been raised from the unhappy domain of divertimenti – light background music to aid the Royal Digestion! The idea of quartets such as these is quite fantastic. Haydn at least was

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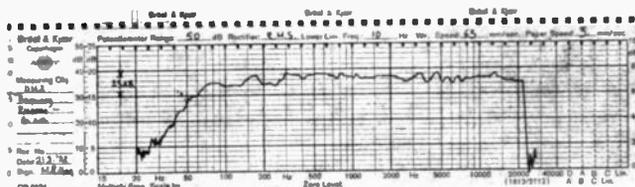


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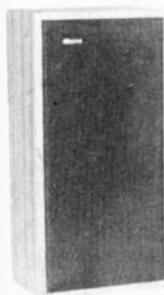
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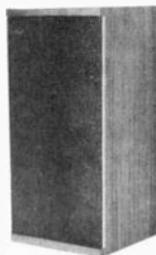
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fortunate in being employed by a Prince (Esterhazy) who was himself a violinist and who kept his corporal diet distinct from his musical diet. Certainly these quartets are amongst the most serious works he produced, and far surpass in quality many of his symphonies. And anyone who can still claim, after hearing these quartets, early as they are, that Haydn was a jovial country lad turned composer, is beyond recall.

This recording, incidentally, is the only one available of Op. 17; and it is a very fine one to have, especially at this price. — T.R.B.

**VERDI — ATTLA (Complete).** Soloists, Ambrosian Singers, Royal Philharmonic Orchestra Lamberto Gardelli (cond.). 2 LP PHILIPS 6700 056

Attila (1846), Verdi's ninth essay in the form is quite simply a mediocre work. There is little here which makes Verdi's fifth (!) opera *Ernani* (1844) so endearing and which justifies the latter's survival in the repertoire. The plot is stupid, and so also most of the verse, but in terms of purely musical achievement there is less here than in that supposed disaster of Verdi's career, *Alzira* (1845). Couldn't we have had Lully instead or other Rameau? And if this is too much for all you Romantic opera fanciers, I can think of other Romantic opera more worth the price of recording. But Verdi is very saleable material these days, and yes, Verdi being Verdi it is always interesting to hear, and documentation by gramophone of an important figure's less accessible works is necessary. Yes, and I am one of those who would like to be able to hear these other works of Verdi more often if only to get a better idea of his development. There are of course some marvellous or interesting moments in *Attila*. Scene 6 of the Prologue set in the Adriatic is the best moment in the work and especially Foresto's aria and cabaletta (*Ella in poter de barbaro*). Much of the writings for Foresto is in fact on a very creditable level. Some other fine moments are Odabella's First Act aria "Oh nel fuggente nuvolo" and Ezio's Second Act aria "Dagl' immortali vertici". But the bad moments offset good ones. The opening scene of the Prologue like most of the second act (the banquet) is horrible. There is certainly no characterisation here to compare with *Macbeth* and one values that opera even more for the advances Verdi achieved there in barely a year. Take the orchestration of the latter opera; there is much in *Macbeth* that one marvels at, the use of the band is, for example, far more effective than here.

An admittedly uneven work such as *Attila* can prove quite exciting with drive behind a performance and fine singing, which is why I find the results achieved here more distressing than usual. There is certainly much energy in this recording, not the least from Lamberto Gardelli's direction. But until Foresto's (Carlo Bergonzi) entrance in

scene 7 I was beginning to feel this set more disappointing than it is. The singing from every principal is, on the whole, good enough but where is the more expert sense of line, and the finer use of *portamento*? Attila (Ruggero Raimondi) and Ezio's (Sherill Milnes) famous duet in scene 5 of the Prologue is sung well but with little else and "Avrai tu l'universo, / Resti l'Italia a me." seemed flat as anything and this scene is certainly not the worst there is in the opera. Similarly, Foresto and Odabella's (Christina Deutekom) scene in Act 1 is marred by Deutekom's harsh tone and thin top. The weaknesses in this score can often be minimised by the acting abilities of the singers. I am afraid, however, only Bergonzi seems to be aware of something more than the stock gestures one hopes to avoid in opera. Much to my surprise, the very brief and mostly nondescript final act is done better by all concerned. One just wishes it had all happened earlier. Recording is excellent, and I for one can still say, better than nothing. — J.A.A.

