JULY, 1973
50c*

electronics TODAY INTERNATIONAL

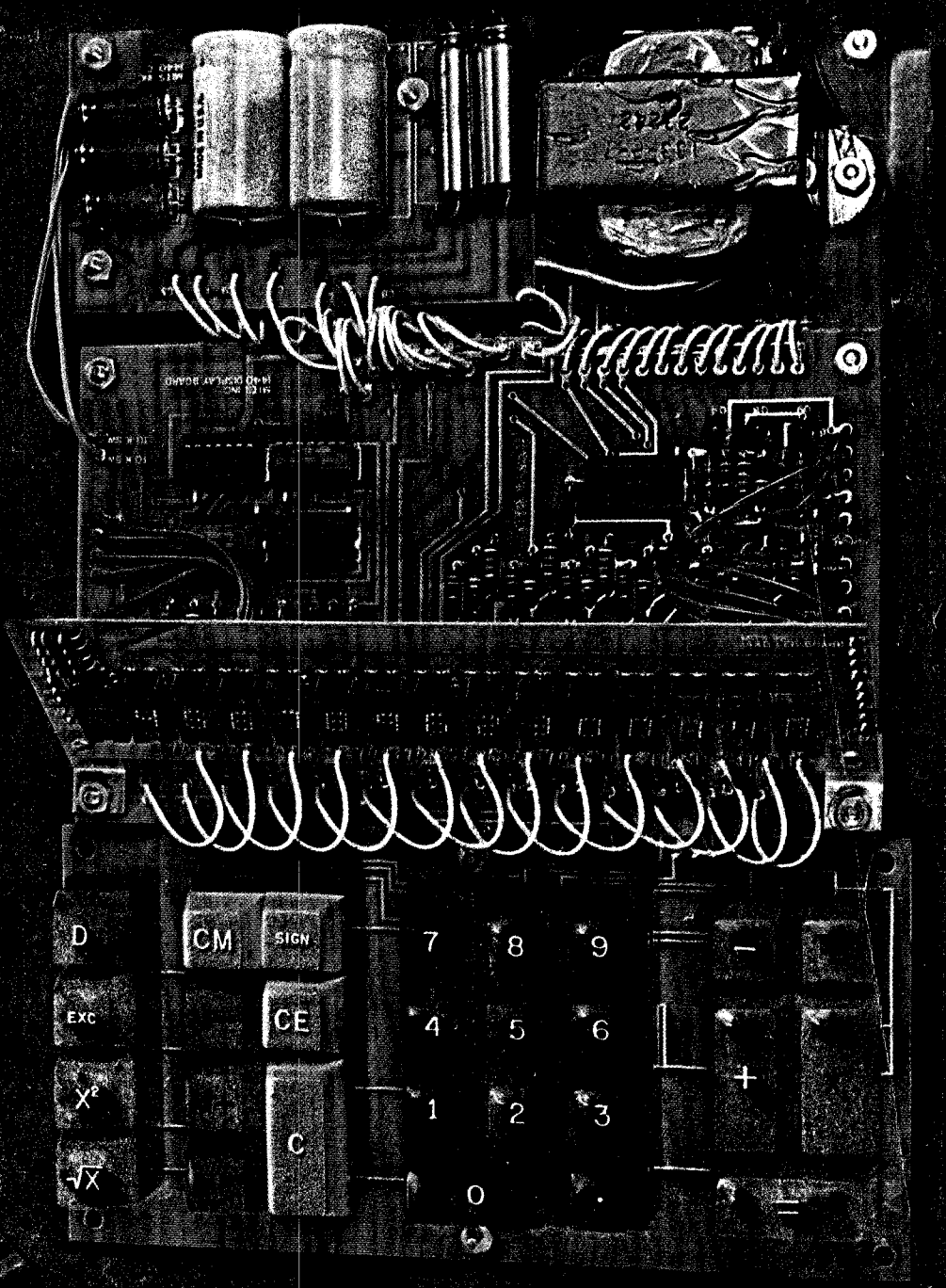
HI-FI

HOW WATERGATE WAS BUGGED

SCOOP TEST -NEW SPEAKER

MAGNETIC LEVITATION

DIGITAL CLOCK TO BUILD



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CHOOSING THE RIGHT CALCULATOR

TEAC

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

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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 5752

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., (G.P.O. Box 148), Suva. Phone: 22710. New Guinea, Paul Mow & Co., Box 449, Lae. Phone: 2953.

electronics TODAY INTERNATIONAL

JULY 1973 Vol. 3 No. 4

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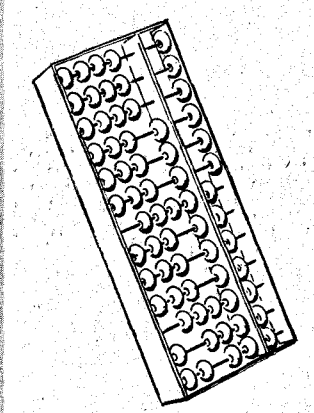
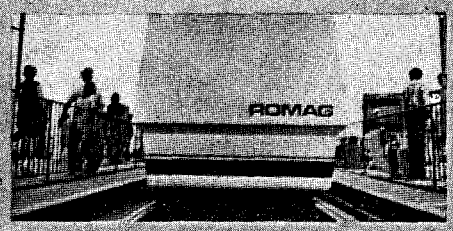
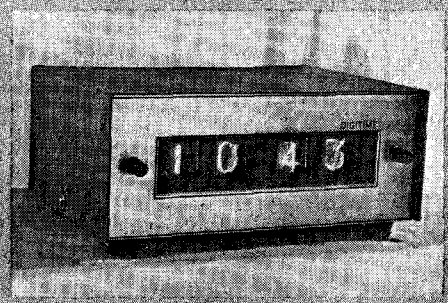
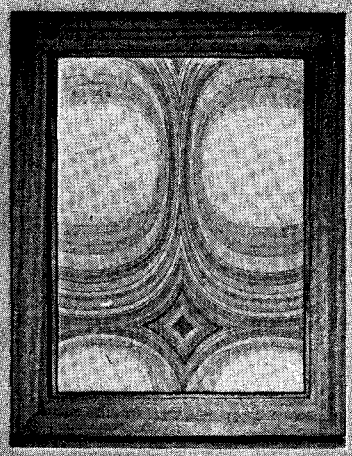


COVER: Typical of the current generation of desktop calculators is this model 1440 from MIT (full report on pocket and desk calculators P24 onwards).







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: Clarrie Levy, Suite 23, 553 St. Kilda Rd. (51-9836). Adelaide: W.J. Parkinson, A.C.P., 24 Halifax St. (8-4121). Brisbane: David Wood, Anday 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 Conpress Printing Ltd., O'Riordan St., Alexandria. Distributors: Australian Consolidated Press. (*Recommended and maximum price only.)

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

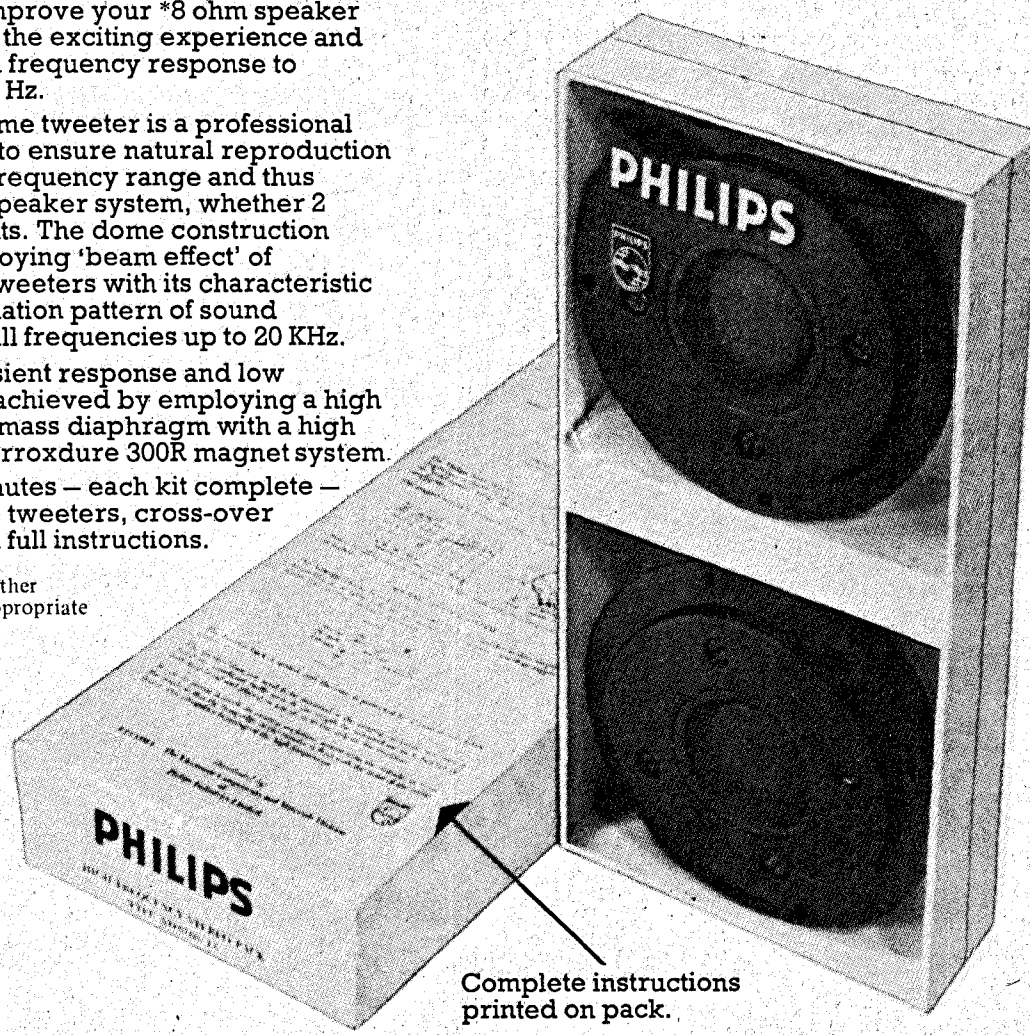
For a modest expenditure you can now significantly improve your *8 ohm speaker system to give the exciting experience and 'presence' of a frequency response to beyond 20,000 Hz.

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:

ELCOMA

ELECTRONIC COMPONENTS AND MATERIALS

Sydney, Melbourne, Brisbane, Adelaide, Perth

153-14

Collyn Rivers
Editorial Director

Brian Chapman
Technical Editor

Wendy Roy
Assistant Editor (Hi-Fi)

Barry Wilkinson
Engineering Manager

Clive Davis
Art Director

Bob Izzard
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Advertising Manager

Terry Marsden
Advertising (Sydney)

Clarrie Levy
Advertising Manager
(Melbourne)

Louis A. Challis
and Associates
(Acoustical Consultants)

Electronics Today International
Ryrie House
15 Boundary Street,
Rushcutters Bay 2011
Tel: 33-4282

UK EDITION

Halvor Moorshead
Editor

Alex Mellon
Advertising Sales

Electronics Today International
Australian Consolidated Press,
107 Fleet St., London, E.C. 4.
Telephone: 01-353-1040

FRENCH EDITION

Denis Jacob
Editeur

Christian Dartevelle
Directeur de la Redaction

Edouard Pastor
Directeur de la Publicite

Electronique Pour Vous
International
17, rue de Buci, Paris.
Telephone: 633-65-43

Where have all the components gone?

HISTORICALLY, the electronics industry has been characterized by a progression of booms and slumps.

At present, what with the world-wide demand for colour TV, and the increasing use of electronics in the automobile and other industries, we are in a boom period and component production cannot keep up with the demand.

Faced with the probability of a subsequent slump, few manufacturers are prepared greatly to expand their existing production capacities. The inevitable consequence is an increasingly serious shortage of components — to the extent that some US manufacturers are quoting up to *two years* delivery for quite standard parts.

Although the full impact of the component shortage has not yet been felt in Australia, parts suppliers are already finding it impossible to fulfill many orders. Low wattage resistors, for example, are now virtually unobtainable.

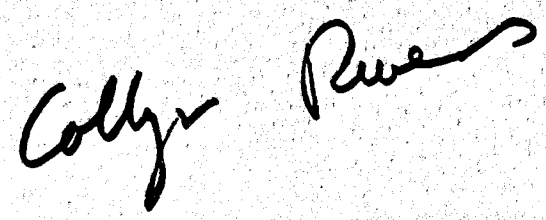
Home constructors should appreciate then, that a parts supplier's inability to obtain what would seem to be quite basic components — such as a 1 k ¼W resistor — may be in no way his fault.

INEXORABLY it seems, the Government of France will continue to test nuclear weapons in the Pacific area despite fierce opposition, not only from Australia and New Zealand, but also from French citizens as well.

In an attempt to defend its intransigent attitude, the French Government points to earlier tests carried out by Britain, USA, and the USSR, but neglects to mention that these tests were carried out at a time when the dangers of radio-active fallout were not fully appreciated.

But now, the hazards of radio-active fallout are known only too well, and even if it is true that the total fallout from French tests is statistically low, it still adds to the cumulative total of radio-active fallout in the atmosphere.

As there is every reason to believe that the consequences of radio-active fallout are linearly related to the dose, there is every reason for those of us directly threatened to protest.



Hear. Here.

The incomparable BSR TD8S 8-track stereo tape cartridge player.

This superb machine literally speaks for itself. This cunningly designed and engineered unit produces an extremely high quality stereo sound reproduction from an eight track cartridge. One cartridge will provide four separate stereo programmes of up to one hour and twenty minutes in length. The machine will then repeat the programme indefinitely. Track switching is completely automatic or can be selected by a simple push button selector. Each track is indicated as it is being played.
An integral solid state 3-stage pre-amplifier gives a fully corrected frequency response ideal for feeding into the auxiliary input on a suitable power amplifier. Motor temperature is controlled by an integral force-ventilation system. The heart of the machine is a four pole dynamically balanced synchronous motor which delivers an unwavering constancy of speed independent of normal voltage fluctuations.
The TD8S is undoubtedly the highest quality 8 track cartridge player available. But why not hear the superior sound of this brilliant machine for yourself at your nearest retailer of sound equipment, because as we said before, the TD8S literally speaks for itself.

Technical Data
Number of tracks: 8 (4 stereo channels); Tape Speed: 3¾ in. per sec. (9.6 cm/sec); Programme Selector: Automatic and manual; Tape Head: Nortronics 4 track with hyperbolic face; Pre-amp Output: 3 stage 750 mv (nominal) 1 Kc Standard Reference Level Tape; Track Playback Sequence: 1 and 5, 2 and 6, 3 and 7, 4 and 8 and infinite repeat; Wow/Flutter: Less than 0.3% total; Frequency Response: Better than 50–10,000 Hz; Power Supply: 210–250 volts, 50 Cycle AC; Dimensions: Cabinet: 261 mm x 206 mm x 99 mm; Net Weight: 5¾ lbs.; Cartridge Dimensions: This unit will accept standard 8 track cartridges measuring 139 mm x 101 mm x 22.5 mm.

BSR (A/asia) Pty. Limited.
Anne St., St. Marys. 2760
TELEGRAMS "BSR" St. Marys. 2760
TELEX 23159 PHONE 623 0375
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BSR McDONALD
TD8S

BSR 118R

Memorex makes tape that can shatter glass. So what?

Sure, that proves our tape records and plays back with the precision necessary to shatter a glass.

But, you buy tape to record and play back your favourite music.

So, it's also important you know that hiss is less noticeable with Memorex. That's because we've increased high frequency response so you can decrease treble on playback.

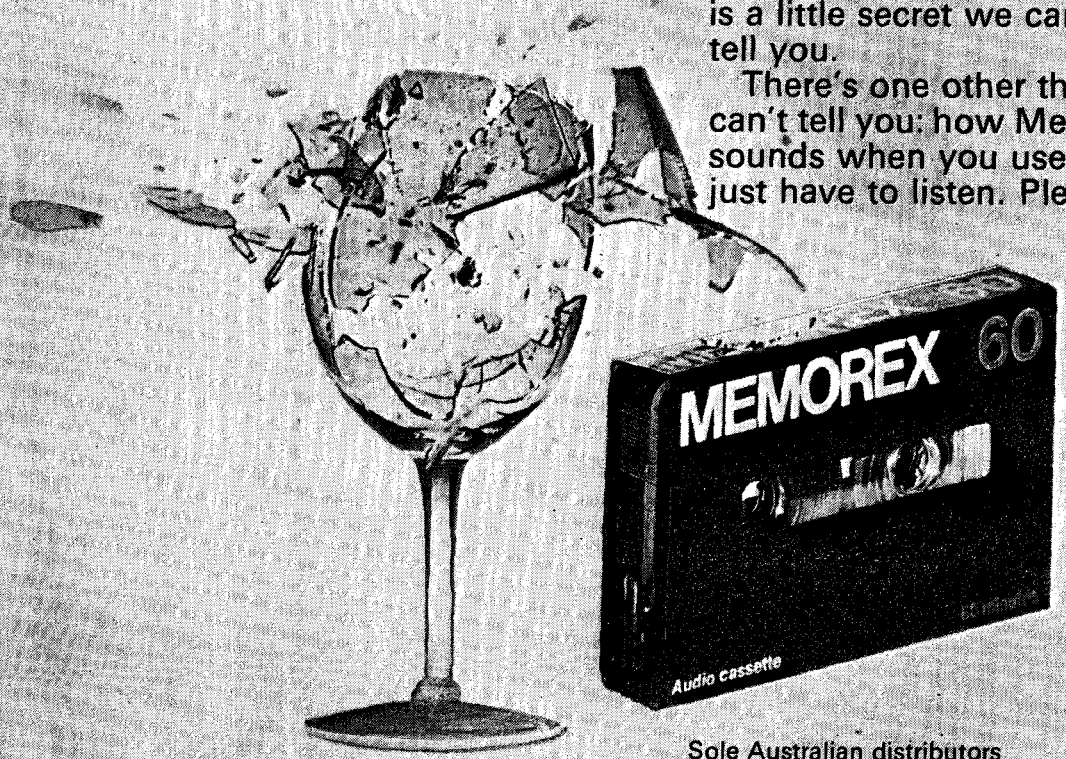
You'll also notice less distortion at high volumes with Memorex. That's because Memorex is more sensitive than the tape you're probably using now.

It's all because of the way we coat our tape.

First, we use smaller gamma ferric oxide particles. That means there are more of them on any given inch of tape. More places to pick up and play back sound.

Now anybody could come along and use smaller particles just like us; except for one thing. It's a tough job to coat small particles in a smooth, uniform manner. But Memorex does it. And, just how we do it is a little secret we can't even tell you.

There's one other thing we can't tell you: how Memorex Tape sounds when you use it. You'll just have to listen. Please do.



MEMOREX Recording Tape
Reproduction so true it can shatter glass.

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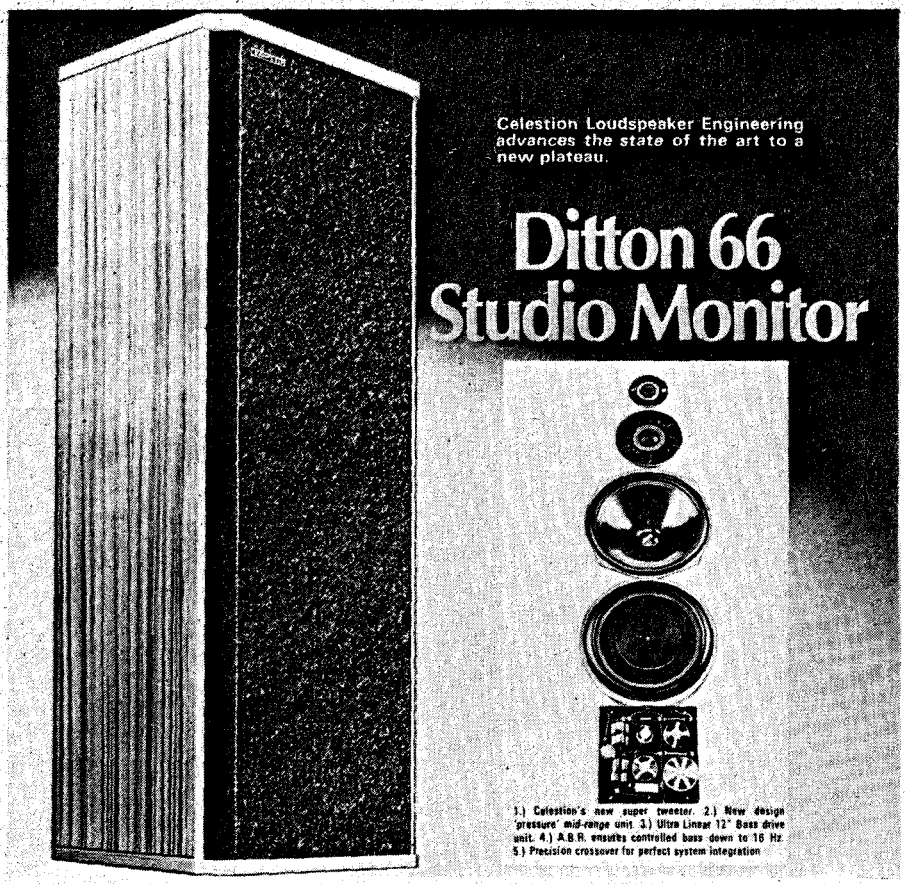
N.S.W.: Linier Sound P/L., 20 Pittwater Rd., Gladesville, 2111.
S.A.: Sound Spectrum, 33 Regents Arcade, Adelaide, S.A. 5000.
A.C.T.: Pacific Stereo P/L., 17 Style Arcade, Manuka, 2603.

LER 038

Celestion

Loudspeakers for the Perfectionist



Illustrated above is the Ditton 66 showing the beautiful appearance of the acoustic enclosure.

Ditton 66 represents the ultimate that soundspeaker technology has to offer. Based on classic principles, but incorporating advances which make this system audibly superior: for example, a new pressure dome mid-range unit of exclusive Celestion design, Celestion's super tweeter, a sophisticated bass unit, and Celestion's ABR (Auxiliary bass radiator) for an extension of response into extreme bass. 80 watts maximum. Dimensions 40" x 15" x 11½".

ALSO FROM THE SUPERB CELESTION RANGE

- **DITTON 15** The renowned high performance bookshelf enclosure. 30 watts max. "HF1300 tweeter, ultra-linear mid-bass, and ABR. 21" x 9½" x 9¼".
- **DITTON 44** 30 Hz to 30kHz. Smooth response using 3 precision speakers, including HF 2000 as used by the BBC. 44 watts max. 30" x 14½" x 10".
- **DITTON 25** Ultra-wide response 20Hz to 40kHz using 1 HF 2000, 2HF 1300's, massive bass speaker, ABR. 60 watts. 32" x 14" x 11".
- **COUNTRY** For the cost-conscious connoisseur. 45Hz to 15kHz. HF1300 tweeter, and fine matching long coil bass unit. 25 watts max. 19" x 10" x 9½".