**MOZART — Piano Concertos K.246 & K.537 — BASF 20 29311-4. Piano Concertos K.414 & K.595 — BASF 20 29320-3.** Jorg Demus (Hammerflügel), Collegium Aureum.

The chances of hearing works of the Classical Period performed on idiomatic instruments are slim, even in these days when we are just getting over the shock of listening, for instance, to the St. Matthew Passion with the sound Bach most probably intended for it. Few, if any at all, seem to mind a more appropriate tonal palette in recordings of Monteverdi and earlier music. The reason for this is simple enough: in the latter case we are concerned with music we have just begun to discover. One only begins to run into trouble with the more familiar baroque repertoire. Telefunken's recording of the St. John Passion came across fairly easily when it was first issued; the more recent St. Matthew provoked a greater sense of surprise. It is after all in more familiar works that we fully comprehend what the use of appropriate instruments entails. Not just the sound but also phrasing must be different. What will we think when we finally get an "original instruments" recording of the *Missiah*?

These records are not the first to present Mozart Concertos with a more idiomatic solo instrument. If memory serves, there used to be on Amadeo, a recording of two concertos. Other composers from the post-Baroque period are getting their due as well: the Bachs, Beethoven, Chopin, Schumann. No-one seems to mind in the case of C.P.E. or J.C. Bach, but Beethoven, Chopin, et al.? Ingrid Haebler's recent recording of three Haydn Sonatas on a fortepiano have convinced me Haydn sounds far less trivial than it does on the modern piano. I wish she had recorded more of the series this way. Haebler of course uses an excellent modern copy of an 18th century original instrument and the majority of recordings featuring more familiar music not only seem to give us pretty hum-drum performances but feature

wretched-sounding instruments. There are of course hardly any modern makers of period pianos, which is not so in the case of harpsichords. But we do have recordings of period harpsichords and these on the whole do not sound as strange as historical pianos. Do harpsichords keep better, are they better restored? Are these pianos mere museum pieces beyond the playability stage? Or does my hearing need accommodation? I must confess these two records startled me for some time after I received them. Bearing in mind my own previous experience with the Telefunken St. Matthew Passion, I felt the imperative necessity of listening more to these records than I would for others.

Yet another question passed my mind: granted the sound of these hammerflügels is accurate, is the pianist using the right technique for them? There is very little problem here of getting used to the orchestra which plays very well indeed. The Collegium Aureum purports to use period orchestral instruments or copies. The winds are obviously of the period variety. Because there is a larger body of strings used here, as compared with the usual number of strings in the *Concentus Musicus* and the Leonhardt Consort one must not expect to hear the same sound one associates with the above groups. But the piano sound can startle. For K.414 and K.595 Demus uses a Viennese Hammerflügel of unknown make dated 1785; for K.246 and K.537 (Coronation) he uses a von Schantz Hammerflügel, dated 1790. I must admit that as I write the sound of either instrument no longer bothers me that much; my hearing's culture has been extended as it were. I am still disturbed by much of the phrasing and the tone in *forte* passages. Is the phrasing a necessary consequence of using these particular instruments? Faster passages also sound odder and harder than slow ones. I often feel Demus forces his tone in the louder and faster sections. But I must confess that I do not "notice" this hardness as much now. I still feel, however, that a more galant way with these works, a more feminine (?) approach would present the sound of these instruments and the music better. The *piano* sections of any of the concertos here would seem to bear my view out that Demus is not perhaps playing these instruments all that idiomatically. In addition his approach to the cadenzas (especially in the Coronation) seems rather unspontaneous and without a better feel for the cadenzas' relation to a movement as a whole. But despite these very probable shortcomings, these are certainly fine performances backed by excellent sound and pressings. Recommended certainly if only as an indication of how our Mozart may sound in the future. If you think this improbable, one need only reflect on how our concept of Bach has changed so rapidly in barely two decades.

A note of caution: if you are used to playing recordings of the Mozart piano concertos at a very high level, try a more modest level; as with the clavichord, these instruments tend to sound ridiculous at high level or at least, they should not sound like modern grand pianos. Much of the strange tone of these instruments begins to disappear as soon as one realizes this fact. After that it is all up to you. — J.A.A.

(Advertisement only)

# ELAC PUZZLE COMPETITION

Prize — An Elac STS. 244-17 Cartridge.

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## SOLUTION TO COMPETITION No. 3

First construct a square using "numbers".

|                |   |                |
|----------------|---|----------------|
| $2\frac{1}{2}$ | 5 | $7\frac{1}{2}$ |
| 10             | 5 | 0              |
| $2\frac{1}{2}$ | 5 | $7\frac{1}{2}$ |

10 ways of adding "numbers" to 15

Then these "numbers" were converted to figures (each square containing a different "figure") to give a total of 10 directions in which the figures add up to 15.

|                                 |                       |                       |
|---------------------------------|-----------------------|-----------------------|
| $\frac{6+6}{6} + \frac{6}{6+6}$ | 1+1+1+1+1             | $4+4 - \frac{4}{4+4}$ |
| $7 + \frac{7+7+7}{7}$           | 5                     | 3-3                   |
| $2 + \frac{2}{2+2}$             | $\frac{9+9+9+9+9}{9}$ | $8 - \frac{8}{8+8}$   |

10 different ways that the figures—all different add up to 15

The only correct entry was sent in by R. Copple, 3 Cairo Street, Cammeray, N.S.W. 2062 who was awarded the prize.

Another most ingenious solution was sent in by Gary Bruckhorst, 29 Pretoria Street, Zillmere, Qld. 4034. His solution was as follows:

|                 |                 |                 |
|-----------------|-----------------|-----------------|
| 15              | $-2\frac{1}{2}$ | $2\frac{1}{2}$  |
| $-7\frac{1}{2}$ | 5               | $17\frac{1}{2}$ |
| $7\frac{1}{2}$  | $12\frac{1}{2}$ | -5              |

As you can see, he uses negative numbers and fractions which are not ruled out. For sheer ingenuity we decided to award an ELAC cartridge to him as well. Now for one which we believe will test your mathematics.

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A. What are the minimum no. of moves necessary to transfer all the discs from the starting column to make another complete column on either of the other two pegs?

The answer to the first part will help you with the next question.

B. How long would it take you to complete the task if you worked as fast as you could, not stopping for anything — meals, sleep etc., until you were finished?

Incidentally, when you have finalised your solutions, you might like to manufacture such a device with say only 24 discs and try your friends on how long it takes them.

Post entries to ELAC PUZZLE COMPETITION NO. 5, P.O. Box 150, Crows Nest, N.S.W. 2065.



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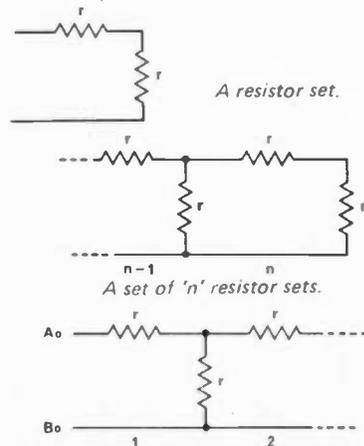
# INPUT GATE

LETTERS  
FROM  
OUR READERS

In reference to your answers to "Piece de Resistance No. 2" in the March 1973 edition, I am writing to ask why Mr. Hyde's first method made "unjustified assumptions" and why it was an "intuitive approach".

In the editor's report, the statements, "we prefer to judge on the thinking process rather than the mechanistic computation process" and "there are logical reasons for choosing a pure mathematical method above an intuitive one" appear. These statements lead me to believe that the volume of work, or the accuracy of the answer (of which surd form is the only exact answer), or the number of different ways of solving the problem are irrelevant. Hence if Mr. Hyde's unjustified assumption is unjustified then he is wrong and you have given the prize to the wrong person because there is a flaw in his reasoning.