INTERDYN

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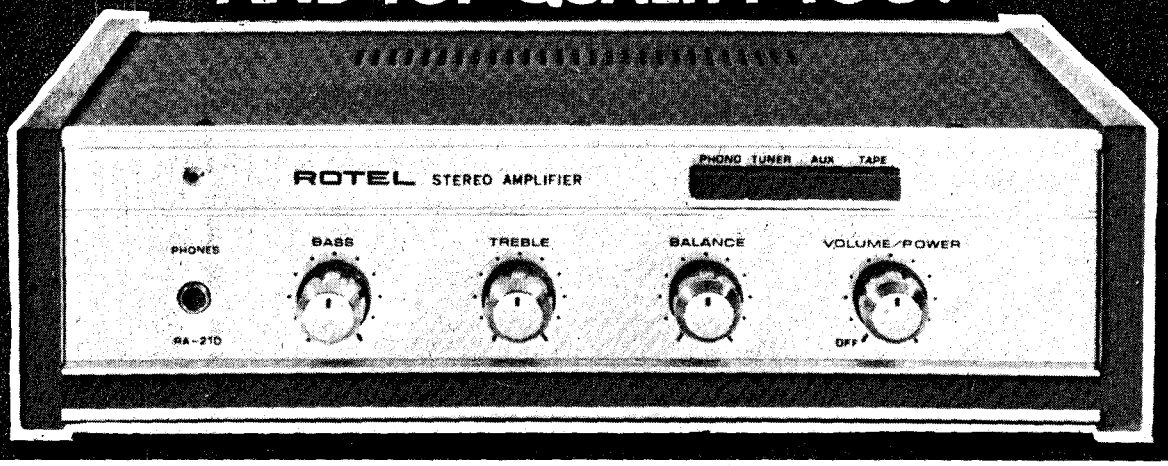
International Dynamics (Agencies) Pty. Ltd.
P.O. Box 205, Cheltenham, Vic. 3192

Hear Celestion at:
N.S.W.: M & G Hoskins Pty. Ltd., 37 Castle St., Blakehurst. 2221. Telephone: 54-1464. **QLD:** Stereo Supplies, 100 Turbot St., Brisbane. 4000. Telephone: 21-3623. **S.A.:** Challenge Hi-Fi Stereo, 6 Gays Arcade, Adelaide. 5000. Telephone: 23-2303. **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.

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!

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, 6 Gays Arcade, Adelaide 5000
Telephone: 23 2203

TAS Audio Services, 72 Wilson St., Burnie 7320
Telephone: 31 2300

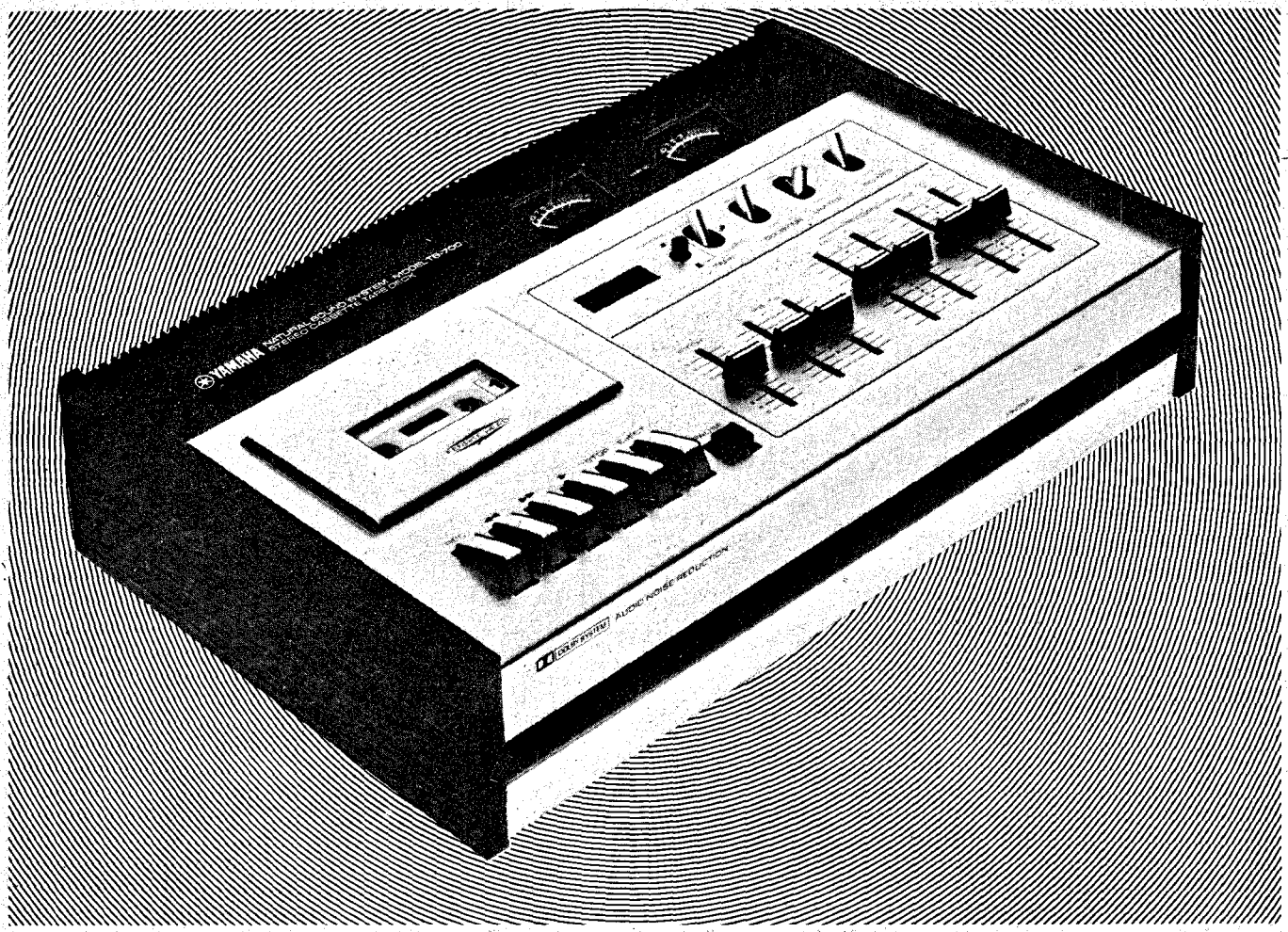
VIC Encel Electronics Pty. Ltd., 431 Bridge Rd., Richmond 3121
Telephone: 42 3762

W.A. Albert TV & Hi-Fi, 282 Hay St., Perth 6000
Telephone: 21 5004

Sole Australian distributors: INTERDYN

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

Yamaha Natural Sound the music of the Maestro not the Mechanic



Yamaha Dolby System TB 700

When the Conductor subdues the Bass, and accents the Strings he does it to produce the total musical effect demanded by the Composer. Yamaha Natural Sound Stereo reproduces the Sound as it was played in its natural harmonic balance then leaves it to you to vary according to your own individual musical taste.

The Yamaha *TB700* Tape Deck, with variable speed plus a built-in DOLBY NOISE REDUCTION system, ensures the most perfect reproduction of sound yet achieved in Cassette Recorders.

For the first time you can enjoy the perfection of Yamaha Natural Sound in a Tape Deck.

Specifications:

Dolby noise reduction system.
S/N ratio better than 58 dB with Dolby Hot pressed ferrite head.
D.C. Servo motor.
Wow and flutter less than 0.15%.
Frequency response 30-16,000 Hz (chromium dioxide tape).
Line input and mic. mixing.
Line input selector.
Three position tape selector (chrome, hi-energy/low noise, standard).
Recording limiter: Permits undistorted recordings.
Playback pitch control ± 5%.
Auto stop.
Pause switch: Thin film I.C's.
Expanded Vu meters—up to + 6 dB.
OTL head phone amp., stabilised power supply.
Three digit tape counter, din connector.
Studio console layout, real wood side panels.

SUGGESTED RETAIL PRICE — $299.00.

ET 7314

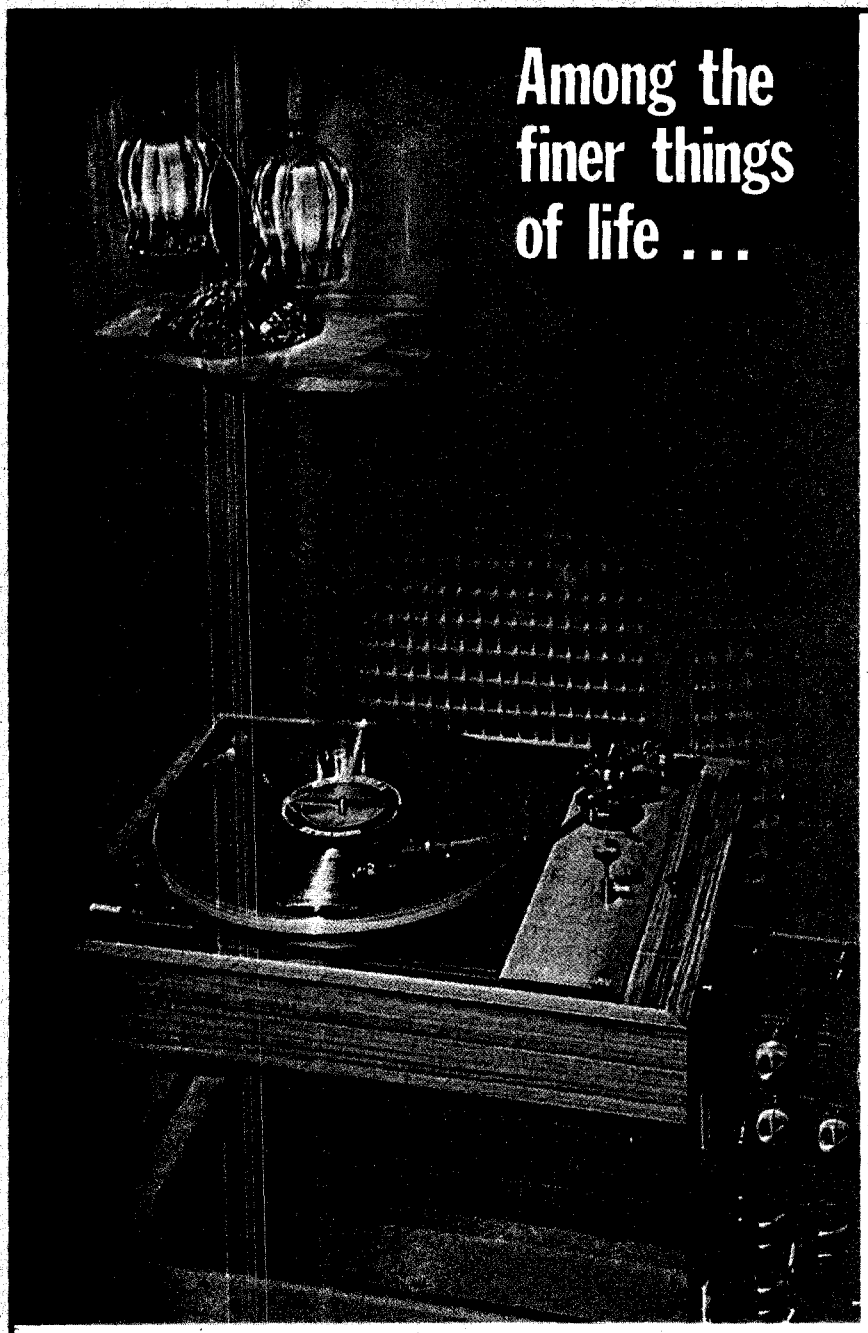
To Rose Music Pty. Ltd.,
17-33 Market Street,
South Melbourne, Vic. 3205.

(TICK APPROPRIATE SQUARE)

Please send me details of: ☐ Yamaha Cassette Deck
☐ Yamaha Turntables ☐ Yamaha Amplifiers
☐ Yamaha Speakers ☐ Name of my nearest Yamaha Dealer.

NAME.....
ADDRESS.....
.....
STATE..... POSTCODE .....

ANOTHER ROSE MUSIC SPONSORED PRODUCT



Among the finer things of life...

The world of Micro is a talented team of engineers, skilled sound technicians and expert designers, specialising in the production of turntables that challenge the ultimate in faithful reproduction of original sound.

The Micro 611 turntable is a professional quality, belt-drive turntable with 8 pole hysteresis synchronous motor assuring smooth, constant and stable rotation, with minimised wow-flutter and high signal-to-noise ratio.

The 611 incorporates the MA 101 Mk II static balance type tonearm, with adjustable, perfect antiskating device, direct reading stylus pressure gauge and oil damped arm lifter.

The Micro Range includes: MR 611, MR 111, MR 211, MR 311 turntable/base/cover. MB 300, MB 600, MB 800S turntables only.

Micro cartridges: M 2100/6, M 2100/E, VF 3100/7, VF 3100/E, broadcast-station-standard VF 3200/E and MC 4 100/E moving coil. Also MA 101 Mk II 4-channel arm, and Micro electrostatic headphones.

MICRO

MR 611

SOLE AUSTRALIAN DISTRIBUTOR

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INTERNATIONAL DYNAMICS
(Agencies) Pty. Ltd.
P.O. Box 205 Cheltenham, Vic. 3192

Hear Micro at:

● **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, 6 Gays Arcade, Adelaide 5000 — Telephone 23-2203. ● **TAS.** AUDIO SERVICES, 72 Wilson St, Burnie 7320 — Telephone 31-2300. ● **VIC.** ENCEL ELECTRONICS PTY. LTD., 431 Bridge Rd. Richmond 3121 — Telephone 43-3762. ● **W.A.** ALBERT TV & HI-FI, 282 Hay St., Perth 6000 — Telephone 21-5004.

Featuring the Broadway 201 SEAS speaker systems, the Rota amplifier [illegible] watts RMS per channel), the high quality Garrard Player with magnetic cartridge, base and cover, and you have unbeatable value at the list price of $313.00; let alone at the special Instrol price of ..... $229.00.

Complete Hi-Fi Catalogue 50 cents

Please send me your complete full-colour hi-fi catalogue and price list containing full details of hi-fi systems and separate hi-fi components. I enclose herewith postage stamps or money order to the value of 50 cents. I understand that the 50 cents will be refunded on my first purchase.

NAME .....

ADDRESS .....

.....Postcode.....

INSTROL HI-FI

91a YORK ST. SYDNEY

(between Market & King Sts.)

Phone: 294258

INSTROL FOR QUALITY SOU

Featuring the Rotel 310 amplifier (15 watts RMS per channel), the now famous Magnavox 8-30 Speaker Systems, the Garrard SP-25 Player, base and cover, and the smooth response of the ADC magnetic cartridge. This is value plus at ..... $299.00.

J.B.L.
System
799

This system features JBL Lancer 77 speakers at $299.00 ea. and a LUX 708 professional 50 watt amplifier at $228.00, thus totalling $826.00. **Instrol** now have reduced this to $799.00 including FREE OF CHARGE the JH belt-drive turntable, featuring the Sansui tone-arm ADC 220XE, acoustically sprung base and hinged cover. **Special System Offer** ..... $799.00.

YOUR **HI-FI**

D SYSTEMS

INSTROL HI-FI

91a YORK ST. SYDNEY

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Phone: 294258

SPECIAL BONUS OFFER

These systems will be sent FREIGHT FREE to any city or town in N.S.W. or Victoria, as well as Brisbane or Adelaide

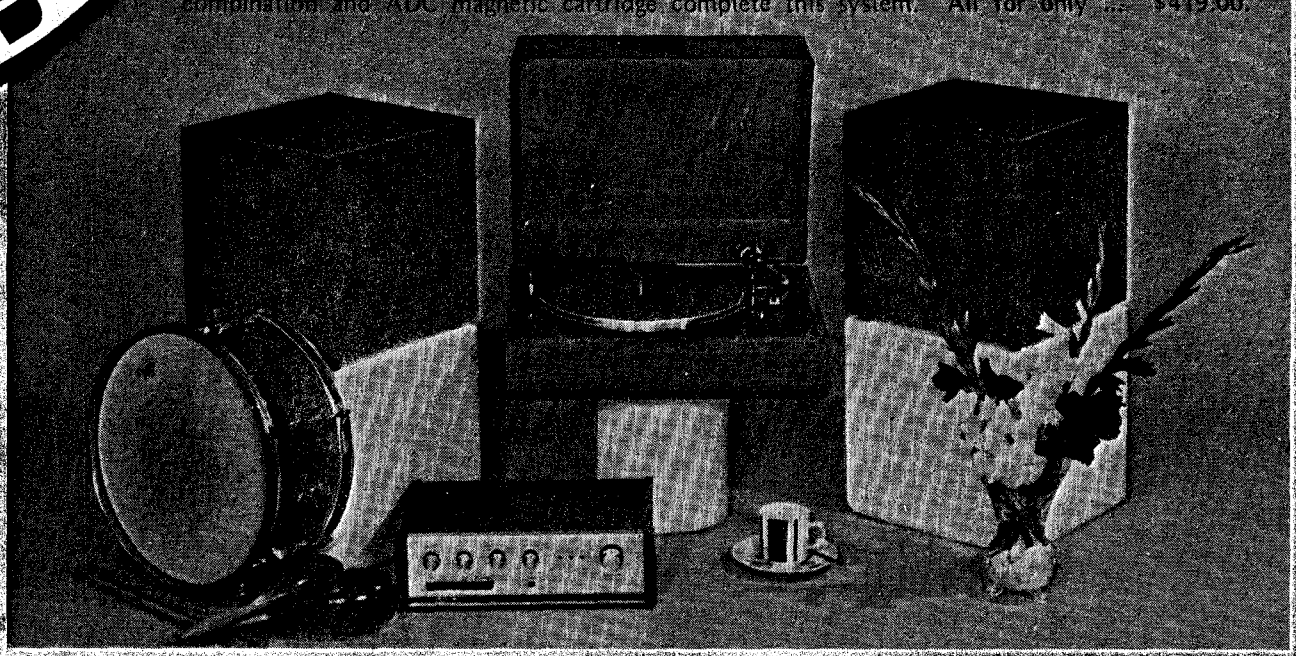
DOUBLE WARRANTY

Every system is not only covered by the manufacturer's warranty but also by INSTROL'S own full guarantee.

T.O. W.B. PALMER
SERVICE SECTION
[illegible] GEORGE STREET
HOMEBUSH 2140.

DNAB
ystem
19

Never before have the omnidirectional Sonab V1 speakers been available in a quality system at such an attractive price. They are backed by a 5 year warranty and come in the largest range of colours of any speakers in the world. The Rotel 310 amplifier, JH belt-drive turntable combination and ADC magnetic cartridge complete this system. All for only ... $419.00.



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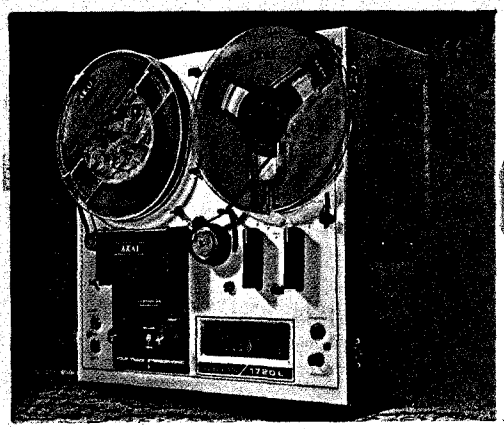
SELLS SOUND FOR LESS!

...not just an idle statement, Douglas Trading want you to save money. Look at these examples...



FANTASTIC SAVINGS!

AKAI 1720L
4 track stereo tape recorder

Complete with tape, spool and 2 microphones * 4 track stereo/monaural recording and playback system * 3 speeds * Track selector * Automatic Shut-Off; Pause control * Tape cleaner * Tone controls * Speaker Switch

TOP QUALITY FOR ONLY

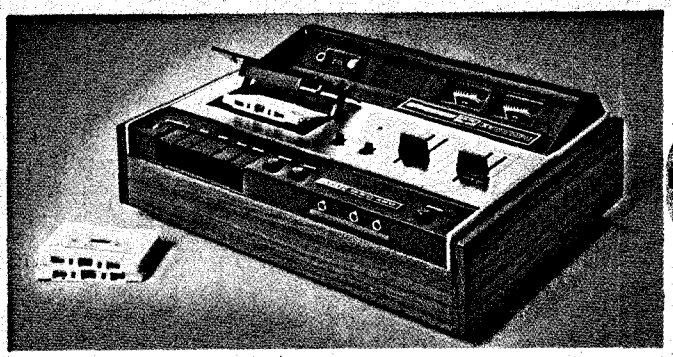
$185

AKAI X-201D
Stereo tape deck

Incomparable 3 motor crossfield head recording system. Automatic and Manual Reverse, Automatic Stop and Shut-Off, Pause Control. Two large VU Meters. Response: 40-22,000 Hz (±3dB) at 7½i.p.s. 40-18,000 Hz (±3db) at 3¾ i.p.s.

SAVE NOW AT JUST

$319



UNBEATABLE VALUE!

AKAI GXC 46D
HI-FI cassette stereo tape deck

* Revolutionary GX head guaranteed for life * Automatic distortion reduction system (ADR) * DOLBY noise reduction system * Epoch-making O.L.S. switch * Amazing HI-FI response: 30-18,000 Hz at 58dB (with Dolby).

A SUPER SAVING! NEW SHIPMENT

$269

AKAI GX 1800D
HI-FI reel/cassette combination stereo tape deck

* Both way transfer * Cassette to reel * Reel to cassette * GX wear-free head — lifetime guarantee * Response: 30-22,000 Hz at 7½ i.p.s. (reel) * Response: 40-15,000 Hz ±3dB (cassette)

SPECIAL PRICE

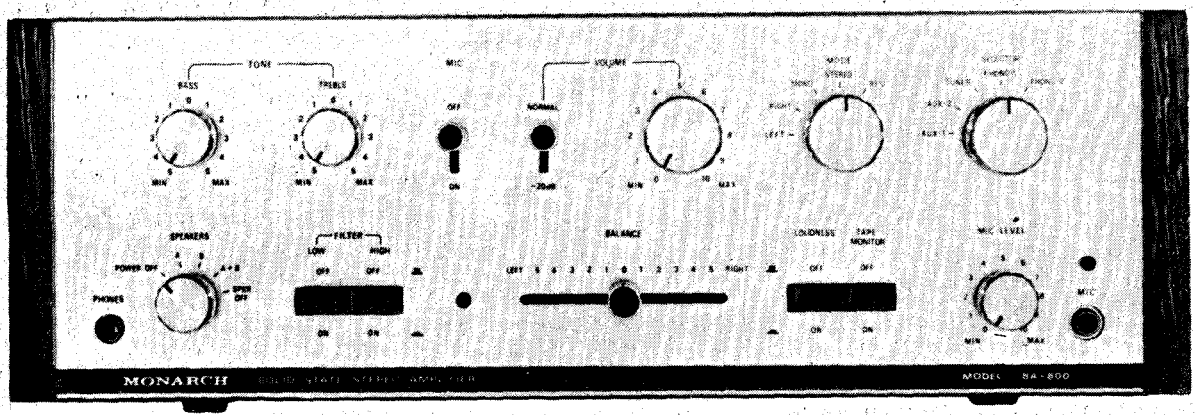
$479

POST YOUR CHEQUE OR ORDER TODAY!

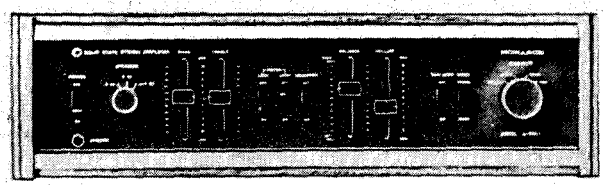
DOUGLAS for HI-FI sound

185-191 BOURKE ST., MELBOURNE 63-9321

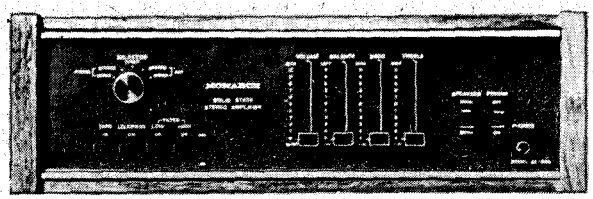
Three Kings



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



MONARCH SA 5001 (60 watts RMS)
Recommended retail price $189



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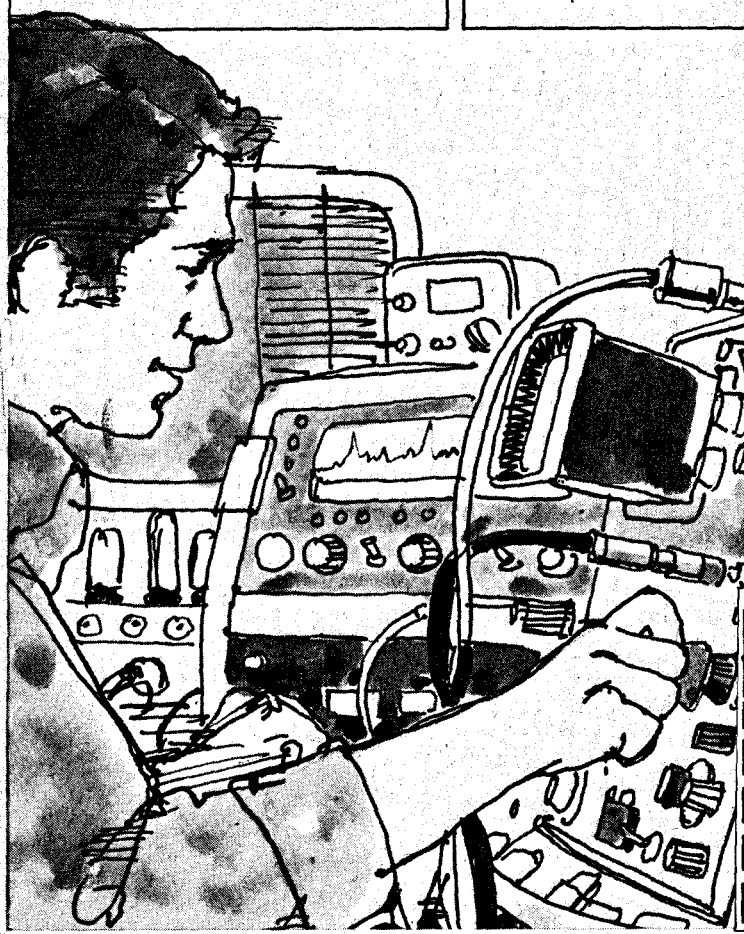

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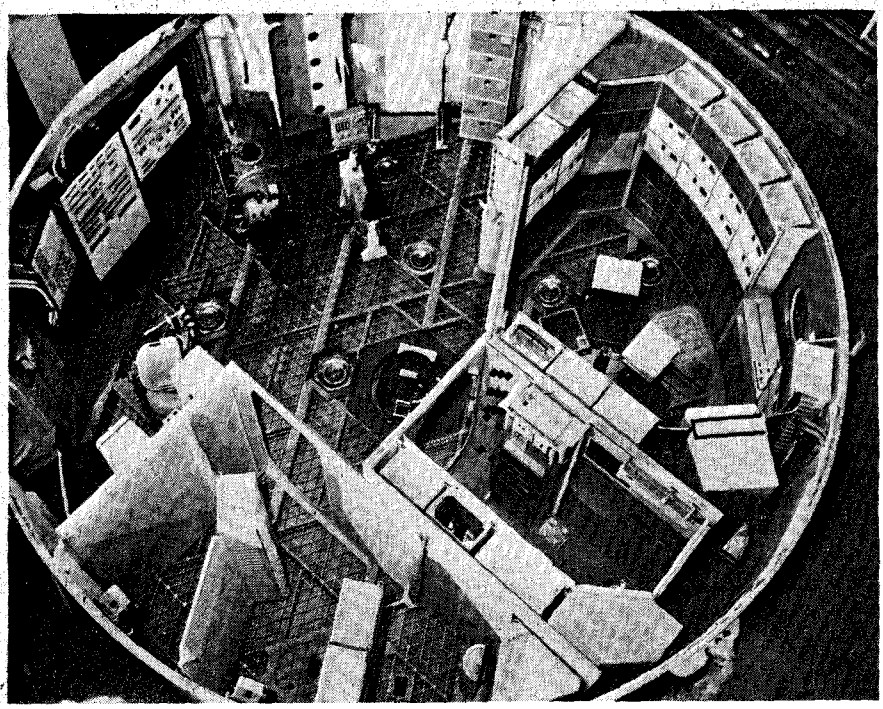
SKYLAB



NASA's dramatic efforts to save aborting the Skylab project have been partially successful and the Orbital Workshop is now in use.

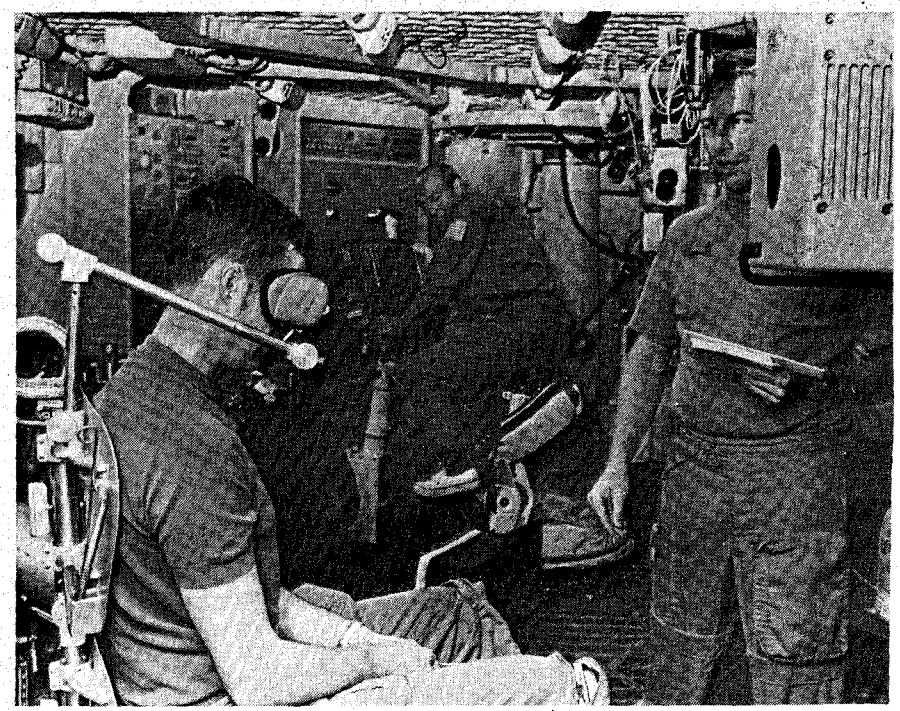
Unlike previous space vessels, Skylab has a surprising large amount of room.

Seen above is the crew quarters sections of the Workshop Trainer immediately before shipment. This area provides crew accommodation for sleeping, food preparation and consumption, hygiene, waste processing and disposal, and performance of several experiments.

The compartment below the crew's quarters is used for a waste tank for storing liquid and solid waste and trash accumulated throughout the mission.

A larger section of the Workshop trainer, not shown here, consists of a large work/activity area and houses water tanks, food freezers, storage provisions for film, and other experiments.

The right hand picture shows the medical experiment area of the Skylab mission.



Scientist-Astronout Joseph Kerwin is in the rotating chair — Astronaut Paul Weitz is making recordings whilst in the background, the mission commander, Astronaut Charles Conrad is using the bicycle ergometer.

The Skylab program will test earth resources remote sensing equipment and techniques to gather information on Earth's ecology, oceanography, water management, agriculture, forestry, geology, and geography. Astronomy experiments will substantially increase knowledge of the sun and its effects on man's existence on earth. Habitability, biomedical, behavioral, and work effectiveness experiments will further evaluate man's capabilities in space flight.

MOSTEK ANNOUNCES NEW AUSTRALIAN REPRESENTATIVE

Mostek Corporation, manufacturer of a wide range of MOS devices, including calculator and digital clock chips, has officially appointed Namco Electronics as their exclusive representative in Australia.

Namco Electronics is a new division of Overseas Corporation (Australia) Limited formed to act as a manufacturer's representative for a number of overseas principals. The company has appointed Total Electronics and Ampec Engineering as franchised stocking distributors of Mostek devices.

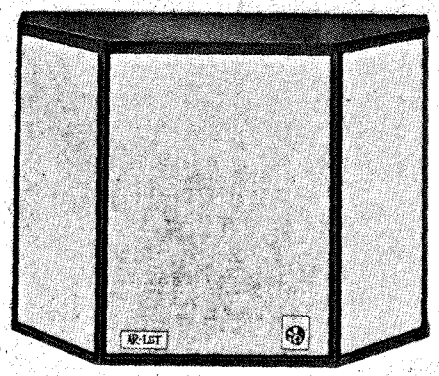
For further information contact Namco Electronics at 239 Bay Street, North Brighton, Victoria.

IF YOU UNDERSTAND THE EXCELLENCE OF AR SPEAKERS YOU DESERVE TO HAVE ONE

The AR philosophy: "the design of equipment capable of reproducing music with the greatest possible accuracy, so that the work of the composer, performers and recording engineers is presented to the listener with the highest degree of precision possible."
Speakers created by Acoustic Research Inc. range from the modestly priced to highly complex engineering achievements. And the same care and expertise is carried throughout the range: when AR develops equipment of lower cost, it embodies only such compromises as will have least effect on the accuracy with which the music is reproduced.

AR 3A

Long considered the reference standard loudspeaker the AR 3A uses a 12" woofer and two hemispherical domes for mid and high range. "Stereo Review" said of it . . . "The best speaker frequency response we have ever measured using our present test setup . . . virtually perfect dispersion at all frequencies."
Highly detailed data available.
$875 pair*



AR-LST

The "Laboratory Standard Transducer" was designed for professional applications. It offers the recording engineer a quantitive standard for the monitoring of recording and mix down operations. It is also used in scientific applications where the accuracy and repeatability of acoustical measurement is a prime requirement. It is also available for individuals who want such a precision instrument in their homes.
Highly detailed data available.
$1,875 pair*

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.
$189 pair*

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'.
$479 pair*

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.
$299 pair*

AR 5

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.
$629 pair*

AR

GUARANTEE:

The workmanship and performance in normal use of AR products are guaranteed from the date of purchase: 5 years for speaker systems, 3 years for turntables, 2 years for electronics.

AR 4XA

A new addition to the AR range and bringing you a third AR loudspeaker under $300 a pair is the AR 4XA. A successor to the AR 4X the AR 4XA uses the same woofer and cabinet as its predecessor but utilises the AR 6 tweeter and a modified crossover. An audition of the AR 7, AR 4XA or AR 6 will show even the most critical listener that the differences are subtle yet obvious.
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* Recommended Retail Price W 1397

news digest

CONVENTIONAL LOCOMOTIVES SIMULATE FAST TRAINS OF THE FUTURE

Diesel locomotives hauling laboratory coaches at 75 mph under a specially designed overhead wire system are reproducing the conditions which would be produced by an electric train travelling at 150 mph on existing electrified lines.

The overhead system, designed by scientists and engineers of British Rail's Research Division, is a vital part of investigations into the problems of collecting power from overhead wires by future generations of high speed trains.

Erected on a two mile section of the 13 mile Research Division test track near Nottingham, the overhead wires and supports of the test facility look, at first glance, similar to those of most other electrified railways. In fact the physical characteristics, spacings, dimensions, etc., have been designed to produce an overall system whose behaviour is that of a system being used by trains of twice the speed of the test vehicles.

The facility is being used to further analyse the performance and limitations of conventional overhead wire systems and current collection equipment before moving on to the development of new designs of train mounted equipment which will enable the electric trains of the future to obtain efficient and reliable current collection from the existing overhead wires. Use of the system means that work can proceed concurrently with the development of rolling stock able to run at the very high speeds involved.

Instrumented pantographs mounted on the roofs of one or both coaches are used to measure a variety of parameters as a test run is made. These include:—

Upper joint trajectory; secondary suspension movement; force applied under the pantograph head; head acceleration; loss of contact.

Signals from transducers fitted to the pantograph can be displayed on an ultra-violet recorder for immediate reference and also be recorded on a twelve channel analog tape recorder for subsequent digitization and computer analysis at the Railway Technical Centre.

Datum points are obtained and recorded using photo-electric cells to detect the passage of structures.

Contact force is determined by using a summing circuit to combine the measurements of head acceleration and force applied under the pantograph head.

It is thought that a theoretical mechanical limit exists to the maximum speed of current collection and that during the investigations verification of this will emerge.

SATURN RINGS APPEAR TO BE ROCKS

The rings of Saturn appear to be made of solid chunks — perhaps rough and rocky — rather than of gas, ice crystals or dust.

That is the finding of two Jet Propulsion Laboratory (JPL) radar astronomers after the first successful radar probing of the huge planet, 1 125 000 km away.

Using the United States National Aeronautics and Space Administration's (NASA) 64 m antenna at Goldstone station on the Mojave Desert in California, Dr. Richard M. Goldstein and Mr. George A. Morris, Jr. directed the 400 kW radar beams at Saturn and its rings a dozen times during December and January and reported these results: "We received much stronger bounceback signals than we expected from such a distance. From our radar results, the rings cannot be made up of tiny ice crystals, dust or gas. Our echoes indicate rough, jagged surfaces, with solid material 1 m in diameter or larger. Possibly much larger."

Dr. Goldstein warned, moreover, that Saturn's rings, encircling the planet from 90 000-140 000 km out, must be considered an extreme hazard to any spacecraft sent into or near the rings.

NASA and JPL plan to send a **Mariner** spacecraft past Jupiter and Saturn in 1977. —NASA.

THORN BEAT COLOUR BAR

In South Africa, Thorn Electrical Industries in conjunction with ITT have obtained a licence to produce colour TVs, thus increasing to six the number of companies so licensed.

The other five licensees are South African Philips; Electra Television Appliances and Partners, which is associated with U.S. General Electric Co. and AEG-Telefunken; Barlow Rand, which is associated with Matsushita and the British TV-program distributor Rediffusion Ltd.; Tedelex, which is associated with Sony, Blaupunkt, and Bosch; and Fuchs Electronics and Partners. At the start of broadcasting, there will be only one television channel, using the PAL color standard developed by West Germany's AEG-Telefunken.

PROJECT SANGUINE

The USA's Naval Electronic Systems Command has let three design contracts for the Sanguine nuclear submarine communications network (ETI, March 1973) to RCA (Camden Division), TRW Systems, and GTE Sylvania.

Each contract is worth three million US dollars. The contracts are, in essence, to pay the costs of each companies entry into a 'contest' to determine which company will build the final network designed to communicate with submerged submarines worldwide.

SOLID-STATE BROADCAST TX

Rohde and Schwerz has just released details of a totally solid-state 300 watt radio broadcasting transmitter.

This UHF transmitter uses four Valvo GmbH (a Philips subsidiary) BLX 15 power transistors in the output stage.

First of the new transmitters will be used — in Munich — by Radio Bavaria.

(Continued on page 21)

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MODEL 1240 DESK CALCULATOR four functions plus one memory register with 4 separate countrols, can be added to, subtracted from, recalled to display or cleared without clearing the calculator. 12 digit Sperry display. Price: Kit **$119.95** assembled **$139.95** +15% Sales Tax.

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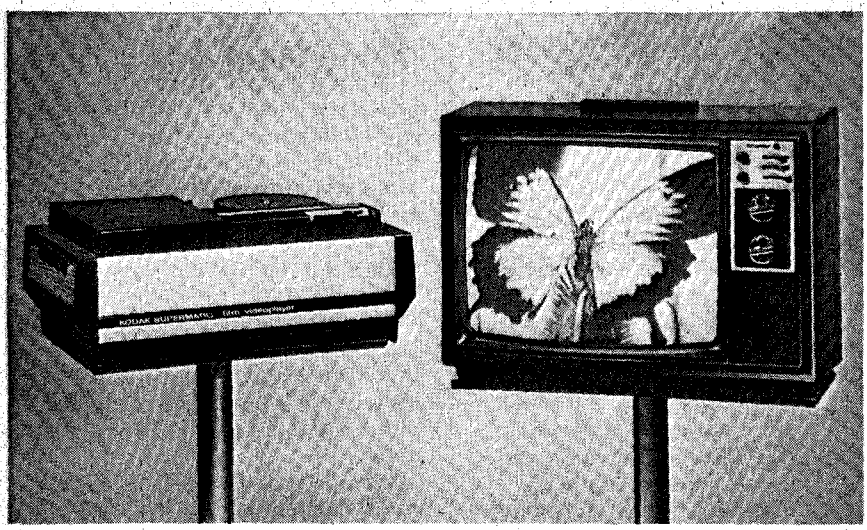
KODAK VIDEOPLAYER PLAYS SUPER 8 FILM OVER STANDARD TV



Eastman Kodak Company has announced it will manufacture and market a super 8 videoplay that can be used in schools, business, industry and government installations to play colour and sound super 8 movies over a standard television receiver or a closed-circuit television system.

Features of the videoplayer include push-button controls, automatic threading, instant review, stop motion, cassette loading, automatic rewind of the film into the cassette loading, automatic rewind of the film into the cassette at the end of the film, and extremely quiet operation. Although the videoplayer can be used in the home to show home movies on super 8 film, it has been designed primarily for professional and institutional use.

The videoplayer accepts Kodak Supermatic cassettes for projection of standard super 8 film. The cassettes can be used interchangeably on existing silent and sound Kodak movie projectors such as the Kodak Supermatic 60 and 70 sound projectors allowing unmatched display flexibility for the videocassette user. Kodak Supermatic cassettes are available in 50-, 100-, 220-, and 400-foot sizes and can be quickly and easily opened to load or unload super 8 film.

The videoplayer uses a flying spot scanner and a continuous film transport system, permitting acceptance of thinner-base film for longer programs, minimal wear on film, and less wear on the mechanism. It runs at 18 and 24 frames per second and conforms to the super 8 magnetic standard of 18 frames separation between sound and image.

It is understood that the unit will sell for US$1195 and is scheduled to be commercially available in late 1973.

DIFFERENTIAL OMEGA SYSTEM

The Bendix Corporation's Navigation & Control Division in the USA has been awarded a contract by the Federal Aviation Administration to supply feasibility equipment of a Differential Omega System for flight evaluation.

Equipment will consist of both an airborne and ground-based Omega receiver, a communications transceiver and data processor and recorders.

The system, scheduled to be delivered later this year, will be tested by the FAA to determine the feasibility of applying the Differential Omega concept in domestic navigation.

Basic Omega, which is scheduled to become fully operational in 1975, consists of a network of eight transmitting stations providing aircraft navigation anywhere in the world.

Operating within the very low frequency band of 10 to 14kHz, the transmitted signals are virtually unaffected by terrain nor will they penetrate the ionosphere and be dissipated in space. Thus, the waveguide formed between the ionosphere and the earth's surface allows the signal to be used thousands of miles away from its source.

Although terrain has little if any effect on the signal, certain atmospheric conditions and a shift in the ionosphere (called the diurnal effect) causes a phase shift of the signal. However, the diurnal effect is predictable and corrections can be programmed into the onboard data processor, making the Omega system useful for long-distance navigation.

Differential Omega permits accuracy to be increased even further by communicating signal corrections from a known location on the ground to the aircraft, either as an automatic data link with the onboard computer or verbally to the flight crew.

The FAA and Bendix will test the feasibility of using such a system as a navigation aid by transmitting corrections determined at the ground-based Omega receiver to the airborne receiver. By providing frequently updated information, it is expected that the aircraft's position can be maintained to within one-fourth mile.

The Omega receiver to be suppled by Bendix is a two-stage superheterodyne conversion strip for each radio frequency channel. Both 10.2 and 13.6kHz channels will be provided in identical configurations for the ground and airborne subsystems. Each receiver will be integrated with a Bendix BDX 9000 digital computer using 4,096-word core memory in the ground station and 8,192-word core in the airborne unit.

NATION-WIDE PAGING SERVICE

A nationwide paging system is being seriously considered in Sweden. The system, which has been successfully field-tested would enable a caller to page a person anywhere in the country.

If implemented, the system will use existing FM broadcast transmitters to handle up to 400 000 customers.

Each system user would carry a pocket-paging receiver with a three-tone coded signal processor.

When a caller wishes to page a system user he uses a normal telephone, dialling a code number which connects him to the paging service. He then dials the personal paging number of the person he is seeking.

Before hanging up he dials his own phone number which is then recorded in a central store.

When the person being paged hears a 'beep', signifying that someone is trying to contact him, he dials the central store and obtains the phone number of his caller.

The Swedish telecommunications authorities have approved the system.

(Continued overleaf)

news digest

If the system is introduced – and there is every reason to believe that it will be – it should start off in 1975.

Initially the Swedish telecommunications authority will market and lease the receivers (first production run will be 5000). Subsequently any manufacturer may enter the market.

Cost of the receivers is estimated at between $100 and $200 plus a further $50 per year user fee.

JAPAN EXPANDS COLOUR TV SALES IN UK

In Britain, Japanese colour TVs are gaining an immensely strong hold on the market.

Despite the lack of a really significant price advantage, sales of these sets rose from 43 783 in 1971 to 156 179 last year – nearly 10% of the 1 780 000 colour sets sold.

Sony are actively planning to manufacture colour TVs in South Wales – with a proposed output of 10 000 sets a month by the end of 1975.

The main reason for the Japanese success was the gross underestimate of demand made by British manufacturers. The current estimate is sales of 2 500 000 sets in 1975 – implying that 30% of Britain's homes will then be equipped with colour TV.

Present UK production capability is about 2 000 000 sets a year thus leaving room for Japanese – and other – imports.

Britain's largest set manufacturer, Thorn Electrical Industries production rose by 60% in both 1971 and 1972 and is planned to increase a further 40% in 1973 to 745 000 sets.

The company is setting up a joint venture with RCA to manufacture colour picture tubes in a new multi-million dollar factory at Skelmersdale. Capacity is an eventual 1 000 000 tubes a year.

SANYO TO MANUFACTURE OUTSIDE JAPAN

Sanyo Electric Co. is setting up two overseas production ventures – one in Singapore and the other in Brazil.

The Singapore venture will be operational this month, the company said. It will be a joint operation with a Singapore businessman to produce radios and tape recorders for the US and European market.

The Brazilian operations will be set up by June in Manaus with Pereira Lopes-Ibesa Industria E Commercio S.A. Sanyo and Marubeni Corp., a Japanese trading firm, will hold 68 per cent of the common stock, and Pereira 32 per cent. The joint venture, called Industria Electronica Pemasa, will produce about 11 000 television sets per year, including PAL-type color receivers.

A spokesman noted that the joint venture will primarily supply the Brazilian market but that, in the future, it will export to Europe.

15W AUDIO-AMPLIFIER ON SINGLE CHIP

The Italian-based semiconductor company SGS-Ates has developed an integrated circuit audio-amplifier that has an output of 10-15 watts at a claimed distortion of less than 1% (at 15W).

This is two to three times the power output of previous single chips.

GERMANIUM TRANSISTORS SAY MOTOROLA

Engineers at Motorola are urging their customers to consider using germanium devices in their latest designs rather than automatically selecting a device from the silicon range. The reason for this rather surprising step, which runs against the popular trend, is that in a number of applications germanium transistors perform as well as their silicon counterparts but cost significantly less. In fact there are times when the extremely low saturation voltage of germanium transistors (0.3V at 150 amps) make them a much better choice than silicon.