I will now look at the problem in terms of a number of resistor sets connected end to end, using the axiom at infinity that  $\alpha + r = \alpha$ .



So adding one more resistor set to the infinite series and using the given axiom, there is still the same number of elements in the series (ie.  $\alpha + 1 = \alpha$ ) and so the two sets of resistors are the same, hence they must have the same resistance.

In this argument, drawn from the definition of infinity, is in fault, I would be deeply indebted to know why.

M. B. Carnegie, Vic. 3163

*In any problem involving infinite series, to assume that a term added onto the beginning of a series makes no difference to the limiting value is not justified. This is not to say that, from an applied point of view, this yields the wrong answer — only that it possibly could.*

*We agree that the surd form is the*

*only accurate form of answer and still say that anyone can substitute values in a formula to obtain a numeric answer. It is how the formula is derived that is important! Mr. Hyde had taken the trouble to give three different methods to eliminate making any assumptions and he was therefore on much firmer ground than those who submitted entries based only on an assumption — even though that assumption is correct. This is the essential difference between pure and applied mathematics. In pure maths you assume nothing. In the past much new theory has been discovered by exploding previous assumption, eg. Newtonian versus Einsteinian physics. The apparently logical answer is not always the correct one.*

— Brian Chapman,  
Technical Editor.

## FORCE DE FRAPPE

Whilst I am in total agreement with last month's editorial concerning the French nuclear tests — do you not think that the arguments against testing have been weakened by China's recent action in exploding an atomic device in the atmosphere.

R.S. Merrylands, N.S.W.

*Certainly — but it is only in the past year that China has had extensive diplomatic relations with other countries and the UN.*

*Since then the experience of Japan and Western European countries — in setting up bipartite agreements — has been that China is prepared to follow the rules of diplomacy and is willing to listen to world opinion. There is reason to believe that China will soon comply with the existing Partial Test-Ban Treaty.*

## ERRATA

Setting up P.A. Speaker Systems, page 63, July 1973.

Paragraph headed 'Power Distribution with Transformers' should read:

'In a series system of speakers, all with the same voice coil impedances, equal power distribution will occur. However if one speaker has 4 ohms impedance and another 8 ohms, the power consumed by the 8 ohm speaker, will be twice that of the 4 ohm speaker.'

In the original copy the expressions '8 ohms' and '4 ohms', in the second part of the second sentence, were inadvertently transposed.



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# RECORDINGS POP

REVIEWER: Mike Delaney

The rest of the best and the best of the rest from the last two (occasionally three) months.

Same old story: too many good albums (none of which I should even attempt to live without) and not enough time/space to do them all justice. But that's showbiz, I suppose . . .

**"BITE DOWN HARD"** — Jo Jo Gunne. E.M.I./Asylum. Stereo. SYL.9006.

Second set from the band formed by Spirit's old rhythm section, Jay Ferguson (keyboards/vocal) and Matthew Andes (guitars/vocal). Nothing much outside of a 12-bar boogie, but then that's their aim — the reason they split Spirit in the first place.

Musically, they do it hard, metallic slick and aggressive, mostly up-tempo. A better job than their first album: more variation in the rhythms, stronger melodies and a more consistently incisive performance — razor-edged; much more dynamic. Very precise. Very clear. 80% exciting.

American bands generally boogie better than the English because they're closer to straight rock 'n' roll. Groups like Free, Humble Pie and Foghat are more deliberate, denser — more into blues; usually more individual and/or stylized. Anyway, as far as all that goes, Jo Jo Gunne are one of the best out of America because they rarely stop to delve. "Ready Freddy", "Roll Over Me", "Wait A Lifetime", "Rock Around The Symbol" bite down the hardest.

**"HEARTBREAKER"** — Free. Festival/Island. Stereo. ILPS.9217.

The new Free, minus Andy Frazer (bass) and Paul Kossoff (lead guitar); plus Tetsu Yamauchi on bass/percussion\* and John 'Rabbit' Bundrick (keyboards). A fatter, more assertive approach — tight as hell and

fiery muscular. Always controlled. Thick, tensile boogie-blues: rough cut subtle; bleeding from its bruises. A beautiful, mellow album — Free's absolute best. Amazingly inventive. Pungent. Far surpassing anything the original band has done.