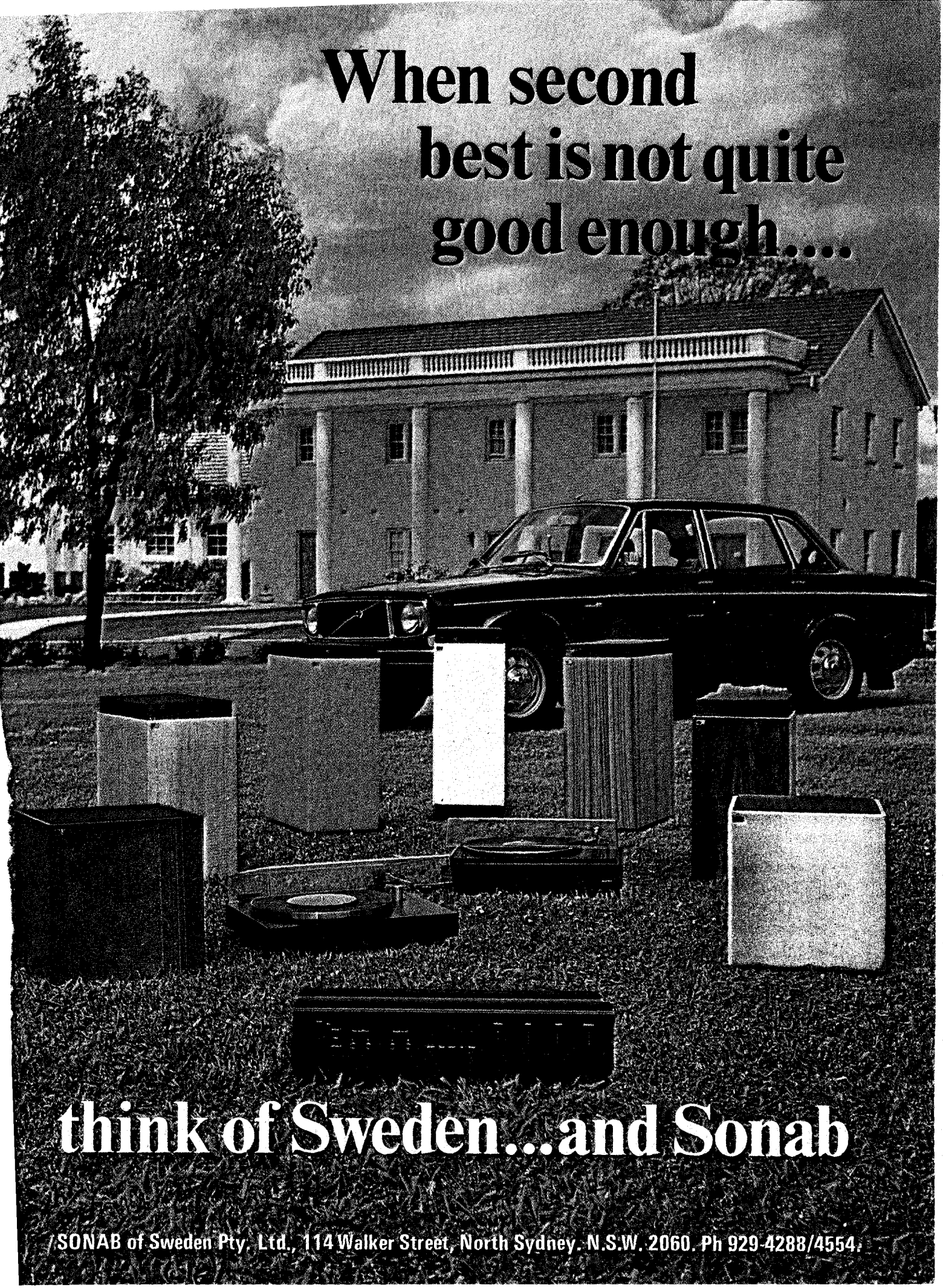
Germanium devices do have some disadvantages, such as lower peak operating temperature (often offset by the lower V_{SAT}), higher leakage currents and are only available in p-n-p.

Advantages of germanium devices which have not already been mentioned include high reliability under temperature cycling conditions, higher gain at high currents, higher gain at low temperature, seventeen years of reliability history and, of course, the fact that all germanium devices are housed in hermetically sealed metal packages.

Motorola are asking engineers to look at both silicon and germanium devices before condemning the latter out of hand and to choose the device that meets the specification at the lowest cost. The number of times germanium will come out tops if this approach is adopted will surprise many.

SIGNETICS INTO CMOS

America's Signetics Corporation are currently developing a new line of CMOS IC's that, they expect, will be in production later this year.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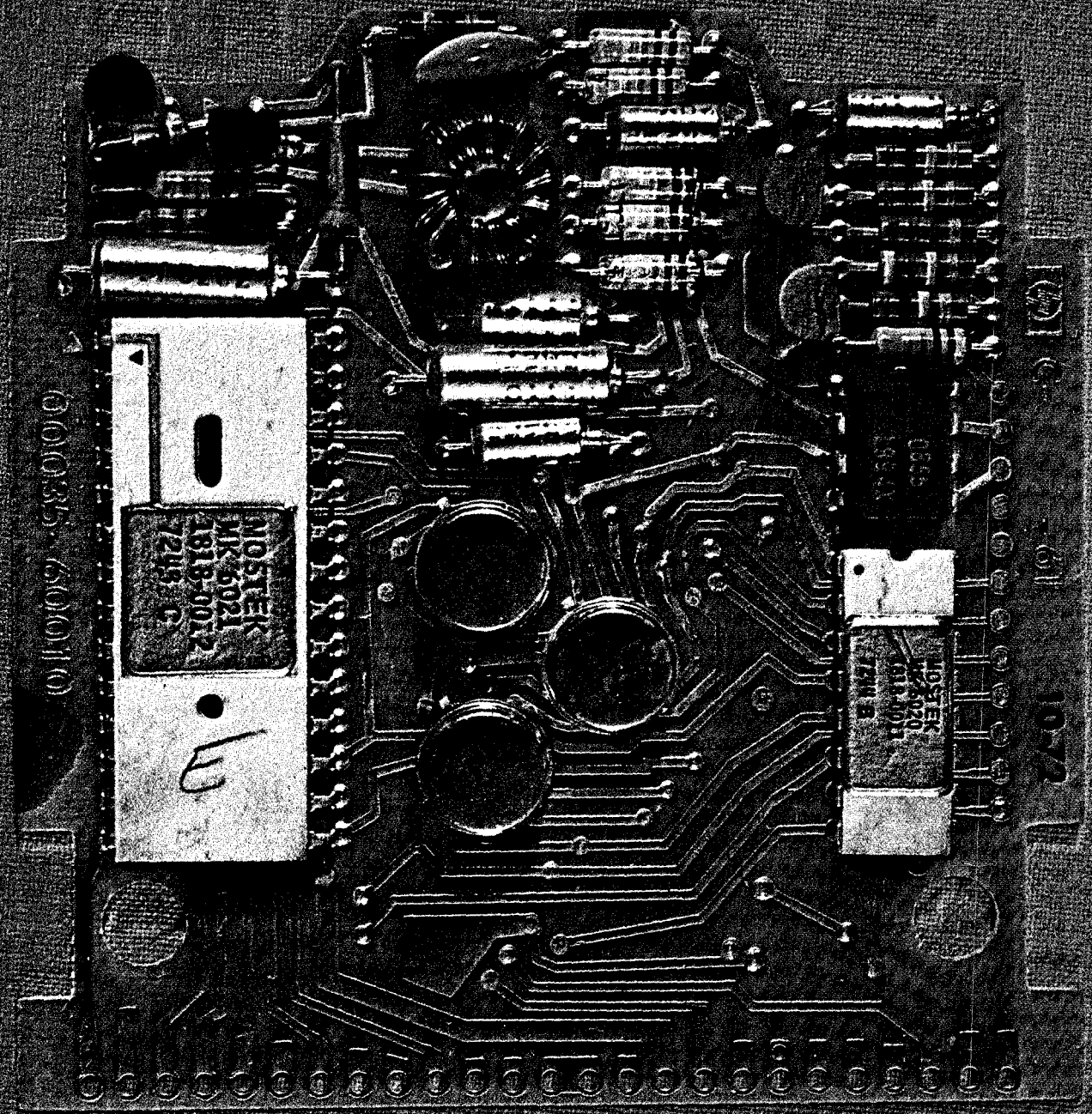


Logic board of Hewlett Packard HP35 calculator

CALCULUS

Had you been late for an appointment with Julius Caeser, you would no doubt have hailed a passing hire chariot and galloped hastily on your way through the cobblestoned streets of ancient Rome.

As you progressed you would have heard a periodic clunk coming from a device mounted on one of the wheels. This device was called a "hodometer" – or road measurer. Every time the wheel rotated one turn, a pebble would pass from one container to another via a small hole. At the destination the driver would simply count the number of pebbles to calculate the charge.

The Latin word for pebble is "calculus" – and so we see how our english world "calculate" had its beginning.

JUST what does make a calculator tick? It is not possible to answer this question fully in a short article such as this because even the simplest of four-function calculators is based on one or more integrated circuits containing at least 5000 transistors. These are arranged in a logic array which would have astounded the computer engineer of 20 years ago – in fact it's still amazing! So we will not get involved too much in the 'innards' of the integrated circuits themselves but will describe the way they are used in currently available machines.

The small electronic calculator can add, subtract, multiply and divide.

CALCULATORS -the inside story

How they work, and how to choose one — our Technical Editor reports.

Most models can handle the decimal point, either by presetting it or by using floating point arithmetic. The number of displayed digits varies between six and 16, depending on the model, with negative results (so called credit balances in the business world) clearly indicated as such.

Operations are done nearly instantaneously, and the machines are silent, small, light, and in most cases service-free. Some personal calculators are capable of remembering a constant for repeated multiplication or division, and some have a completely separate memory which may totalise numbers for recall whenever required. Still others, to be described later, can solve functions such as logarithms, trigonometric identities and such like. One recent model is even capable of solving accounting equations (such as compound interest) at a single keystroke — and all this for a selling price of around $400!

With such features as these, and with the virtual assurance that prices will continue to fall dramatically, (we hazard a guess at $40 per 8-digit, four-function calculator by the end of the year) it seems most likely mum will be checking the grocery bill on her pocket four-function calculator, and the kids in a few years time will all have their personal, electronic slide-rule to remove the unnecessary drudgery from mathematics.

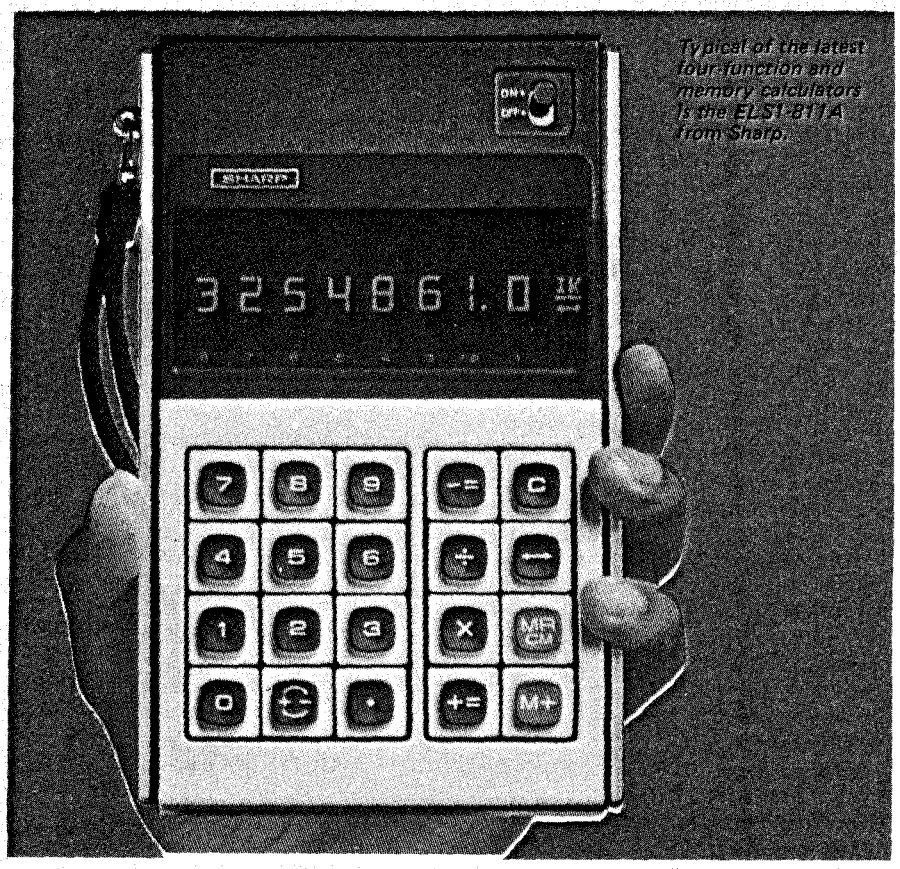
The electronic calculator, although it looks simple enough, is really the most complicated machine available to the consumer today. In a way it may be said to be a scaled down version of a digital computer with some important differences. The computer is designed for flexibility and hence it needs to be continually reprogrammed for each problem of a different kind. It must also be capable of performing many different functions with the computed data — It may drive a teletype, control a process automatically, or print out the data at high speed. It may also produce a range of answers to a problem from a string of input variables. Thus we say that the computer is not dedicated to any one job. But it suffers for this by having complicated input and output structures. Thus to add two and two by computer you must first program the machine to perform arithmetic and instruct it what to do with the results — a time consuming process for one calculation to say the least!

The personal calculator on the other hand, is a dedicated machine. It solves mathematical problems in accordance with a program that is built into the integrated circuits. It accepts data from a manual keyboard only, and presents its output almost invariably direct to a display. Some other types of calculator approach the computer more closely by having external program capability, but they are *still* calculators *not* computers because they are dedicated to solving individual mathematical problems. The computer on the other hand may solve thousands of such problems in less than a second in order to perform its programmed function. Nowadays the two machine capabilities overlap to some extent and it is sometimes difficult to differentiate between a programmable calculator and a mini-computer, but that is another story.

The calculator revolution moved into full swing when Texas Instruments (the inventors of integrated circuits in the late 50's) began mass producing a single-chip, MOS/LSI calculator-logic device in late 1971. Bowmar and Eldorado Electrodata were the first to use these devices to manufacture small calculators which retailed in the US for around $200.

30 000 TRANSISTORS IN YOUR POCKET

It is interesting at this point to compare these LSI (Large Scale Integration) calculators with the first electronic computer ENIAC. This machine, built in 1946, used 18 000 vacuum tubes and occupied 1800 feet of floor space. The LSI calculator contains up to 30 000 transistors, in integrated form, and can be carried in your pocket.



Typical of the latest four-function and memory calculators is the EL51-811A from Sharp.

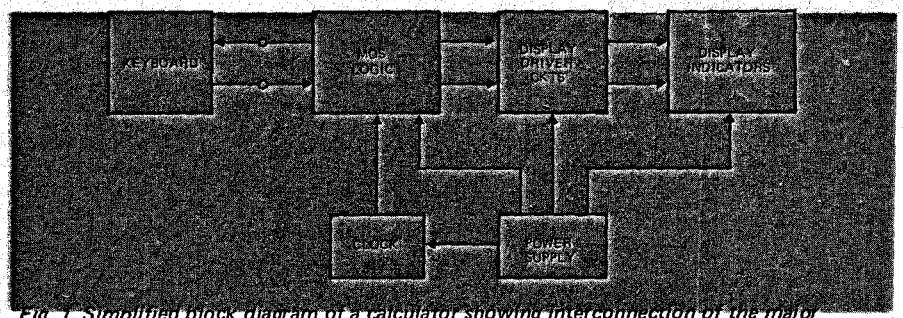


Fig. 1. Simplified block diagram of a calculator showing interconnection of the major component blocks.

This degree of miniaturization was made possible by the progress in MOS (Metal Oxide Semiconductor) technology. Where, for example, an RTL (Resistor Transistor Logic) or TTL (Transistor Transistor Logic) integrated circuit contains on average 10 transistors per silicon chip the integrated circuits fabricated with the MOS technology can typically accommodate 1000 to 5000 transistors per chip.

This increase by a factor of at least 100 in the number of transistors per chip opened the way for using integrated circuits as memory elements, where 1000 or more bits of information can be stored in one integrated circuit. In fact, single chip devices capable of storing 8192 bits of information are now available.

Another advantage of MOS integrated circuits, in addition to miniaturization, is their small power consumption. Typically the power consumed by an MOS integrated circuit is 10 microwatts per transistor, compared to 10 milliwatts per transistor in an RTL circuit. Nothing being perfect in this world, MOS integrated circuits have also certain drawbacks. One of them is their relative slowness (microseconds switching times rather than the nanoseconds required by modern computers). Another drawback has been the relatively high cost, in particular when compared to a large magnetic core memory. But MOS prices have fallen such that they are now challenging even core as a storage medium. A third drawback is that early MOS circuits could easily be damaged during handling through static electricity discharges. Therefore special precautions, like grounding of all tools, have to be taken during production, assembly, and testing of such circuits. Most modern MOS devices incorporate protection circuitry against this eventuality, and some later families such as CMOS may be handled without fear of such damage.

Considering the advantages and drawbacks of the MOS technology, it can be seen that it is ideally suited for personal calculators where speed is not too important and a division lasting 100 milliseconds is still considered pretty fast.

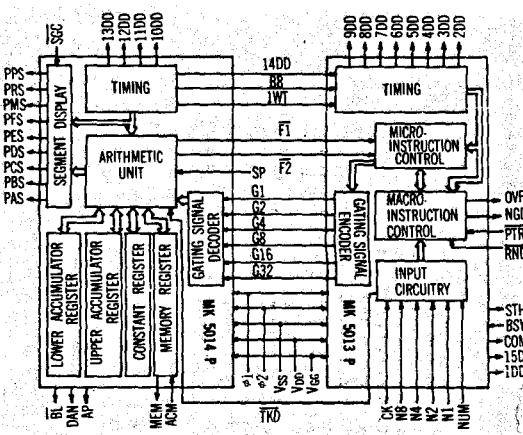
A typical personal calculator contains from one to six MOS LSI integrated circuits with a total of 5000 to 30 000 transistors and perhaps a dozen or more discrete transistors and a few non-MOS integrated circuits to interface with displays. Chips are now coming on the market which include all circuits except power supply, display and keyboard. Typical of these newer systems is the Philips EDC200/210 set (see Fig. 1).

In a typical calculator, MOS integrated circuits perform the arithmetic and memory functions, direct the flow of logic, and store the instructions and results. The discrete transistors provide the interface between low power, low voltage MOS integrated circuits and high power, high voltage displays (e.g. Nixie tubes). Discrete transistors are also used for clock signal generation and for voltage regulation. Standard TTL or RTL ICs are used for interface between MOS ICs and medium-power, low-voltage displays like LEDs (Light Emitting Diodes). Standard ICs are also used for translation of numbers from the form in which they are handled by the calculator into appropriate display form (either numbers 0-9 in Nixie tubes or the proper segments in multiple segment displays).

The main blocks of an electronic calculator are the power supply, keyboard, display circuitry, clock generator, input scanner, registers, arithmetic control unit, the ROM (Read Only Memory) for instruction storage, and the output control. We will not describe the power supply or the keyboard as these are entirely conventional.

CLOCK GENERATOR

The clock generator provides a series of pulses at a rate between 20 kilohertz and 500 kilohertz, depending on the calculator model. These pulses synchronize the flow of information between various calculator blocks and step the logic through the program steps contained in its ROM (Read Only Memory).



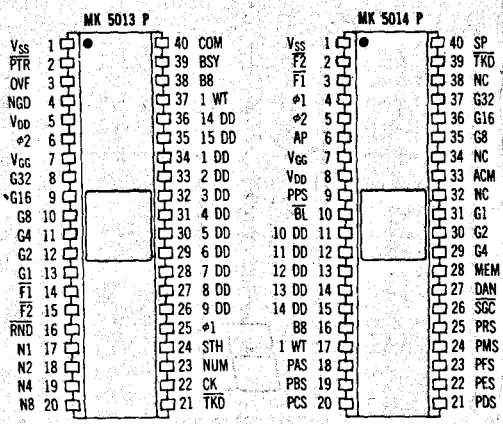


Fig. 2(a)

INPUT SCANNER

The input scanner continuously scans the keyboard so that it can detect which key has been depressed. The numbers from the keyboard are entered into the input register and the selection function (−,+,x,÷) is translated into an initial address to the ROM. The input scanner is then disabled until that key is released and the control ROM has completed its function. This prevents erroneous entries.

REGISTERS

Every calculator has at least two or three shift registers. Firstly there is an input register which stores the number entered by the keyboard one digit at a time in BCD (Binary Coded Decimal), each digit requiring four bits of storage. Thus the number 1973 would be stored as:—

1	9	7	3
0001	1001	0111	0011

(8421 weighting)

A 12 digit calculator would therefore require 48 bits of storage capacity in each shift register.

Each number as it is stored in the input register is decoded and appears on the output display.

When an add, subtract, multiply, or divide command is entered, the command is stored and the contents of the input register are transferred into a register known as the 'Accumulator', freeing the input register to accept a

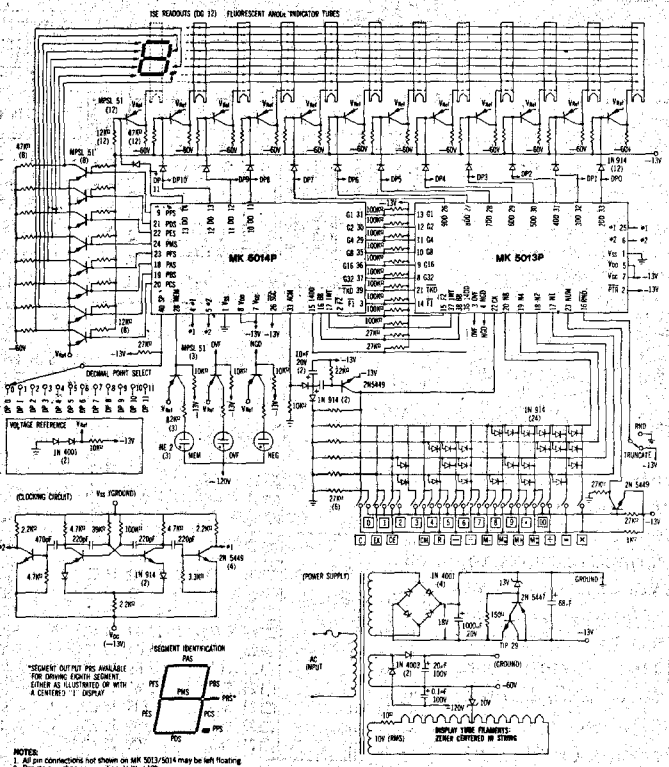


Fig. 2(b)

Fig. 2(a) Block diagram and (b) circuit diagram of Mostek, two chip, 12 digit calculator with constant and memory. The display is multiplexed, and transistors are used to interface the output of the chips to the high voltage requirements of a Panaplex display.

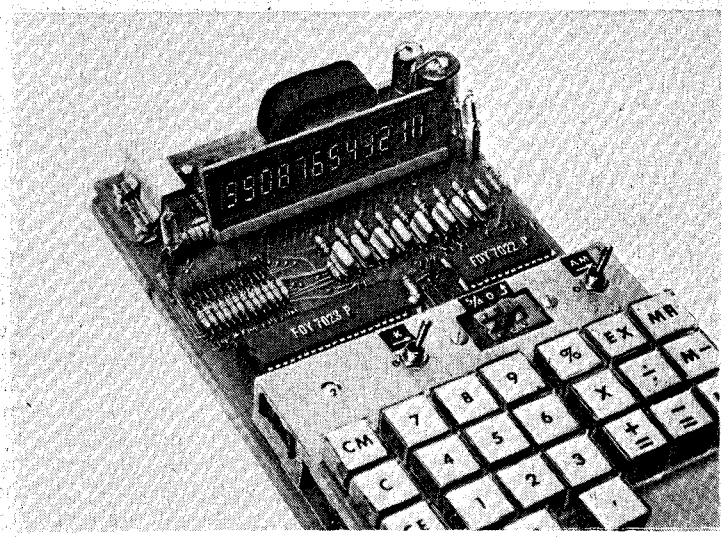


Fig. 3(a) Prototype calculator using the Philips EDC200, two chip set and the Philips Pandicon display type ZM1500/12. It has 12 digit capability, full memory, percentage floating or fixed point operation, and round-up or round down.

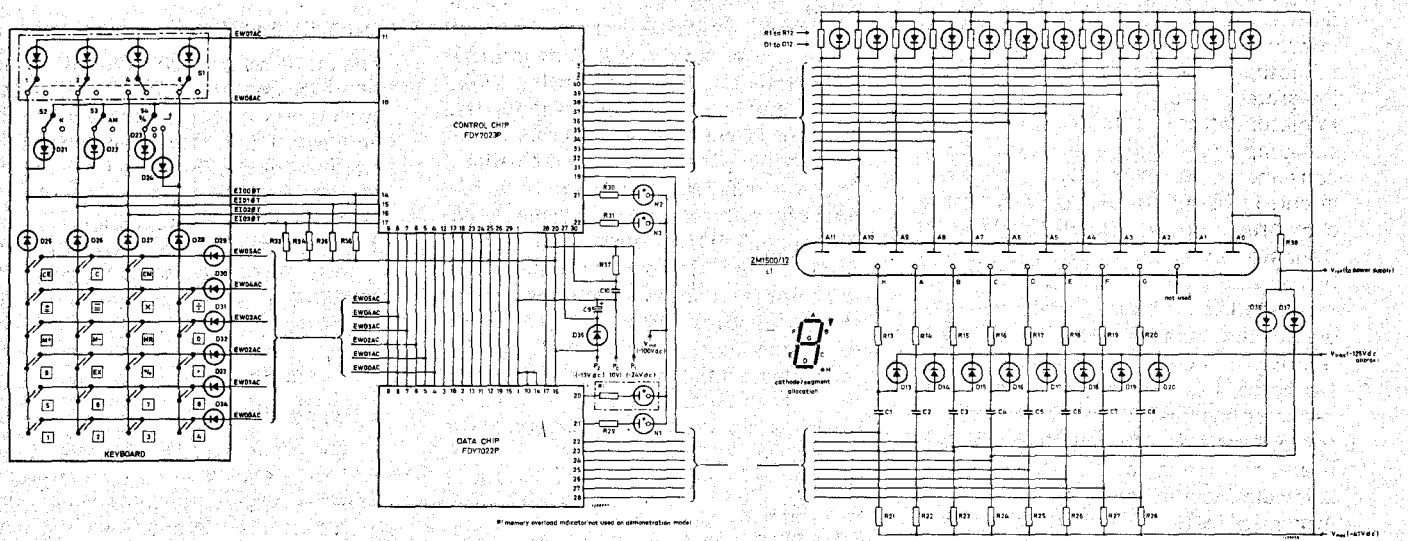


Fig. 3(b) Circuit diagram of Philips EDC200 shown in Fig. 3(a)

new number. When the first key is selected for the new number the input register is cleared, and the new digits are stored and displayed as the keys are pressed. The calculator now awaits a new command. If the 'equals' key is pressed, the command is carried out (for the two stored numbers) by the arithmetic and control logic, and the result displayed.

For multiplication or division a third register is used to shift the digits left or right and store intermediate results. This register is therefore sometimes known as a multi-quotient register.

Those calculators which have a 'Constant' facility have a switch that prevents the number initially transferred onto the accumulator from being cleared. Successive operations may therefore be performed without continually re-entering the constant.

A further register may be used as a 'memory' in which totals can be accumulated. The contents of this register can ideally be separately cleared or recalled to the input register for further processing as required without destroying the contents of the memory. This facility adds considerable power to the calculator.

ARITHMETIC CONTROL UNIT

The arithmetic control unit provides logic for performing additions and subtractions. Multiplication is performed by repetitive addition and shifting of digits in the multi-quotient register in association with the ROM. In the same register, division is performed by subtraction and shifting. Most calculators, depending on the circuitry, will either truncate (cut short) the results, or round them to the next digit. For example, a simple calculator will show $2 \div 3 = 0.6666$, a more elaborate one would show the result as 0.6667. Because all numbers are stored and operated upon one digit at a time, the calculators are true decimal machines. Therefore, the results are exact as long as they can be represented with the number of digits available for display.

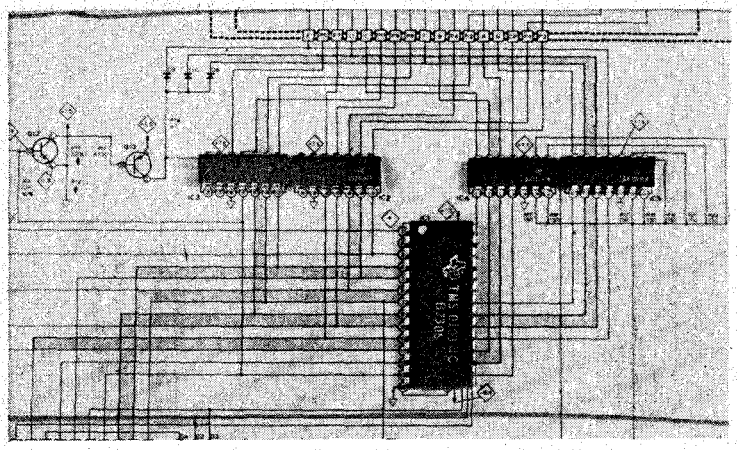


Fig. 4. This Texas Instruments' chip set is for an eight digit floating-point calculator with constant facility. The 28 pin pack, TMS0/03, is MOS/LSI and performs the calculator logic. The other four chips decode the outputs to drive a seven segment LED display. The circuit is that of the Heathkit IC-2009 calculator in which these chips are used.

READ ONLY MEMORY

The Read Only Memory provides instructions to the arithmetic unit and to the registers in order to perform the required arithmetic operations. Part of each instruction is the address of the next instruction in the ROM. Both multiplication and division require approximately 50 instructions each. The keyboard operation entry leads to the address of the first instruction corresponding to a particular arithmetic operation. The control is then transferred to the second instruction using its address attached to the first instruction and so on until the complete operation is performed.

OUTPUT CONTROL

Output control transfers the number stored in the output register to the display indicators. To save on BCD-to-decimal translators, the display indicators are generally operated in time-shared mode. Digits are scanned and transferred one at a time and the display is repeated every few milliseconds. At this fast rate, it appears to the eye that the display is continuous.

Other functions of the calculator are imbedded within previously described major blocks. These are control of the decimal point, storing of constants for multiplication or division, checking for negative results and activation of the negative sign, checking for overflow etc.

DISPLAYS

In personal calculators, particularly those designed for battery powered operation, the display poses a problem in terms of both power dissipation and cost. Older calculators almost invariably used single neon-indicator tubes for each digit. But with this type of display a high voltage power supply is required as well as drivers capable of high voltage operation. Neon indicator prices cannot be reduced much below about $2.50 per digit, and this coupled with extra mounting and driver costs has ruled them out for new designs. In fact one of the pioneers of neon indicator tubes is phasing them out of production completely except for replacement quantities.

Those displays which are at present enjoying the most favour are multi-digit units constructed using gas discharge, light-emitting-diode or liquid-crystal technologies.

Gas discharge displays such as the Panaplex or Pandicon are favoured where large digit size (¼" or more) is required. Up until recently LEDS (light emitting diodes) have enjoyed almost exclusive use in calculators employing digit heights of around ⅛". However they are still too expensive to be used for the larger digit sizes. More recently liquid crystal displays (LCDs) are being used as 'life' problems and ac drive requirements of these displays have been largely overcome.

The tendency now in the 'pocket' calculator field is to integrate all the display drive circuitry into the one chip together with the rest of the logic. Thus true one-chip calculators are beginning to become available.

THE SCIENTIFIC CALCULATOR

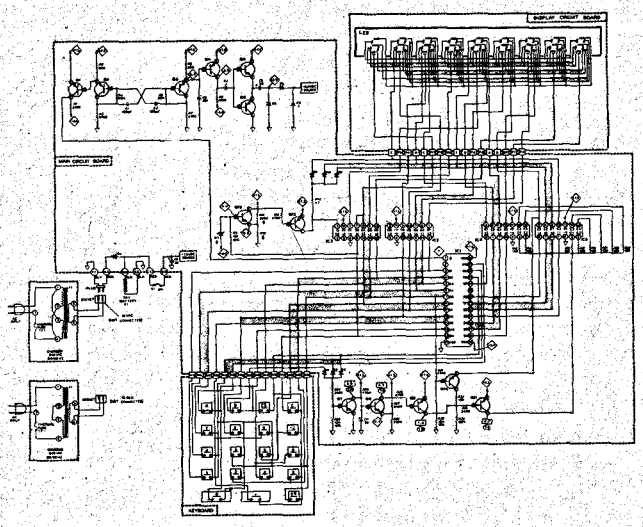
The four-function calculator, although extremely useful, has limited mathematical capability. It cannot handle very large or very small numbers, nor can it handle transcendental functions (that is, trigonometric, logarithmic, exponential etc) or in most cases even square root. Thus they are a long way from replacing the ubiquitous slide-rule.

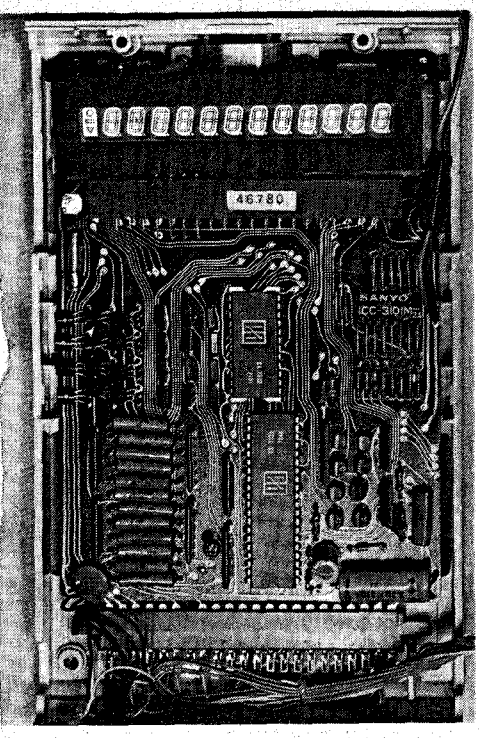
A new class of personal calculator is now appearing, members of this family being known as scientific calculators. Typical examples are the Hewlett Packard HP35 and HP80, the MITS 7400 and the shortly to be released Texas Instruments SR10.

The block diagram of an HP35 can be seen in Fig. 7. The essential differences between this and the four-function system is the inclusion of more registers, four of which are arranged in an operational stack, much more extensive ROM to perform the transcendental function calculation, and a re-orientation of the display so that numbers may be represented in scientific notation. The 15 digit display is capable of registering *and operating on,* numbers between 10^{-99} and $9.999999999 \times 10^{+99}$, the last two digits of the display being used to represent the exponent.

Calculators of this class can be said to truly replace the slide rule. They provide an accuracy which had previously been unattainable even with seven place logarithm and trigonometric tables.

Fig. 5. Circuit diagram of the Heathkit IC-2009 calculator kit which uses Texas Instruments MOS/LSI chips.





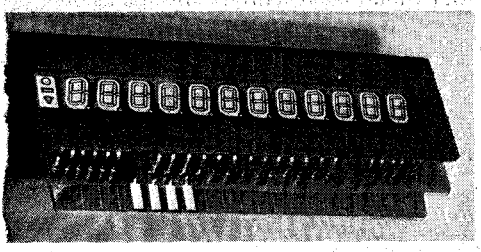


Fig. 6. Typical 12 digit calculator, the Sanyo ICC3101 uses two chip logic and a seven-segment, fluorescent display panel.

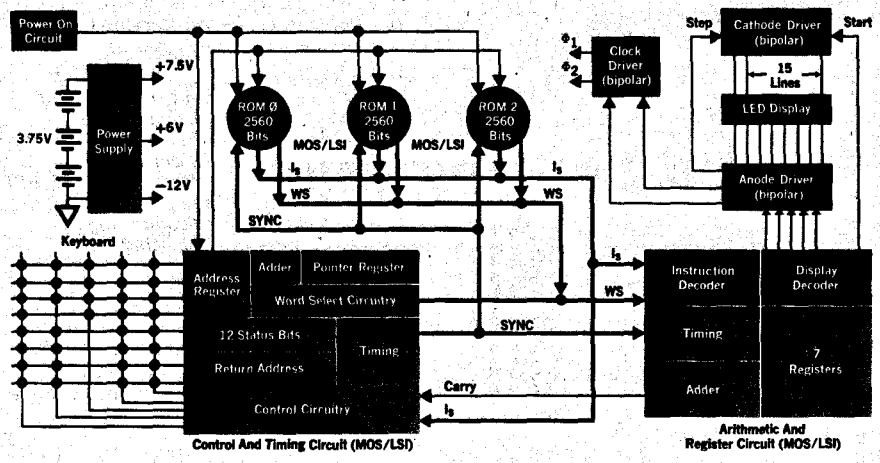


Fig. 7. Block diagram of the HP35 calculator.

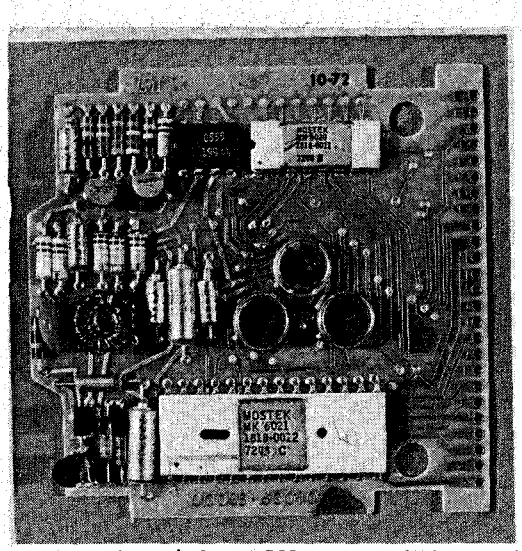


Fig. 8. Logic card of the HP35 calculator is deceptively uncomplicated in the light of the calculator's capabilities.

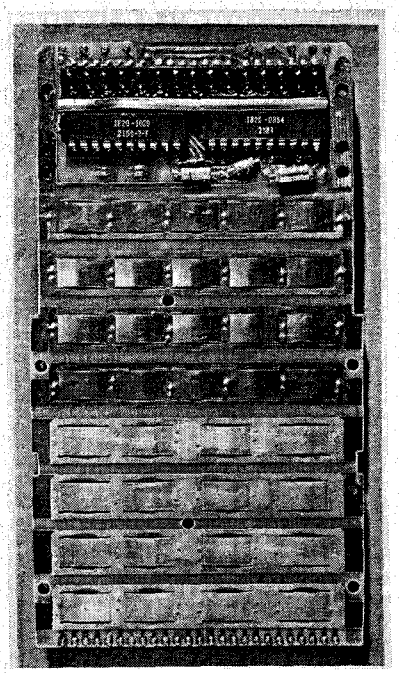


Fig. 9. Gold-plated keyboard contacts, display decoders and the three display chips (each with five characters) of the HP35.

WHAT OF THE FUTURE?

In the future, we see the four function calculator remaining as a very cheap ($30 and non repairable) unit for the consumer market, and a memory will probably become a standard feature.

The pocket scientific calculator will have more models dedicated to specific branches of engineering. For example — as the HP80 is dedicated to accounting problems, we will see others dedicated to surveying, navigation, electronics etc.

No doubt for the desk range we will also see the incorporation of a cheaper printer, and plug-in programmers will also become available, at reasonable prices, which will give the calculator a capability approaching the mini-computer. Already one company has plans to introduce such a programmer for its under $500 scientific calculator. The question now arises — Now that we have all this calculating power what are we going to do with it?

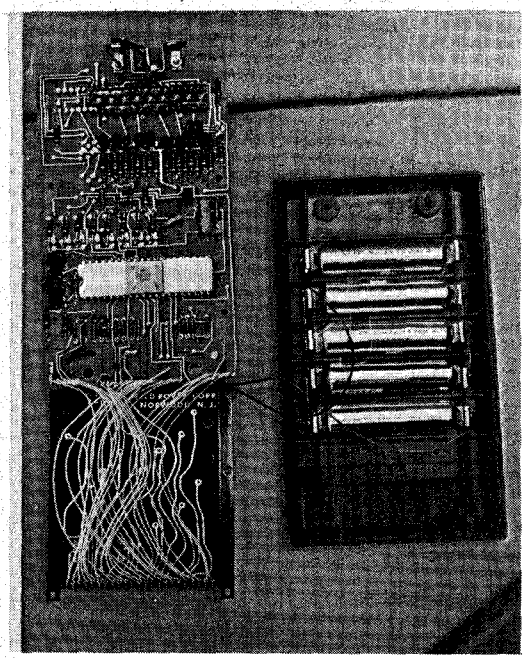


Fig. 10. (left) The Mini- Executive 8-digit calculator from Advance uses one-chip logic for fixed or floating point operation with constant facility.

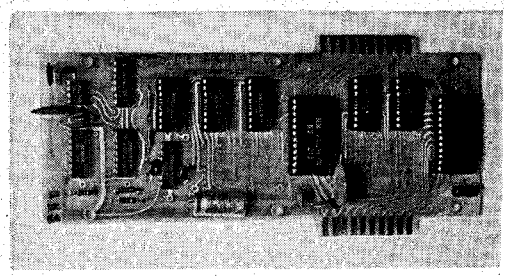
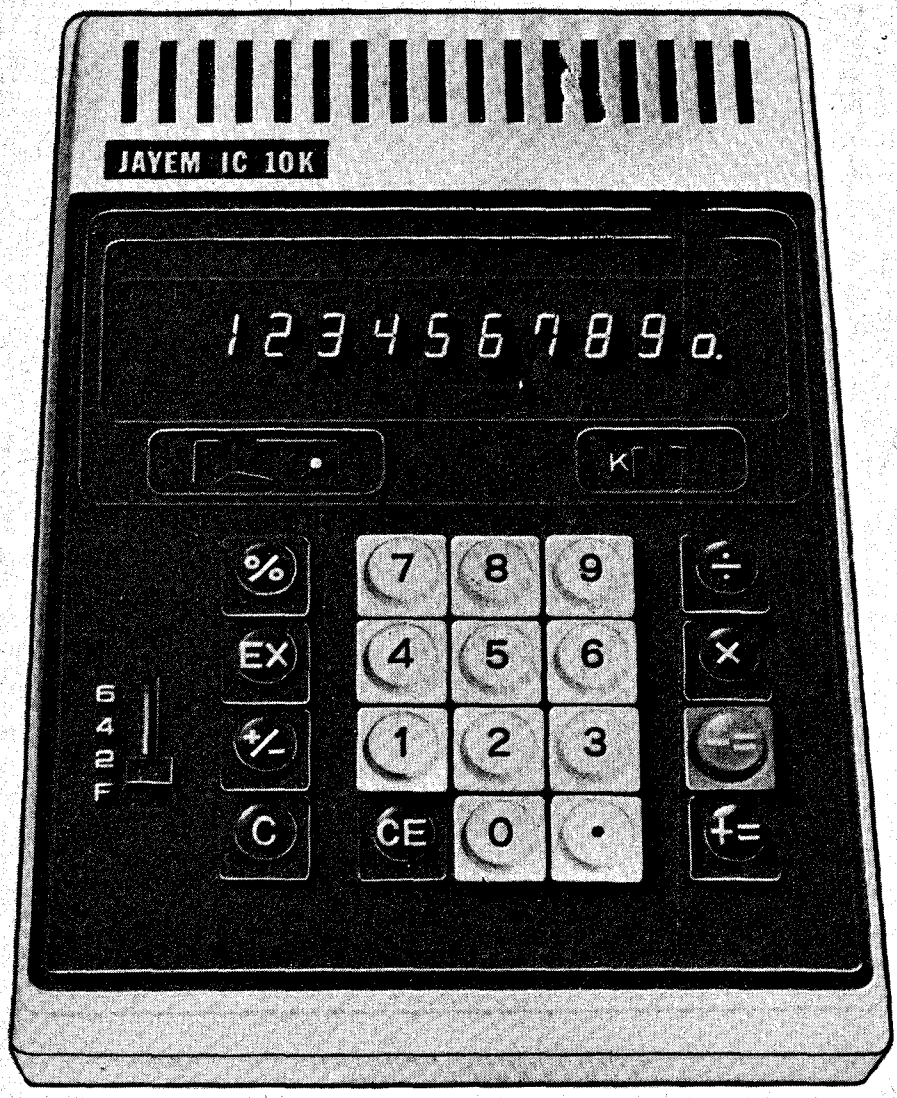


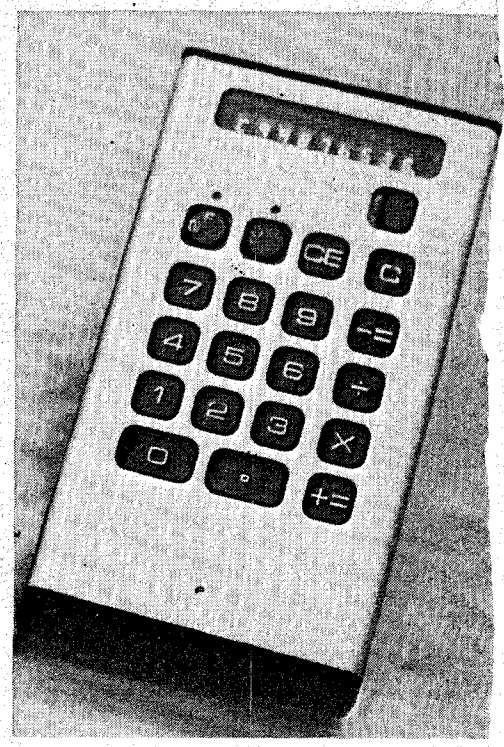
Fig. 11. An alternative for those who wish to build a calculator into other equipment is this MAPS 14 digit system from National Semiconductor which has two memories, percentage and constant as well as floating or selectable fixed point operation. A version using scientific notation will shortly be available.

PERSONAL CALCULATORS

HOW TO CHOOSE A CALCULATOR TO SUIT YOUR NEEDS



The JAYEM 1C 10K from Jacoby Mitchell is excellent value for money and has been approved to Australian standard C-100.



The Advance Mini-Executive

SHARP DEVELOPS CALCULATOR

Just as this article was going to press, Sharp announced a 12 digit calculator to sell (in Japan) at $27. The calculator is built around a one-chip MOS device developed and manufactured by Sharp.

THERE is little doubt that one of the fastest growing fields in electronics these days is that of personal calculators. In fact with retail prices plummeting downwards, the personal calculator (in its simplest form) is becoming a consumer item – just like transistor radios, cassette recorders etc.

It is reliably estimated that about three million personal calculators of either the pocket or desk-top variety will be sold throughout the world this year. Even more would be sold but for the world-wide component shortage.