Quite simply, Paul Rodgers has the definitive rock 'n' roll voice. It stalks, assaults, pulverizes, scalds with pain; is ultimately in command.

"Heartbreaker"; "Wishing Well", "Travellin' In Style", "Muddy Waters" — four of the eight fine cuts.

\*Yamauchi is now with the Faces, if and when they decide to continue.

**"GYPSY COWBOY"** — New Riders Of The Purple Sage. C.B.S. Stereo. SBP.234273.

Initially sponsored by Jerry Garcia, New Riders grew from the Grateful Dead family circa "Workingman's Dead"/"American Beauty". A truly beautiful band: running



mellow, crystal clear, deep and wide and easy. Always directed.

New Riders seem to take all those indefinite, excruciatingly elongated Jefferson Airplane styled half-melodies/marathons and edit out all the richness, splicing in all those good feelin' feelings of the country — just like the Dead and the Byrds. Sweeter than the Dead. As articulate as the Byrds.

"Gypsy Cowboy", their third album, is the best yet. They've reached roughly the same point in what they're doing as the Byrds with "Sweetheart Of The Rodeo". Buy it.

**"DOUG SAHM & BAND"** — Doug Sahn. W.E.A./Atlantic. Stereo. SD.7254.

Ex-Sir Douglas Quintet name-sake with lotsa help from his friends — David Bromberg (dobro and slide guitars), David Newman (tenor sax), George Rains (drums), Dr. John (organ/piano), Charlie Owens (steel), Bob Dylan (vocals/various instruments). A cast of thousands.

An excellent album: all broken, gnarled, dead-pan old country boogie — spunky sentimental and gracious. Warm all over and really cooking hard. "San Antone", "Faded Love", "Wallflower", "Blues Stay Away From Me", "Papa Ain't Salty" are some of the best.

**"HOLLAND"** — The Beach Boys. W.E.A./Brother. Stereo. MS.2118.

A startling recovery from the mediocre



"Carl & The Passions — So Tough" release of late last year, "Holland" comes closest in design to the masterful "Surf's Up" — possibly the Beach Boys' definitive album. A work of genius.

"Holland", recorded in Baambrugge/The Netherlands, re-affirms the band's position as one of America's most consistently inventive and influential music sources — surpassing the Byrds in their overall impact.

A generously melodic, totally riveting performance. A magnificent album: "Sail On Sailor", "Funky Pretty", "California Saga" and "Steamboat" equal anything they've done in the past.

**"OF A SIMPLE MAN"** — Lobo. Phonogram. Stereo. 6369. 801.

Feather-weight contender for the middle-of-the-road poet stakes. Very clean. Pleasantly innocuous. Mostly cutesy kitsch. "Of A Simple Man": "Where do robins sleep on the road?/And how can a little ant carry that load?/Why write words that we have to erase?/Why does everyone have more than one face?" Jesus!

**"SHOOT OUT AT THE FANTASY FACTORY"** — Traffic. Festival/Island. Stereo. ILPS.9224.

Traffic motivate with total form and directness; motioning from tone to tone; texture through texture; disposing its energies with incredible insight, sensitivity and order. Along with Cream and the Who, they've been one of the few post-Beatles English bands to innovate rock 'n' roll.

Recorded in Jamaica with new rhythm section, Roger Hawkins and David Hood, Traffic's latest is by far their most varied set: as stirring as the 'live' "Welcome To The Canteen"; as hypnotic and fluid as "The Low Spark Of High-Heeled Boys".

"Shoot Out" is more persuasive, the melodies less defined and the arrangements more sparing — closer to their goals beyond. A brilliant band: intense, majestic, amazingly evocative. Consummate musicianship. Totally overwhelming.

**"EAT IT"** — Humble Pie. Festival/A & M. Stereo. SAML. 34826/7.

Humble Pie leaves no alternative, no means of escape. Much heavy metal munching; much and frequent wielding of the million ton shit hammer; much hounding and pounding senseless. Humble Pie much as we have come to know and love them.

Backed by the Blackberries. a

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thunder-thighed girlie vocal trio, Steve Marriot comes a couple more steps in proving that English brat rock does indeed require more volume and less taste than its American punk equivalent. MC5 and Black Oak Arkansas can go eat their hearts out!

**"TANX"** - T. Rex. E.M.I./T. Rex. Stereo. BLN.5002.

Not as immediately convincing as "The Slider" probably because Bolan's latest batch of persona fails to connect straight off. Bolan is/was "Electric Warrior"; is/was "The Slider". He was "Telegram Sam" and "Metal Guru" and 'the king of the highway/queen of the hop' and 'the cat in the alley/the fleet foot voodoo child'.

Some say he's getting pretty desperate; that the mask is slipping; that he's starting to look like an ego maniac trying to earn a

crust. Some say he wasn't anything else to begin with. Is the 'silver-studded sabre tooth dream' drawing to its end? Have we been had?

Next album reveals all.

Meantime, settle back with "Tanx" - a bit patchy, rushed in places, sometimes tired, sometimes over-played, sometimes brilliant. "The Street & Babe Shadow", "Born To Boogie", "Left Hand Luke", "Electric Slim & The Factory Hen", "Rapids", "Highway Knees", "Broken Hearted Blues", "Life Is Strange" - essential Marc Bolan.

**"NOT TILL TOMORROW"** - Ralph McTell. W.E.A./Reprise. Stereo. MS.2121.

Ralph McTell is one of England's first contemporary folk singer/songwriters. More pronounced than Ian Matthews. More rhythmic, more defined - very conscious of form; very much in the James Taylor/Cat Stevens ballad tradition. Still, he is his own main man.

As a singer/songwriter he's exceptional; as a performer, his control and eloquence makes up for the lack of adventure. "Not Till Tomorrow" is his most interesting album to date: "Zimmerman Blues", "First Song", "Sylvia", "Another Rain Has Fallen" and "Gypsy" are the picks. Low-key. Always full of charm. Slightly less appealing than, say, Jesse Winchester, McTell still hasn't come up with anything to better his classic "Streets Of London".

**"PORTLAND"** - Gary Ogan & Billy Lamb. W.E.A./Elektra. Stereo. EKS.75048.

Very warm and laid-back spiritual, Ogan & Lamb have difficulty in projecting as both writers and performers. What they do is graceful, honey sweet, very open and optimistic. Simple country-gospel - nothing too intense.

A reasonable album suffering from no variety.

**"NO REGRETS"** - Doug Parkinson. Phonogram. Stereo. 2907.004.

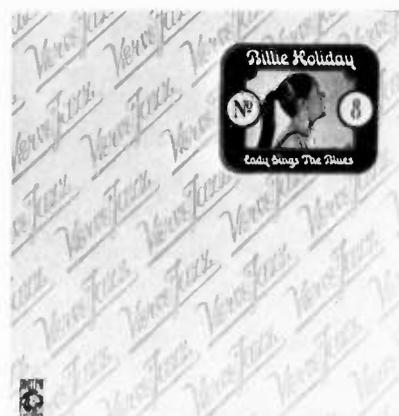
Generally, a bit too laboured, a bit tedious in places - over blown; lacks a really positive direction. Parkinson's first album could've been better if he'd varied his choice in material. Arrangements are very solid, reasonably subtle, occasionally hypnotic, sometimes exciting. Much the same goes for the playing and most of Parkinson's vocal work. "Takin' It Easy", "And Things Unsaid", "Sweet Rock 'n' Roll", another version of "Dear Prudence" and Ray Burton's "Love Gun" are the highlights. Could prove a little too sophisticated for his audience.