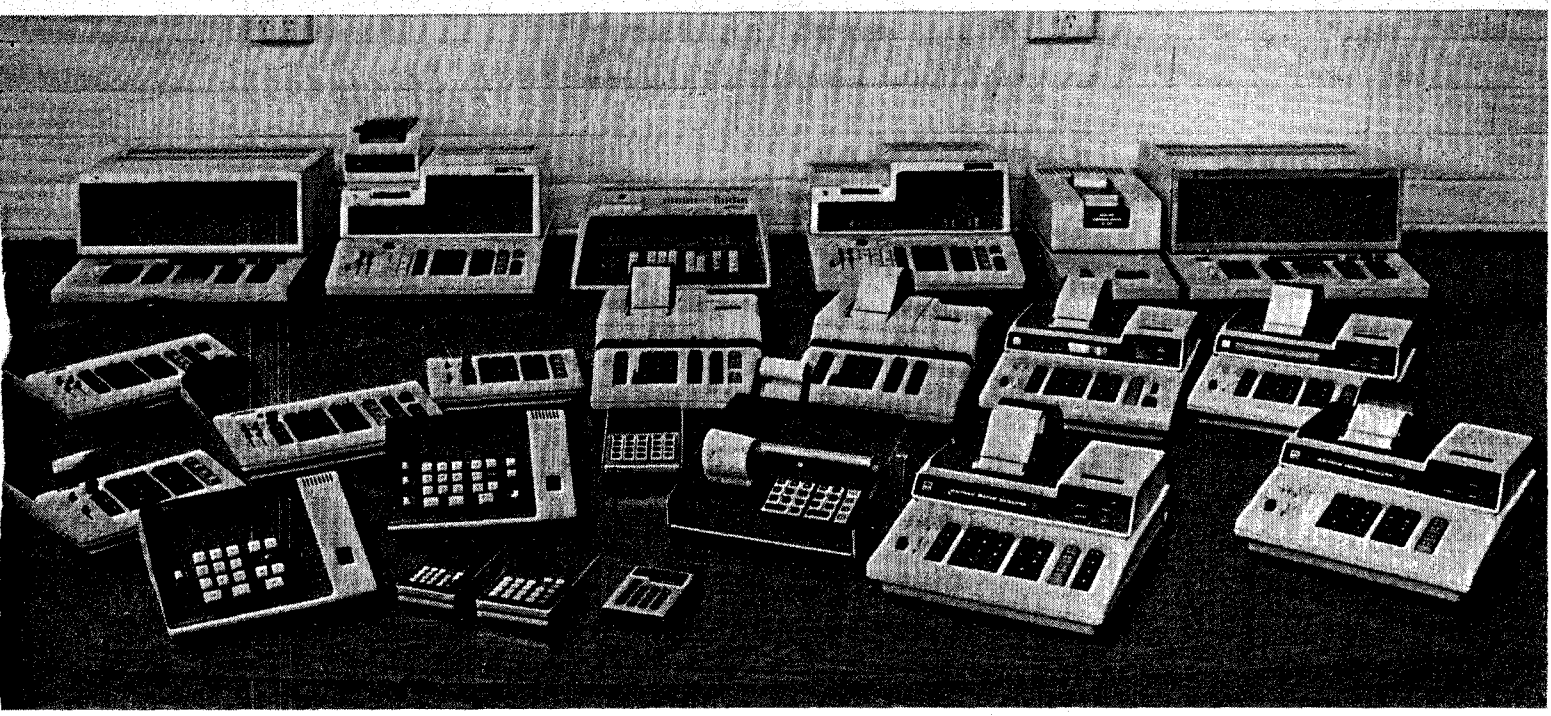
Prices for the simple four-function units have plummeted in a very short space of time from $200 to less than $100. Already, a Japanese unit is being marketed in the US for $43 (about $30 Australian).

Hewlett Packard sold 50 000 of their HP-35 calculators in the first year – all they could make in fact. In many countries there is a waiting list for these even now.

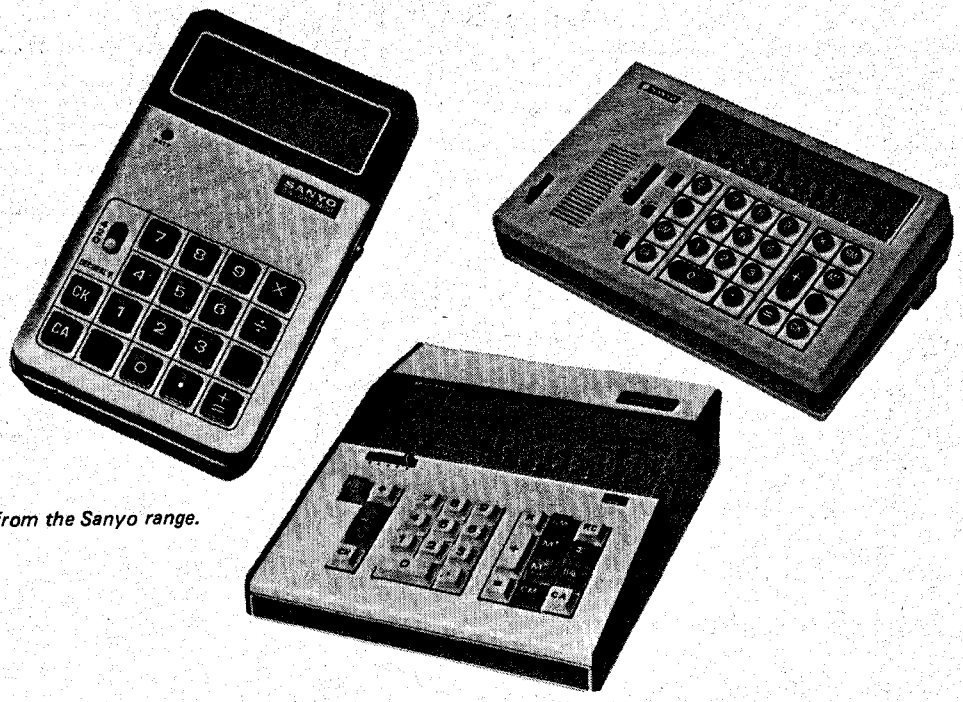
In such a climate, many larger companies have pulled out of this highly competitive and – as it's becoming – cutthroat market, whilst on the other hand, hundreds of other sometimes-dubious companies are being formed to assemble IC's, keyboards and displays into their own case. The aim? – to make a quick killing on the rising consumer tide and then get out. This of course leaves the owner of one of these 'once-off' machines without service and, if anything goes wrong with his machine, he might as well throw it away.

BUY ONLY FROM AN ESTABLISHED COMPANY

There are still other companies in



Part of the vast range of calculators available from the Sharp Corporation. Surely a calculator for every need.



Calculators from the Sanyo range.

Australia that import calculators and apply their own brand name to them. These companies, in the main, have carefully selected the product and offer full service back-up. No-one need fear of buying a calculator from well established companies, such as Jacoby Mitchell (JM-IC 10K and Advance), Hanimex, (Toshiba, Ricoh) or Remington (Casio).

Apart from well-established importers, companies such as Sharp, National and Canon have their own organisations in Australia with full service facilities available.

The message is to buy only from a well established company, and buy a brand that *guarantees* continuity of service. Even though today's calculators are very reliable, they can still go wrong.

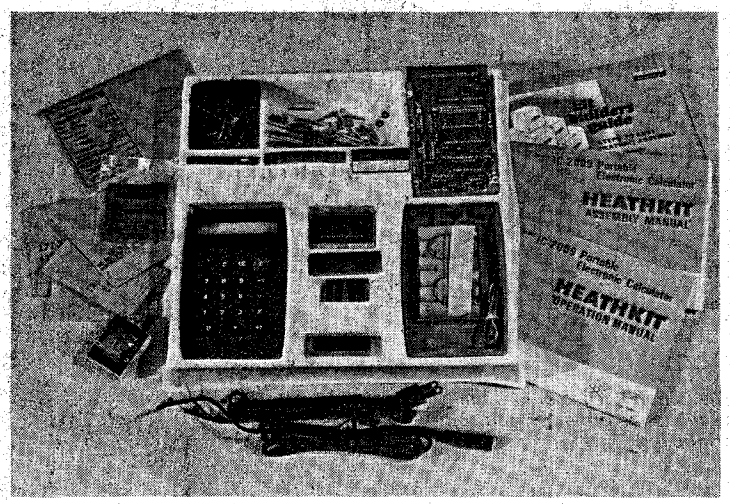
WHICH CALCULATOR TO BUY

Having decided that you need a calculator, the question still remains — which one? To aid you in your predicament we have prepared a listing of some 60 of the most popular calculators in the under $500 range. The list is by no means exhaustive, in some cases individual companies have more models in their range than are listed, but from it you should be able to pick a few that seem closest to your needs. All that then remains is to examine these machines and pick the one which has the best appearance and operating characteristics at a price to suit your budget.

The first thing to do is to ask yourself why you need a calculator, and what you want to do with it. Answers to these questions will very much determine the most suitable type for you.

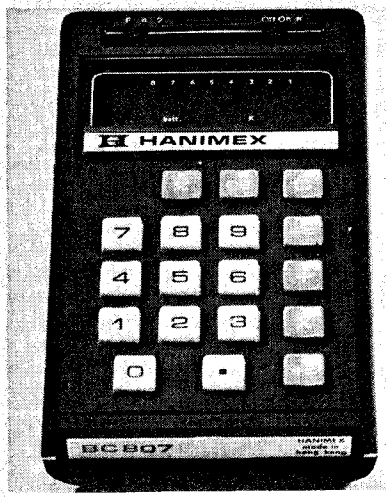
PERSONAL CALCULATORS

Sharp's ELS1 814 has full memory 8 digit display and very low battery drain due to the use of CMOS logic.



KITSET CALCULATOR

The Heathkit IC-2009 calculator kit comes complete with charger and nickel-cadmium batteries and features perfect overflow characteristics. ETI staff assembled one of these kits and found the result to be very satisfactory — full report next month.



The Hanimex BC807 and MC1202 calculators.

If you work with money you will require a machine that is specially constructed for finance calculations. If you only want to add up the grocery bill the simplest four-function fixed decimal place machine will do. If you are an engineer, or require in any way a machine with mathematical capability, then you have a selection problem indeed — not the least of which is the price you can afford to pay.

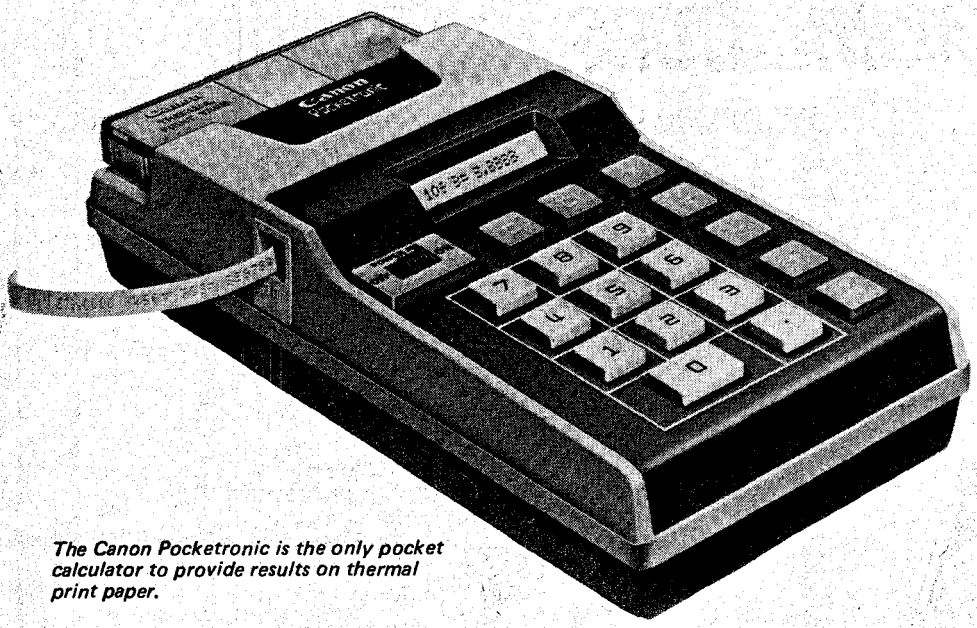
CHOOSING A FOUR-FUNCTION CALCULATOR

Four-function calculators range in price from $67 to $300, and, as with anything else in this world, you get what you pay for, although some machines are much better value for money than others.

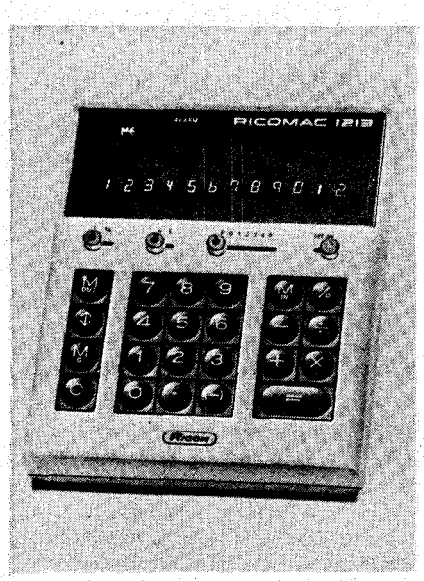
The first feature one should examine is the number of digits available, and the organisation of the decimal point. For example if one wanted to know the cost of 1536 items at 2.53 each, the answer to this simple problem requires a six figure display. Further, the multiplication of two four-figure numbers will give an eight-digit result. Hence it is wise to choose a calculator with at least an eight-digit display.

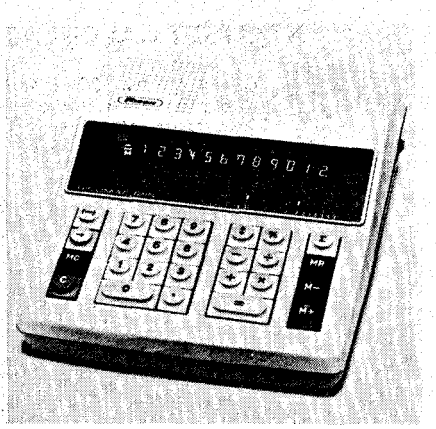
Next look at the decimal point situation. Two modes are commonly used — floating point and fixed point. In floating point, the decimal point is automatically positioned in the answer. Thus when multiplying 123.45 x 6.78 (= 836.9910), the decimal point is automatically positioned four places to the left.

In a fixed point machine we select the number of decimal points to be displayed at 0, 2, 4 etc. as required. Thus the above problem would be



The Canon Pocketronic is the only pocket calculator to provide results on thermal print paper.





Three from Ricoh, the 1213, 1215 and 1000P.

solved with a two-point selection as follows:

123.45 x 6.78 = 836.99

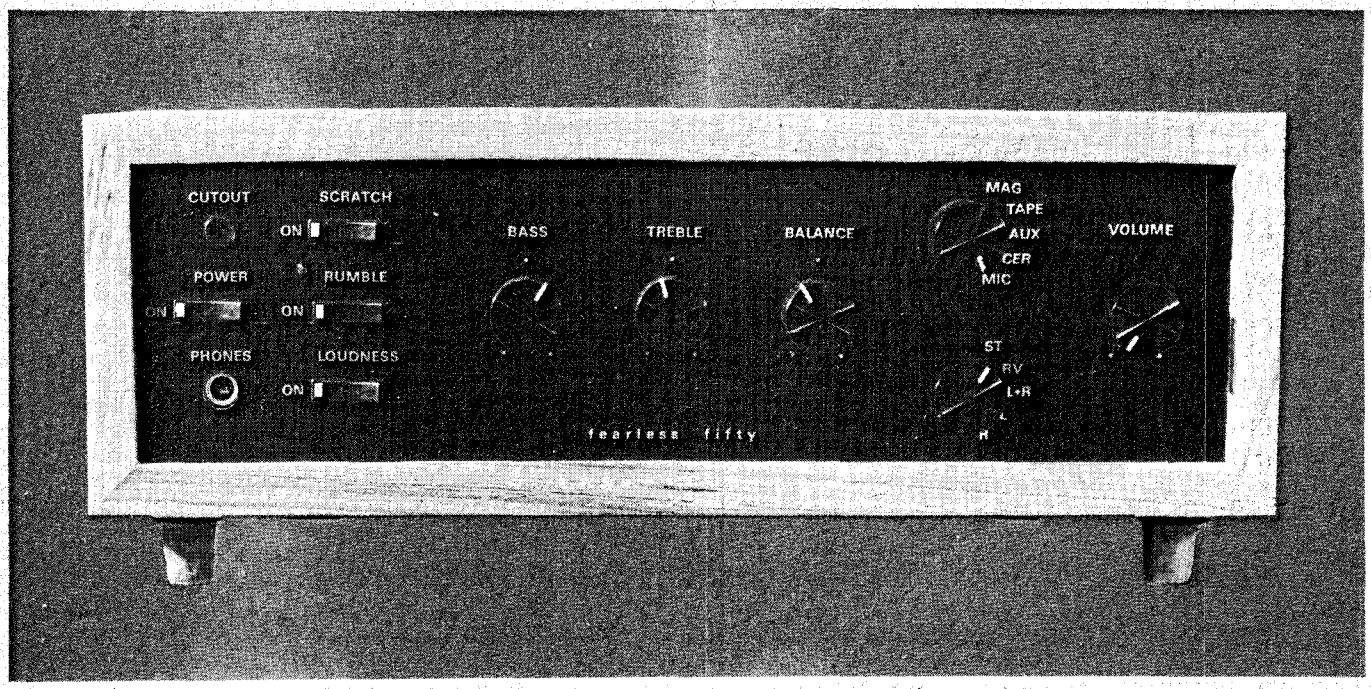
Floating point is more suited to engineering or mathematical calculations whilst fixed point is more suited to financial calculations. Note however that where the decimal point is fixed, the number of whole digits that may be used is reduced, thus in an eight-digit machine fixed at two decimal places (836 x 123 = 102828.00) any answer that exceeded six digits to the left of the decimal point would 'overflow' the capability of the machine. Better quality machines have 'fixed' or 'floating' point operation that is selectable to suit the problem.

Machine operation under overflow conditions is an important consideration.

In some cheaper machines, an attempt to enter a nine-digit number into an eight-digit register will cause the display to blank out, or display all zeros. This overflow condition cannot be cleared without clearing the whole machine. It is preferable that the machine retains the digits entered up to full capacity and then disables the keyboard, so that more cannot be entered, whilst at the same time putting up a signal that the entry has overflowed. Normal operation should then be possible using the entered number.

The same overflow condition may occur in the result, e.g. if two six-figure numbers are multiplied, the answer will have 12 digits which will overflow an eight-digit machine. In most machines, 'lock out' will occur, and in some the display will be

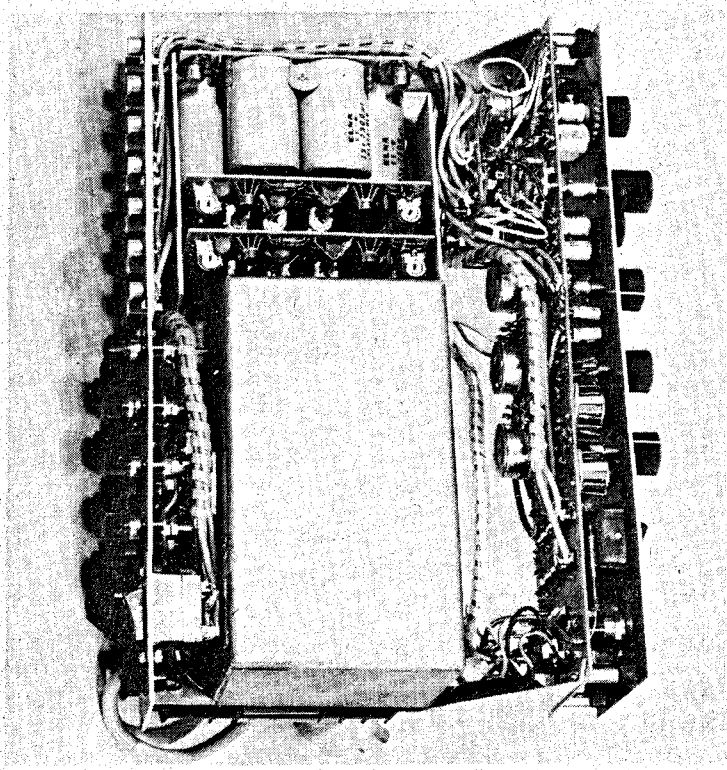
(Continued on page 95)



electronics TODAY INTERNATIONAL
product test

FEARLESS 50 AMPLIFIER

Compact 50 watt amplifier is Australian designed and built.



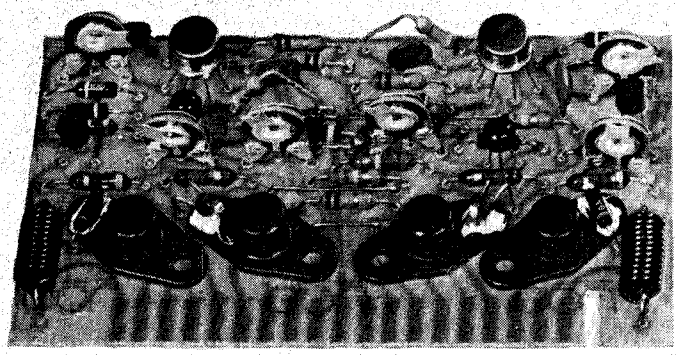
FEARLESS Electronics was started a couple of years ago by two university students. The company's aim was to utilise the latest advances in semi-conductor technology to produce a better amplifier. The result was the Fearless 50 reviewed in this article.

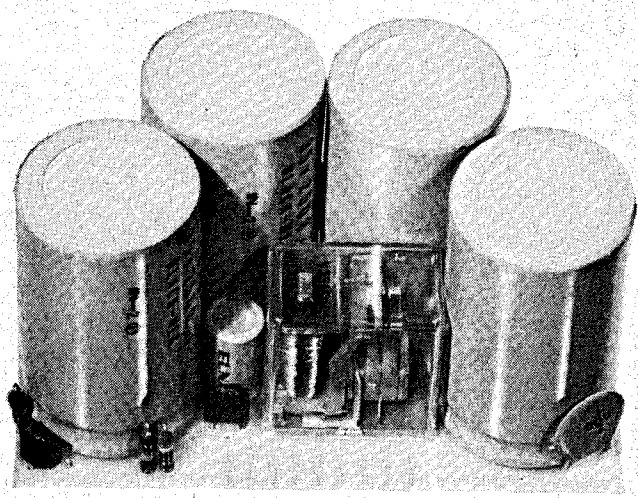
The unit arrived packed in corrugated cardboard. This provided more than adequate protection. By the weight of the carton, we expected to see a relatively large unit, comparable in size to most commercial amplifiers with a similar power rating. To our surprise, the unit is extremely small — measuring only 31.5 cm wide by 12.5 cm high by 24.5 cm deep.

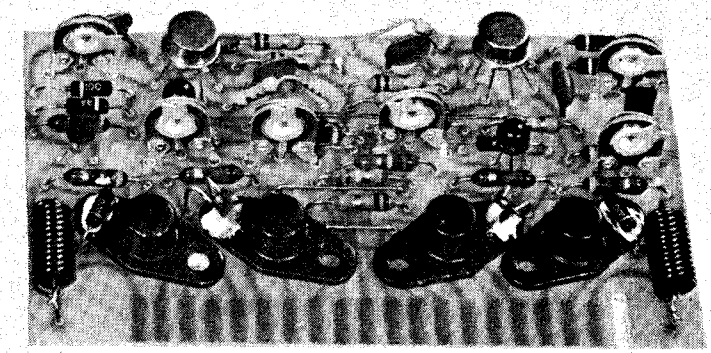
The amplifier is housed in an oiled teak-veneered timber enclosure and has a black anodised recessed front panel with silver printing. The enclosure was very well constructed.

From left to right, the front panel has the following controls:—

On the left hand end there is an orange cut out light in the top corner with a rocker type power switch below, and a ring tip and sleeve headphone socket below that. Next in







MEASURED PERFORMANCE OF FEARLESS FIFTY AMPLIFIER (NO SERIAL NO.)

Frequency Response:	20Hz to 20kHz ±½dB		
Power Output for Rated Input:			
Stereo Mode:	50 watts per channel (both channels driven)		
Quadraphonic:	15 watts per channel (both channels driven)		
Channel Separation:	100Hz	1kHz	10kHz
	75dB	69dB	55dB
Hum & Noise (with respect to rated power — 15 watts)			
Auxiliary:	74dB unweighted	85dB 'A' scale	
Phono:	65dB unweighted	75dB 'A' scale	
Total Harmonic Distortion (at 15 watts)	100Hz	1kHz	6.3kHz
	0.07%	0.04%	0.09%
Tone Controls:			
Bass:	19dB boost at 50Hz 20dB cut at 50Hz		
Treble:	15dB boost at 10kHz 15dB cut at 10kHz		
Rumble Filter:	4dB cut at 50Hz		
Scratch Filter:	8dB cut at 10kHz		
Loudness Control:	10dB boost at 50Hz 3dB boost at 10kHz		
Dimensions:	31.5 cm wide by 12.5 cm high by 24.5 cm deep		
Weight:	8 kg		

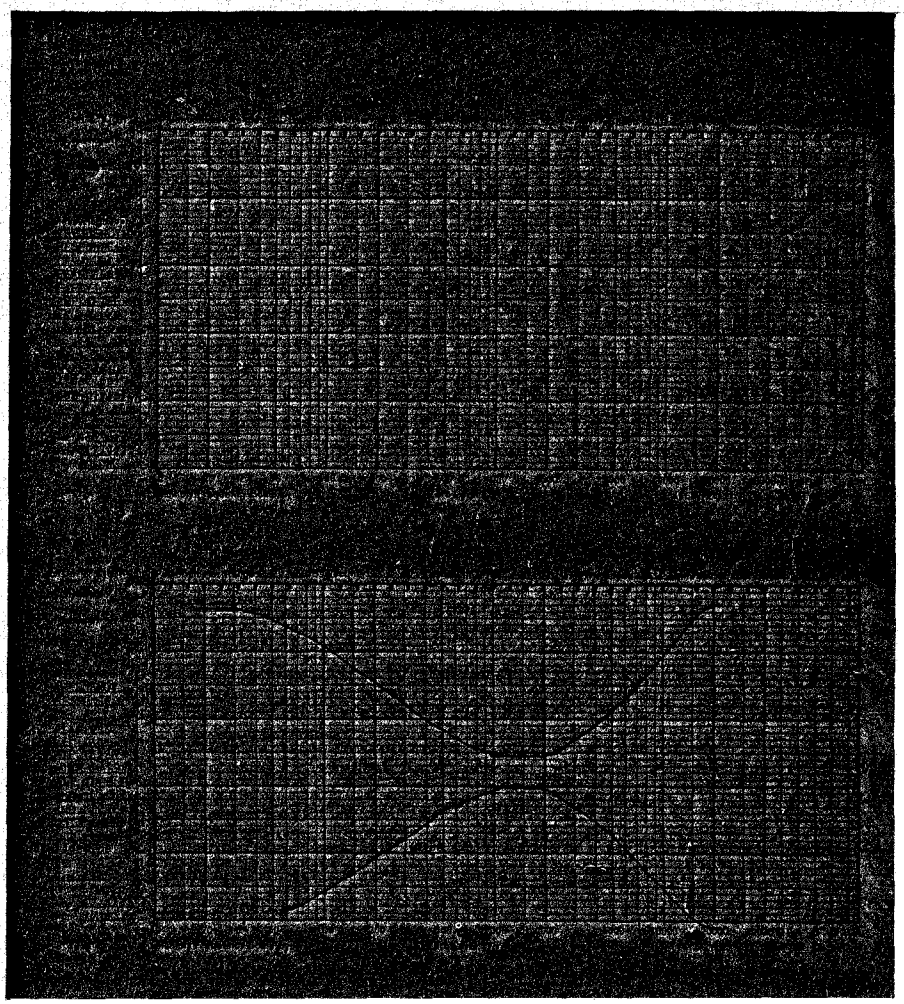
line are three rocker switches mounted vertically; one for scratch filter select, one for rumble filter select, and one for loudness filter select.

The centre of the panel contains three control knobs, horizontally in line. The left-hand one is for bass boost and cut, the centre one for treble boost and cut, and the one on the right-hand side is for left or right balance adjustment.

The right-hand end has two rotary switches mounted one above the other. The top one has five positions: magnetic input, tape input, auxiliary input, ceramic input and microphone input. The lower one also has five positions: stereo normal, reverse stereo, left and right channel mono, left channel mono, and right channel mono. The far right-hand control is the volume potentiometer.

The most interesting feature on the front panel is the scratch filter. This will be discussed later in this review.

On the rear panel are seven pairs of RCA sockets mounted horizontally in line. These are for magnetic input, tape input, auxiliary input, ceramic input, microphone input, preamplifier output and rear panel input. Next to these are four pairs of screwed terminals for left rear speakers, left front speakers, right rear speakers and right front speakers respectively. Depending on how these terminals are wired up, it is possible to obtain 15



we give you the auto features the rest try to sell

fully automatic stereo turntable
BFU-121

apan
MUSIC MAKER

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

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

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

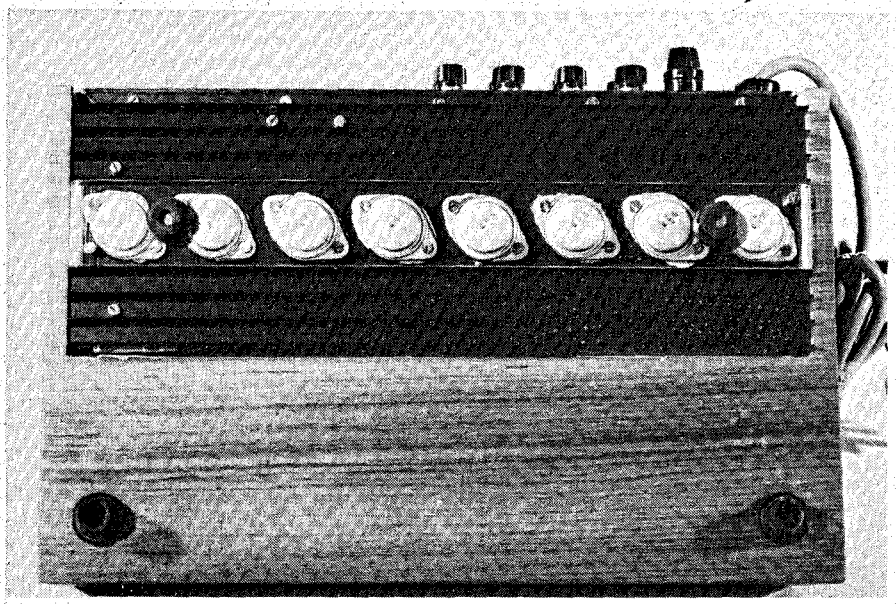
Manual and semi-auto models also available.

RALMAR
agencies pty. ltd.
431 Kent Street, Sydney Tel.: 29 4338

AGENTS:
QLD: Tallerman & Co. Pty. Ltd., Robertson St., Valley, Brisbane
VIC: K.J. Kaires & Co. Pty. Ltd., 4 Hill Court, Macleod
S.A.: Wm. M. Matthew & J.A. Dunn Pty. Ltd., 251 Hutt St., Adelaide

STATE DISTRIBUTORS:
W.A.: G.K. Cameron & Co. Pty. Ltd., 246 Churchill Ave., Subiaco
A.C.T.: Sonny Cohen & Son, 20 Isa St., Fyshwick
TAS: W. & G. Genders Pty. Ltd., Launceston, Burnie, Hobart
N.T.: N.T. Musical & Electrical Wholesale Pty. Ltd., 54 Cavenagh St., Darwin

watts per channel quadraphonic, or 50 watts per channel stereo. Furthest right is a selection knob for quadraphonic or stereo mode, and below the switch is a Japanese two pin outlet which can be operated from the front power switch, and a mains fuse. One noticeable exclusion was a nameplate with relevant electrical information and unit serial number.



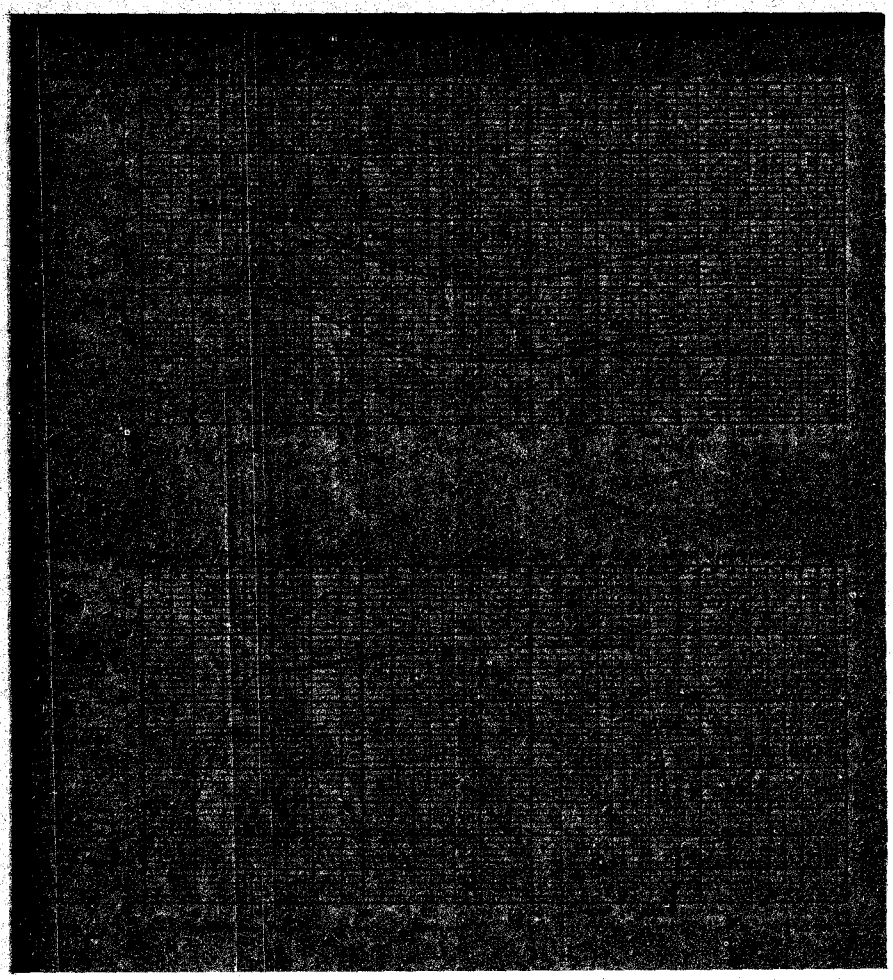
MECHANICAL CONSTRUCTION

Instead of being mounted in the normal vertical fashion, the heatsink is mounted horizontally underneath the base of the amplifier and across the full width.

The internal layout of the amplifier is extremely compact, with the power transformer taking up about 40% of the total internal volume. The remainder of the space is taken up with a printed circuit board mounted directly behind the front panel, and three further printed circuit boards, mounted front to back, beside the power transformer. This transformer, although fully shielded, was rusting on the fold points of the metal case; a coat of paint would have markedly improved the appearance.

Due to the compactness of the amplifier, the circuit boards were impossible to service in place. However, with the exception of the board across the front panel, they were all provided with edge connectors so that they could be easily removed for service.

The wiring harnesses were tightly packed in and around the circuit boards and the main heatsink. The RCA sockets on the rear panel could be shorted out, if pushed too hard against an aluminium shield located just behind them. Alternatively, if one used an RCA plug with a relatively long centre pin, it could be possible to short the centre pin out against this aluminium shield when pushing in the plug.



Overall rigidity of the mounting frame, in particular the front panel, was rather light and the only structurally rigid member was the heatsink onto which all other components were mounted.

All the filter circuitry was located on the front circuit board, and the circuit boards adjacent to the transformer contained the left and right channel power amplifier drivers and the power supply.

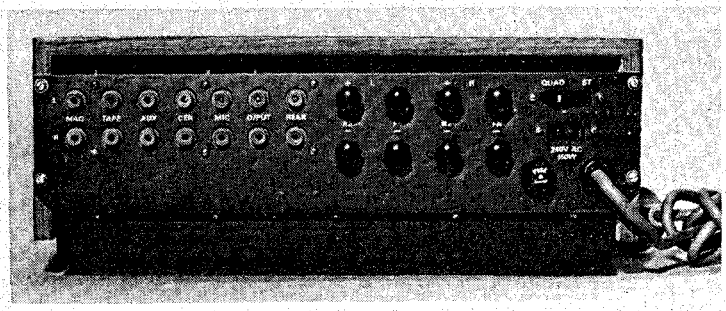
One interesting feature of the wiring is the use of shielded coaxial cables from each of the RCA sockets to the front panel controls. This arrangement proved to be disastrous when we tried wiring up our turntable which happened to have a common earth return from the pick-up head. This resulted in an earth loop reducing the signal-to-noise ratio to only 20 to 30 decibels. Separate earth wires from each channel of the cartridge will eliminate this problem.

The heatsink across the bottom is fitted with thermal sensors to cut-out when the heatsink temperature exceeds 70°C. Operation of the thermal sensors energized a relay and illuminated an indicator on the front panel.

An unusual feature of the circuitry is the use of 10 integrated operational amplifiers in various stages of the amplifier and in the tone controls.

The 50 watt output is also unusual in that it is a differential output, and as such must not be earthed under any circumstances.

(Continued on page 38)



MEASURED PERFORMANCE

Our laboratory test proved even more interesting. Firstly, the unusual scratch filter has a notch configuration with a centre frequency of 14 400 Hz. This resulted in excellent attentuation of all components above approximately 10 kHz, and resulted in a flat frequency response up to 9 kHz. Generally scratch filters have a 6dB or sometimes 12dB roll-off, and this results either in inadequate attentuation of the annoying high frequency components, or loss of some of the harmonic content of the programme source below 10 kHz.

The amplifier needs considerable ventilation if it is to be operated continually at its rated power, and, if continuously driven with a sine-wave input, the output transistor heatsink becomes very hot, causing the protection circuit to operate.

The specified input sensitivity in the manufacturers' handbook was higher than that measured, for example on the auxiliary input, we found 150 millivolts resulted in the rated output of 50 watts per channel when both were driven — not 180 millivolts as specified.

Signal-to-noise ratio was very good provided a separate earth was used on each channel input. But as mentioned before, considerable problems could occur if the amplifier were connected to a turntable having a common earth on the cartridge or tone arm.

Total harmonic distortion at 1kHz was 0.04%, rising slightly with an increase or decrease in frequency to 0.07% at 100Hz, and to 0.09 at 6.3kHz.

The frequency response measured was the flattest we have ever measured on any amplifier. There was no measurable deviation between 20Hz and 20kHz. Quoted response is from 5Hz to 100kHz $^{+0}_{-3}$ dB at 1 watt weighted output.

The loudness control provided a constant boost irrespective of output level.

One of the unusual comments in the manual was that it was not possible to monitor a tape whilst it is being recorded, in fact any attempt to do so causes damage to the amplifier — a strange limitation in that many people prefer to use a three head tape recorder so that they can monitor the tape being recorded.

By utilising the latest technological developments, the designers of the Fearless 50 have combined compact design with excellent performance — however in its present form the amplifier lacks a number of features normally included in competitive units.

If these features can be included in a MK II version — and a number of minor details improved — this would be an extremely good amplifier indeed.

Recommended selling price — $260 ●

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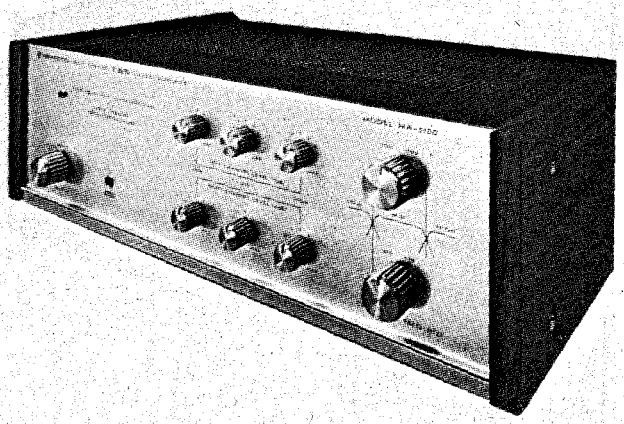
KENT HI-FI PTY LTD has the SOLUTION!



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KENWOOD

4-power electronic crossover amplifier.

incl. tax $185.00

Among most leading audio Hi-Fi field specialists, it is widely understood that direct driving of each speaker unit is the latest, most ideal method. This method means an increase in sound quality. Since it also means an increase in costs, having the advantages of such a system seems like too much to hope for.

This KENWOOD unit is the only one in the world that includes the inner-electronic dividing network plus four main amplifiers in itself. The MA-5100 is far more efficient and costs far less. Attach the MA-5100 to your receiver or amplifier to perfect your own ideal IDS music system.

RMS OUTPUT

Both Channel Driven
- High range amplifier: 6/6 watts at 8 ohms
- Mid range amplifier: 13/13 watts at 8 ohms

FREQUENCY RESPONSE (fc: cut off Frequency)
- High range amplifier: 500 ~ 50 kHz±1 dB
- Mid range amplifier: 20 ~ 50 kHz±1dB

HARMONIC DISTORTION
- High & Mid range amplifier: Less than 0.09% at –3 dB rated output

INPUT SENSITIVITY AND IMPEDANCE 100 mV (20 K ohms)

MAX. INPUT VOLTAGE 3 V

"LOW" TERMINAL OUTPUT VOLTAGE
- Input to Output: 1 : 1

HUM & NOISE 85 dB

SPECIFICATIONS

CROSSOVER FREQUENCY M/H 3.5, 5 kHz
L/M 400, 800 Hz

SLOPE –12 dB/oct.

DAMPING FACTOR
- High range amplifier: 24 (at 8 ohms)
- Mid range amplifier: 32 (at 8 ohms)

ACCESSORY CIRCUIT Headphones amplifier and jack, channel selector, crossover frequency selector (400, 800 Hz and 3.5, 5 kHz) direct output terminal, and signal through circuit.

1 YEAR WARRANTY COVERAGE

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432 Kent Street, Sydney
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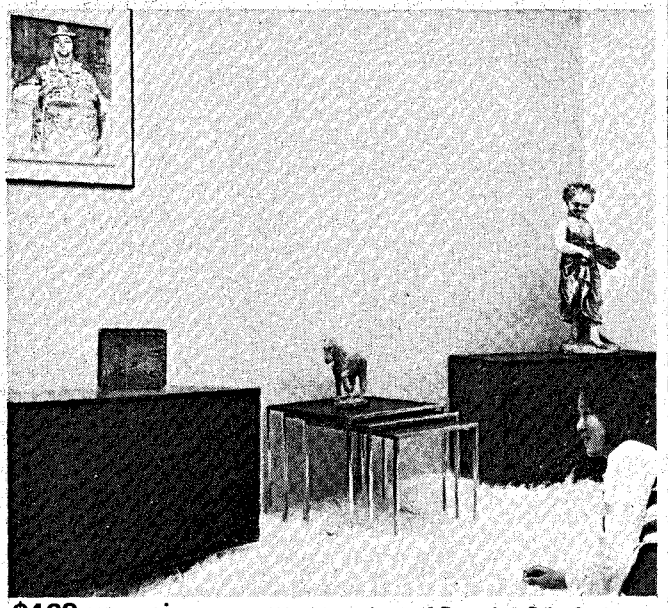
KEF TRANSMISSION LINE SPEAKER SYSTEMS

HIGH QUALITY PERFORMANCE AT A PRICE *YOU* CAN AFFORD

Horizontal model equipped with mid range transmission.

$489 per pair



$462 per pair

Settings courtesy of Brosalco P/L, Sydney

TRANSMISSION LINE SPEAKER SYSTEMS are the sound of the future. Recording techniques are constantly improving as technology develops, and this has brought about the need for superior forms of speaker systems, box-type speakers are no longer satisfactory for the discerning enthusiast. Enter the transmission line speaker, offering vast improvements in bass and midrange response, a truly natural sound.

Transmission line systems are expensive, but KENT HI-FI offers you transmission line speakers, using the same top quality parts found in systems costing over $2,000 for one quarter the price. You have your choice of American walnut or teak finishes (special finishes on application) in either horizontal or vertical styling.

AT LAST! You really can afford the very best.
CUSTOM TRANSMISSION LINE SPEAKERS

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(where the best equipment costs less)
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Phone 29-2743

SPECIFICATIONS
30-20,000.
Power handling in excess of 25w RMS.
Crossover: 400, 3,000 or 400, 3,500 using electronic crossover.

COMPONENTS
woofer-KEF B139
mid-range-KEF B110
Tweeter-KEF T27
Super Tweeter optional

ONE YEAR WARRANTY, LABOUR PLUS PARTS

THE WATERGATE BUGGING

— how it was done, Collyn Rivers reports.

SOMETIME during the second week in June 1972, two men, James McCord and Howard Hunt, entered the Watergate headquarters of the US Democratic Party and installed a number of bugging devices in selected areas.

The two conspirators were subsequently spotted by an alert security guard — and their subsequent trial and indictment triggered off a scandal that has made the late and unlovely President Harding's escapades of the 1920's seem by comparison to be mere peccadilloes.

The main bugs consisted of so-called 'infinity transmitters' and were installed inside each of four telephones inside the Democratic Party's headquarters.

The Watergate infinity bugs were adaptations of the 'conventional' infinity transmitters described in our article on bugging in March 1972.

These bugs enabled all sound within the bugged rooms to be picked up and transmitted to the conspirators' listening station in the Howard Johnson Hotel — just across the road from the Watergate building.

HOW THEY WORKED

A block schematic drawing of these bugs is shown (in simplified form) in Fig. 1. The section that was installed inside each telephone is shown in dotted lines. This section consists of a frequency sensitive decoder that actuates a miniature multi-pole relay. The conspirators used a resonant reed encoder that was switched onto the telephone line *immediately* after the bugged telephone's number had been dialled. This encoder generated a tone (probably 500 Hz) that was detected by the decoder concealed within the bugged telephone. This caused the relay to be actuated which in turn open-circuited the bell ringing circuit and connected the handset's microphone to an inbuilt audio amplifier the output of which was connected to the telephone line.

Thus the bugs, once actuated by the conspirators, picked up all sound within the room and transmitted it to the bugging headquarters — even though the handsets were still on the rests: if a third party tried to ring the number whilst the bug was in use he would receive a normal 'busy' tone.

The conspirators also installed a small microphone and low-power FM transmitter inside a fire alarm smoke detector that was conveniently fitted to the ceiling of the Democratic headquarters. The low-power signals from this unit were received just outside the Watergate building and then relayed by a more powerful transmitter to the bugging headquarters across the road.

The relatively sophisticated bugs described above appeared to be mass-produced. They carried no manufacturer's name — but this lack of identification is normal practice. Certainly, even outside the USA, it is not too difficult to purchase this type of equipment if one is sufficiently determined and can pay the high prices involved. But surprisingly — at least to those who are not aware of the extraordinary amount of surveillance equipment commercially available — most of the electronic bugging equipment used by McCord and Hunt was purchased on the open market. For example the conspirators bought a considerable quantity of communications equipment — transmitters, receivers, microphones, etc. from the Kelcom Division of Bell & Howell. Invoices and shipping documents from that firm show that the equipment was shipped to McCord and his associates on May 26 — about

IF YOU THINK YOUR PHONE IS BUGGED

The Watergate scandal has highlighted a piece of advice we gave to business organizations last year — in view of the recent US experience it is worth repeating.

If you believe that your telephone is liable to be bugged, do not under any circumstances use a direct line into your office.

Instead ensure that your calls are made via your normal company switchboard.

It is virtually impossible to monitor calls made in this way unless the listening post is set up inside the same building.

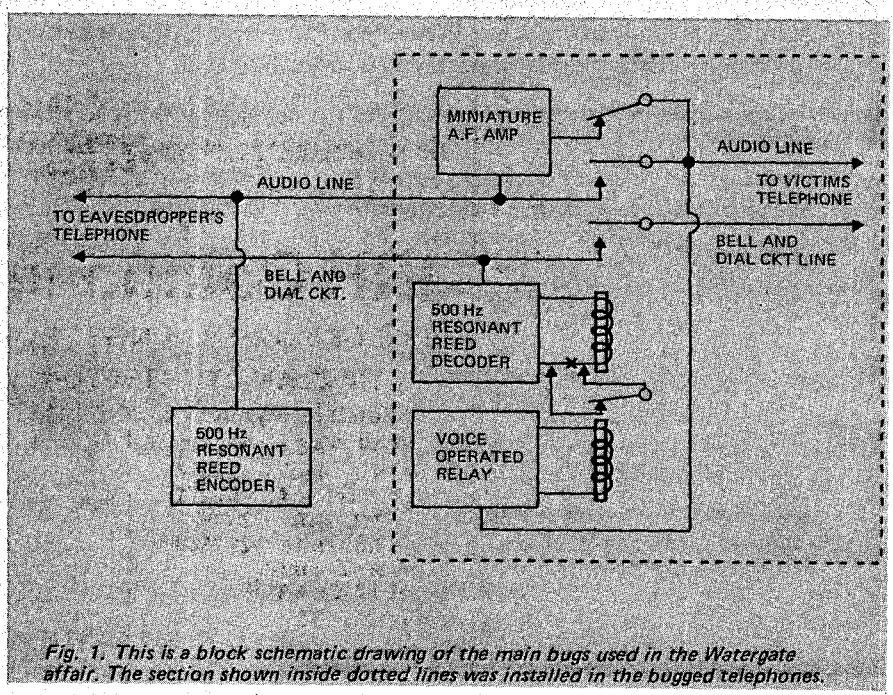

Fig. 1. This is a block schematic drawing of the main bugs used in the Watergate affair. The section shown inside dotted lines was installed in the bugged telephones.

three weeks before the bugs were installed.