**"STEALER'S WHEEL"** - Stealer's Wheel. Festival/A & M. Stereo. SAML. 68121.

Eclectic pop-rock, heavily Beatles-late-sixties in influence and form. Song team Leiber-Stoller sort of held Stealer's Wheel together long enough to draft their first album. Featuring Gerry Rafferty and Joe Egan, two ex-folkie soloists, the band expertly covers large masses of musical halvah - gospel-soul-country-rock. Sometimes like the Everly Brothers, sometimes like Randy Newman, largely covering things much in the manner of the Beatles: "Late Again", "I Get By", "Stuck In The Middle With You" all relate circa "Get Back" and thereabouts. Another interesting album.

**"THE ORIGINAL RECORDINGS"** - Billie Holiday. C.B.S. Stereo. SBP.234300. "Lady Sings The Blues" - Billie Holiday. Phonogram/Metro. Stereo. 2355.045. "God Bless The Child" - Billie Holiday. C.B.S. Mono. 2BP. 220093.

Two single sets released to catch the sales benefits proffered by the forthcoming movie, "Lady Sings The Blues" - loosely based on Billie's life with Diana Ross starring. In America, the sound track revived so much interest in the lady that four



Holiday albums jumped into the top 100 within two months of premiere.

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Billie Holiday is simply one of the greatest

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# POP

jazz singers ever to set foot on a stage: instinctive, natural, intensely emotional. No, not a blues singer. Holiday sang popular music in a jazz context, influencing generations of vocalists - Sinatra, Peggy Lee, Nancy Wilson.

"The Original Recordings" features cuts recorded mostly between 1935-41, with a shattering "You've Changed" - a track lifted from her '58 album, "Lady In Satin". "God Bless The Child", "All Of Me", "I Cried For You", "Gloomy Sunday" and a lilting, humorous "What A Little Moonlight Can Do" are also included - several of which are amongst her earliest recordings. Holiday at her most animated. Uniquely individual.

"Lady Sings The Blues", No. 8 in the Verve Jazz Series which also features Ella Fitzgerald, Wes Montgomery, Louis Armstrong and Gerry Mulligan, is another composite mostly covering her work in the early fifties. "Love Me Or Leave Me", "Willow Weep For Me", "Strange Fruit", "God Bless The Child" are the highlights. Arrangements are more elaborate, less lively, sometimes overly histrionic; her deliveries more poignant, disarming - often communicating much more emotion than the songs actually contained. Not as vivid as her earlier work, though just as penetrating, Billie was hard into smack by the time this batch was put down. Mainly, it shows.

Another Holiday set, and possibly the finest locally available, is the twin "God Bless The Child" - 28 cuts including "Havin' Myself A Time", "Georgia On My Mind", "If My Heart Could Only Talk", "Am I Blue?", "I Cover The Waterfront", "Practice Makes Perfect" and "St. Louis Blues". This would serve as a great introduction for those unaware of just how good Billie Holiday is. It's only \$8.95 but you'll probably have to look REAL hard. Contains a majority of her earlier and original performances.

Holiday's contribution to the techniques involved in singing is unique. She was a conversational singer, bringing to popular music the easy, credible feeling of speech. Buy some.

"FLYING CIRCUS" - Flying Circus. W.E.A./Warners Bros. Stereo. WS.20010.

They went to Canada because nobody back here wanted to know about anything



outside their three hit singles, "Hayride", "La La" and "Run, Run, Run". Before they split they left us with two wonderfully warm, gentle albums, "Prepared In Peace" and the hopelessly mis-titled "Bonza, Beaut & Boom, Boom, Boom". Nobody heard either of them. Nobody even cared.

Recorded in Canada with a fat \$50,000 advance from American Capitol, "Flying Circus" is, very simply, a fine, generously musical album - the likes of which one seldom hears.

Very tight, always precise and inventive-to-a-point, Flying Circus make it on the strength of their melodies - each of which is a jewel, steeped in five-part harmony, concisely executed with much warmth, much sunshine.

Meatier, harder; instrumentally more varied and efficient - the only big thing left for them to improve is their lyrics. "Thousand Years", "Maple Lady", "Summer Song" and the lilting "Me & You" are the stand-outs.

"A GOOD FEELIN' TO KNOW" - Poco. C.B.S./Epic. Stereo. ELPS.3657.

Poco with more subtlety and less exuberance - closer to boogie; still trying to 'pick up the pieces'. A good album - less magnetic, less immediate, more detailed and deliberate. They used to be rollicking high energy - country adrenalin running vivid and high. These days, it's laid-back, less spontaneous and much less of a buzz. Still good though.

"BARBARA KEITH" - Barbara Keith. W.E.A./Reprise. Stereo. MS.2087.

Barbara Keith hardly pulls any punches - not even once. The only thing of real interest about her first album is that she wrote "Free The People" - a rather nondescript version of which is featured. Generally, it's White Gospel - watered down and just pleasant. Very ordinary.

"LAST TIME AROUND" - Buffalo Springfield. W.E.A./Midi. Stereo. MID.20020.

One of the most influential and underrated of all mid-sixties' Californian bands, Buffalo Springfield shaped up second only to the Byrds as the definitive in folk-rock. Harder, more dynamic and earthy, they were always forced to live in the Byrd's shadow even though, musically, they were poles apart.

"Last Time Around" is not the Springfield's last album as the title implies. Instead, we have a reasonably thorough composite running through their first two original albums, "Buffalo Springfield" ("Burned", their first single "Nowadays Clancy Can't Even Sing") and "Buffalo Springfield Again" (six cuts including "Bluebird", "Mr. Soul" and "Rock 'n' Roll Woman"). "For What It's Worth", their one hit single, and Neil Young's "I Am A Child" are also included.

A fine legacy from the band that everybody everywhere forgot to notice. Stephen Stills, Neil Young, Poco's Ritchie Furay and Jim Messina (Loggins & Messina) all started out in the Springfield. ●

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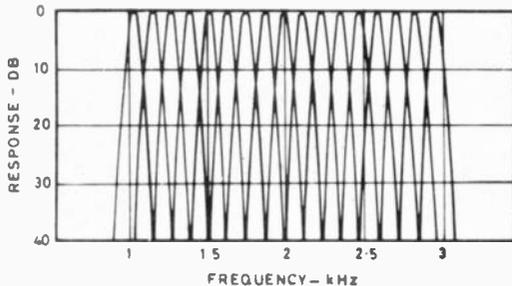
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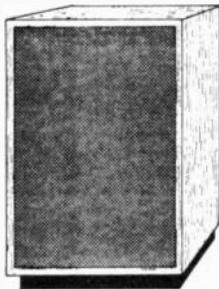
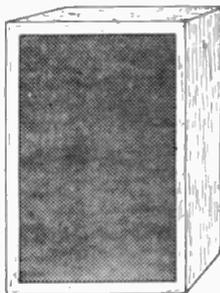
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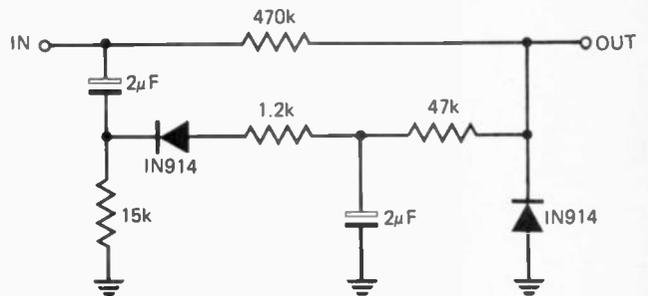
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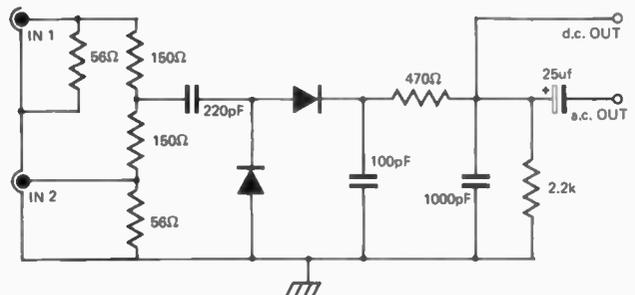


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