Bell & Howell state that the equipment sold to McCord was normal off-the-shelf communications gear. The company does in fact make surveillance equipment but this they stress is sold only to 'bona-fide law enforcement agencies'. They emphasize that they did not make any of the actual bugging units used in the Watergate conspiracy.

Another firm that supplied equipment to McCord was the CEI Division of Watkins-Johnson.

This division specializes in the manufacture of military electronic countermeasure receivers — it is believed that the sale to McCord and his associates was for a type RS 11 wideband receiver. This receiver is a standard commercial item — produced as an offshoot of the company's military equipment — and is available to anyone who wishes to buy one.

The Watergate inquiry is not yet over and it is quite probable that evidence may yet be given which will highlight the ever increasing use of surveillance equipment — not only by industrial saboteurs — but by the FBI, the CIA, the Secret Service, and now it seems at the highest levels of government itself. ●

MAGNETIC LEVITATION

by Dr. Peter Sydenham

Will magnetic levitation replace the wheel?

THE repulsive and attractive forces produced between magnetic poles have been experienced since magnetic lodestone was discovered many thousands of years ago. But on a comparative time-scale, our knowledge of the electric magnet is quite recent. It was only in 1820 that Ampere, Arago, Davy and Henry laid the theoretical and practical foundations of the design of electromagnets showing that they were, in fact, analogous to the permanent magnets already in existence. Forces produced with electromagnets were soon harnessed to build galvanometers, electric-wire telegraphs, generators and motors. Few, if any, worthwhile applications used the force as a suspension.

Theoretical considerations developed by Earnshaw in 1839 proved that it is not possible to site a strong magnetic pole (of either kind — permanent or electric) in a static magnetic field without added positional constraints. This was derived as the consequence that magnetic force increases as the inverse square of the separation between the force source and the magnet. Since then, numerous inventions have been devised attempting to make use of magnets to provide stable suspension, but it is only in the last decade that real success has been forthcoming.

Like poles attract and unlike poles repel, so each offers the possibility of suspending one mass relative to another. If the polarities are opposite (or one pole is a magnetisable material) the magnet hangs, using attraction. The system, however, is unstable, for the closer they come altogether the greater the attractive force accelerating them toward each other — they end up tightly clamped.

Like poles repel, so the suspended magnet would, hopefully, sit above the other magnet. However, our experience shows any slight imbalance about the central position produces an unstabilising collapsing force that increases as the top magnet starts to slide off the top. An alternative suspension uses N-S and S-N pairs in a horizontal direction, as shown with

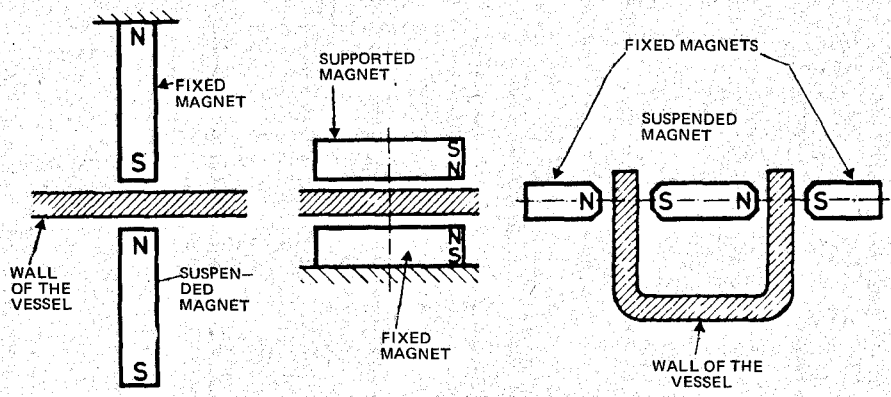

Fig. 1. Three basic alternatives exist for suspending a mass using a magnetic field.

the other alternatives in Fig. 1. This also will be unstable moving to one end or the other.

A unique feature of the magnetic suspension is that a physical (non magnetic) material can exist between the two magnets, a feature not offered by bearings or air cushions.

STABILISING A MAGNETIC SUSPENSION

An obvious way to produce a stable suspension is to incorporate extra devices to obtain stability in the vertical or horizontal directions as needed. These can be, in the repulsive system, low friction guides or more magnetic pairs placed in the vertical plane.

The usual way to stabilise the attractive system uses a servo-control that senses the relative closeness of the two poles (one may be induced by the magnet) using a displacement transducer signal to control the power of the electromagnet attracting the suspended mass. This, therefore, maintains the distance constant and the closed-loop feedback is, in effect, modifying the inverse square law to one having a highly stable region.

The principle is used in a recently marketed chemical balance with microgram resolution. A schematic of the system, having its origins in the work of Professor Gast of the West Berlin Technical University, is presented in Fig. 2. A permanent magnet provides attraction for the majority of the mass of the weighing pan; a control winding provides the

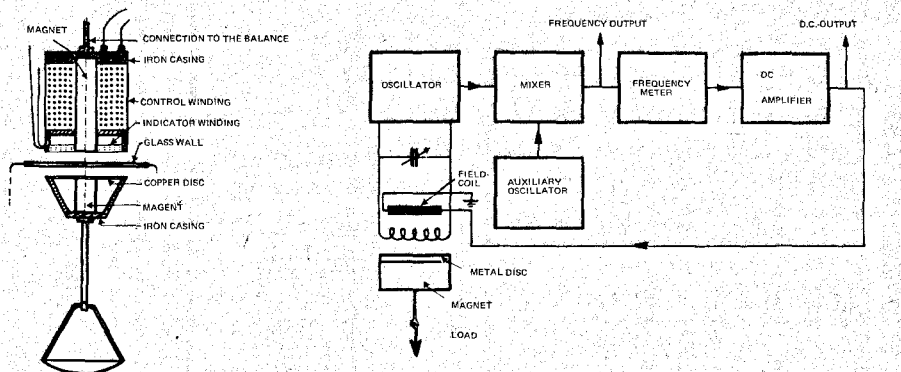

Fig. 2. Cross-section through the magnetic suspension used in a sensitive chemical balance. The schematic circuit arrangement shows how a variable frequency output is obtained and the suspension stabilised.

extra force required, both operating through the wall of the evacuated weighing chamber. The operation is as follows: As the pan moves up toward the magnet coil the copper disk reduces the inductance of the indicator/position-sensing coil. This, in turn, alters the frequency of the sensing tuned circuit providing a variable frequency output related to displacement. Stability of suspension is provided by converting the variable frequency to a direct current that then feeds the control winding, controlling its attractive force. If correctly phased, the feedback causes the pan to remain suspended.

The same setup can be used to measure flow by passing the fluid up against a drag-plate mounted where the pan would be. It can also measure density if the upthrust of the pan is monitored when it is immersed in a fluid. A gravity meter has been constructed using a superconducting suspension coil in this way, the feature of superconductivity being the smoothness of the field strength.

Another instrumentation example using magnetic suspension is the experimental magnetically suspended motor developed by NASA staff. The rotor (see Fig. 3), consists of a suspension cylinder, that rotates as part of the rotor, and imbedded magnets that produce the motor torque when reacted against with an external starter winding. There is no real difficulty with suspending the two ends of the rotor inside the suspension coils for it automatically aligns itself to be in the centre, the position of least magnetic reluctance. Active stabilisation is needed, however, to control the rotor position between the two coils for without it the rotor would pull to one or the other end. Here photocells sense the end of the cylinder controlling the solenoid field strengths so as to retain the rotor midway. A special design of motor was developed to reduce the radial forces experienced in a normal design of motor. The suspension is quite stiff — 20kg/mm, in fact, and the power needs relatively small — around 10W per bearing. This development leads the way to more reliable and more sensitive motors, especially in gyroscope application where the frictional torque of normal bearings provides an unwanted precession torque.

If the inductance of the magnet coil in an ac-excited attractive type suspension is series tuned with a capacitor, movement of the suspended magnetic material alters the resonant circuit current adjusting the suspension force to compensate. But this only holds well enough for a situation where the movements occur slowly or are static. Jayawant and Kaplan of the University of Sussex have continued on from earlier work on suspension design using this method and have researched, with working models, ways to improve the dynamic stability. A solution proposed uses a saturable reactor as shown in a schematic of their system given in Fig. 4. (Russian workers have also reported the use of this tuning idea, but to reduce forces, in a variable reluctance position sensor.)

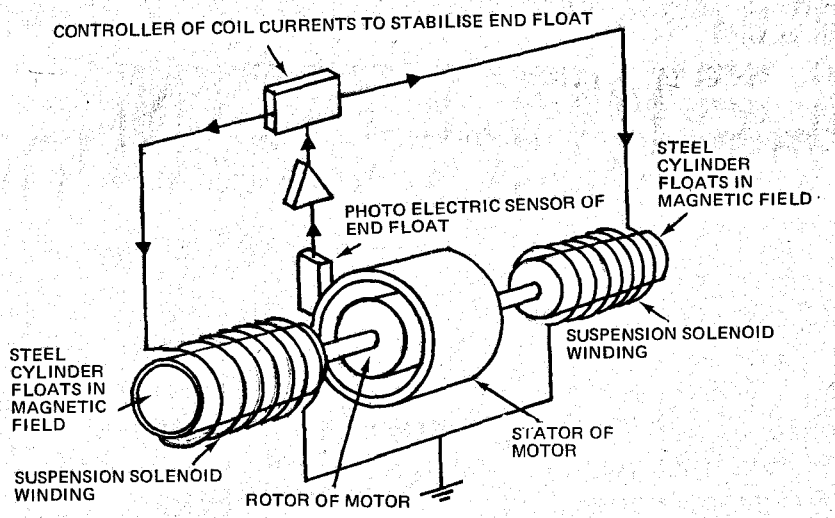

Fig. 3. Arrangement of a motor using magnetic suspensions instead of contact bearings.

There is a notable exception to the Earnshaw theory mentioned earlier: Braunbek showed in 1939 that the introduction of a material having a relative magnetic permeability (μ) less than unity into the field space would result in stable levitation. Diamagnetic materials have μ less than unity — bismuth and carbon being examples. The magnetic forces exerted in this case are, however, only capable of supporting minute loads so it offers little real advantage in normal situations. Superconductors, however, behave as almost perfect diamagnetic material (flux cannot penetrate the skin) so it is possible to provide a stable suspension in special cases without the need for auxiliary devices. A gyroscope, using a superconducting rotor has been built using this principle. Research has also been carried out on the use of levitated superconducting rings to confine plasma.

THE GREAT INTEREST — MAGLEV VEHICLES

We have already seen some of the proven uses of magnetic suspensions but these, although revolutionary, are fast becoming overshadowed by the growing interest in their application for the support of high-speed trains. To appreciate the designs suggested for maglev trains we must first consider the properties of magnetic suspensions when used as a continuous frictionless guided slide rather than as a single point stationary support.

A time varying field, such as that produced by an ac magnet, will produce a counter field that can provide lift. The so called "Foucalt railway" devised by Bachelet in 1912

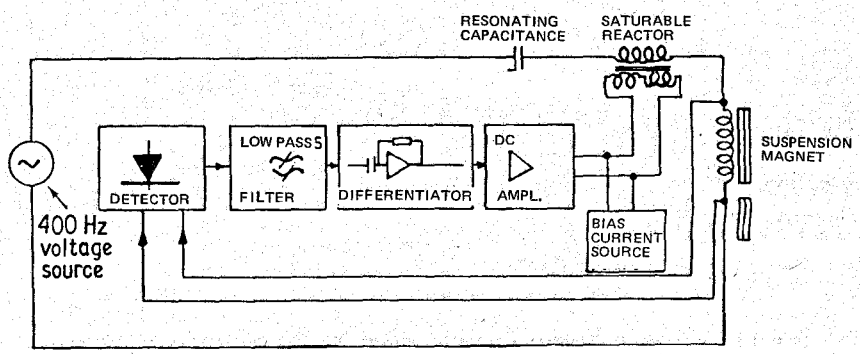

Fig. 4. This arrangement is used to obtain dynamic stability from a tuned ac attracting suspension.

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MAGNETIC LEVITATION

used the eddy currents, induced in a thick aluminium plate by the fluctuating field, to provide a repulsive force between the plate and a continuous row of fixed coils lying along the track of the model system. This method, at the time, had high penalties, namely, excessive power requirements to provide the lift, small gap clearance and costly magnet systems. Consequently up to a decade or so ago, maglev by this method seemed to be a non-starter in a large-scale economic situation.

If, however, the magnet is moving relative to the conducting plate it is possible to make use of Bachelet's idea without the need for ac excitation of the electromagnet. For example, a magnet moving over the surface of an aluminium sheet will induce eddy currents that repel it. In effect, an image magnet is produced as shown in Fig. 5. (You might try mounting a bar magnet on wheels so that it just clears the surface and run it over an aluminium rail or surface – it should lift off as the speed rises.) This principle is now one of the main contenders for levitating trains. Changes in technology, from the 1950s onward, have enabled magnetic levitation to become a practical reality. Initially it was the new found ability to produce high coercivity ferrite permanent magnetic materials of relatively light weight that enabled a number of groups to build and test vehicleses using repulsion between permanent magnets. A cross-section of a scale-model constructed by Polgreen around 1966 is shown in Fig. 6.

The next, and most relevant development, toward efficient maglev systems was the improved capability with superconducting technique – larger and more reliable refrigeration units were developed; unique conducting cables were devised and manufactured that do not lose their superconducting properties until very high magnetic fields are approached.

Superconducting magnets, being 100 times stronger than normal magnets, have the potential advantages that they can produce a suspension clearance ten times greater than normal magnets and that, once set going, the superconducting current only needs topping up at intervals, thus avoiding the need to carry current generating equipment on the train. The first advantage is very real for the cost of producing and maintaining a permanent way rises rapidly when tolerances exceed 10-50mm.

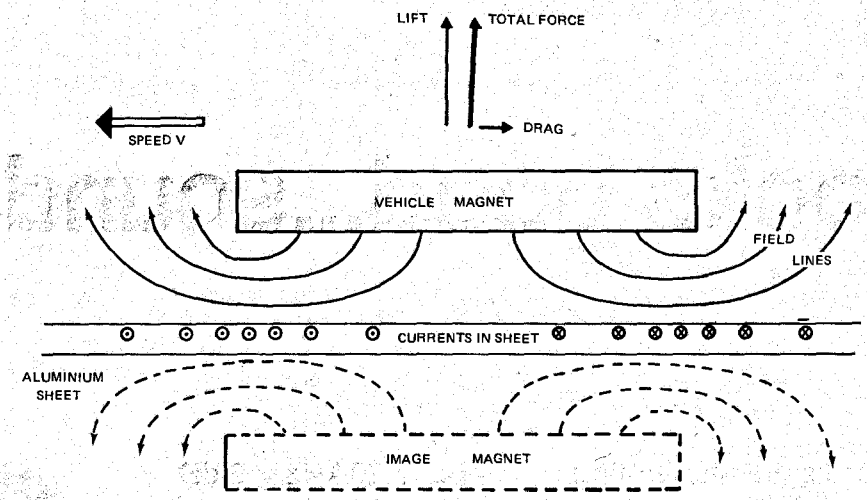

Fig. 5. A magnet moving over a conducting plate produces a field as though an image magnet existed below.

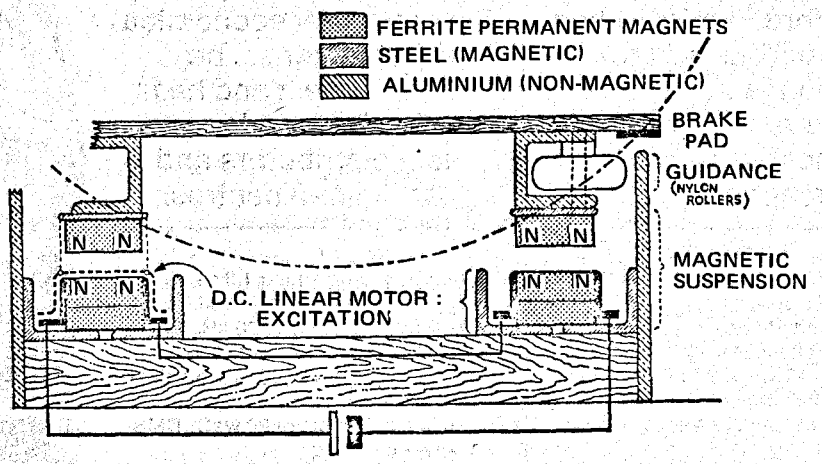

Fig. 6. Polgreen's maglev system using permanent magnets in a repulsive mode.

MAGLEV VERSUS AIR CUSHION

High speed surface transport has become one of the engineering musts of today. Until quite recently it was thought that the only way economically to overcome the friction and track wear problems experienced in high-speed rolling wheel railways (like the Japanese, 200km/h, Tokaido Express) was to use air cushions reacting against the inside of a tunnel or on a continuous concrete box. Indeed, much money has already been expended developing trains like the British Rail Advanced Passenger Transport (APT) unit. On the "for" side of hover trains is accumulated experience, with operational hovercraft carrying from two to hundreds of people. If, however, you have experienced a ride in one (such as the huge SNR1) that carries 200 people and many vehicles, you will, no doubt, agree that the noise and vibration levels are hardly insignificant – ear muffs are recommended for one newly developed air cushion vehicle!

For a while maglev lagged behind, but there is now evidence that it can economically provide a near noiseless operation, as much as fifty times reduction in operating costs of the high speed train, and an intrinsically more reliable suspension principle.

This year will see the real start of British interest in it. Jayawants' group at Sussex, and Rhodes' group at Warwick University, have received around $250,000 each from the Wolfson Foundation to build, to the prototype stage, both the attractive and repulsive maglev alternatives. Already several German private enterprises have made small, low speed systems for evaluation. Maglev vehicles developed by Krauss-Maffei and Messerschmitt-Bulkow-Blohm are shown in Fig. 7.

At this stage in time it is clearly too early to say which is the best for both concepts are not quite as straight-forward as appears on the surface; one of the main problems

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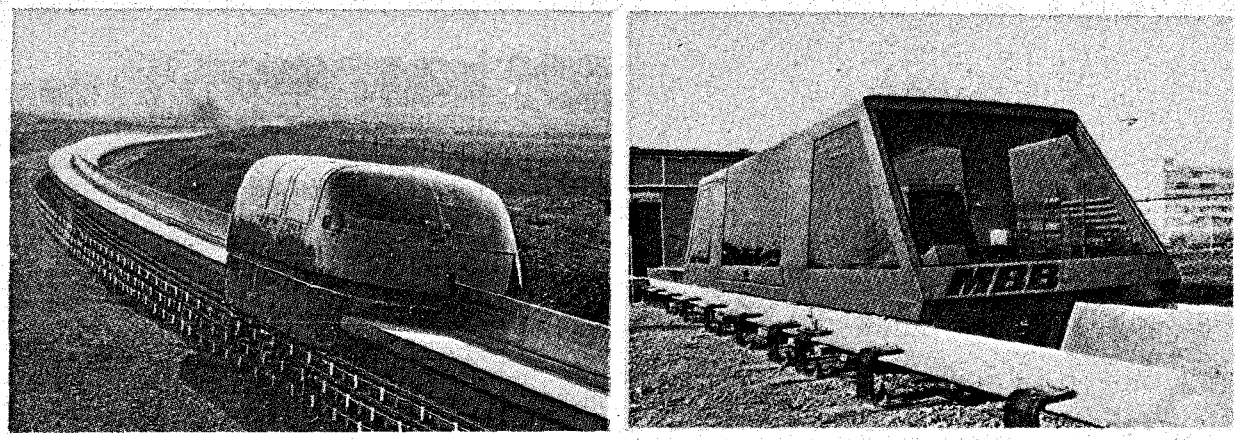

Fig. 7. In Germany these two maglev vehicles have been developed by Krauss-Maffei (left), and Messerschmitt-Bulkow-Blohm (right). Both vehicles are levitated by attractive ferromagnetic forces — the lift magnets being attracted to the bottom of an inverted U-shaped lift rail running along each side of the guide-way. Propulsion is obtained via linear induction motors. Three-phase power is picked up by the vehicles, and after conversion to the required frequency and voltage, is used to drive the linear induction motor's armature. The armature reacts against the vertical aluminium rail that can be seen in the centre of the guide-way.

being the reduction of the magnetic drag force.

THE MAGNETIC DRAG FORCE

The high field strengths available with superconducting magnet coils enables Bachelet's idea to be resurrected as an efficient suspension in which a magnet is moved over a fixed plate. The plate need not be thick provided it is well supported (10mm is envisaged for a 660km/h train), for the flux is unable to penetrate very far into the surface due to the rapid flux movement. Calculations show that a 30 000 kg. 100 passenger train should be lifted about 100mm by superconducting magnets.

In order to exclude the field from the plate the eddy currents must flow to provide the reacting field. These produce ohmic losses that result in a drag force being created that opposes the motion of the vehicle along the track. (The eddy current damper in watt-hour meters makes use of the drag force to slow the movement when power flow ceases). It has been shown theoretically that the magnetic drag force of a conducting sheet rail reduces as the velocity$^{1/2}$ and that it approaches a limiting value. In other words, the faster the train goes the less the increase in drag forces. Even so they are considerable. (It has been pointed out that the aerodynamic drag at high speed could be even more significant). Coffey and others, from the Stanford Research Institute have estimated that a 100 passenger train moving at 660km/h would experience a magnetic drag of 1.5 MW. A section across the maglev vehicle proposed by Coffey's group is given in Fig. 8. Note the simplicity of the levitation and guidance walls: the wheels would provide support at speeds less than 100km/h.

The price paid for using the simple L-shaped track is the high drag-force.

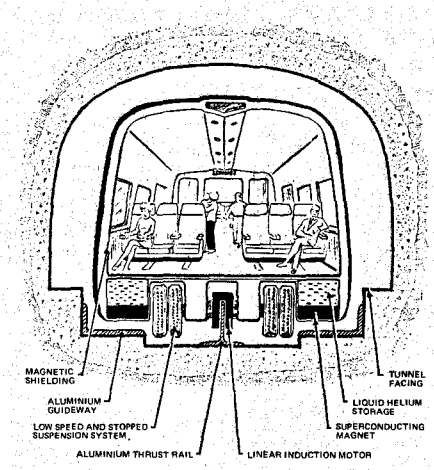

Fig. 8. Stanford Research Institute proposal for a train using the plane sheet suspension.

Another group (Powell and Danby) evolved what is known as the "null-flux" track that consists of loops of conducting material rather than a single flat sheet. Their original scheme (1966), provided levitation from a flat track, in which are embedded loops lying horizontally: mutual induction provides the repulsive lift force. Sideways control would be realised with the field from more loops set in the vertical plane, but not protruding above the top surface. Inside the vehicle could be superconducting loops of alternating polarity. This scheme also must dissipate losses (as a drag force to be supplied by the propulsion motor — the magnet strength is not affected). Their first idea for limiting the drag force was to reduce the loop losses by using series inductors. By 1969 they had realised a better method — the "null flux" concept — which made use of other coil configurations that provided minimized mutual inductance between track and train loops. This could be realised by having the train loop external to the body with a fixed loop

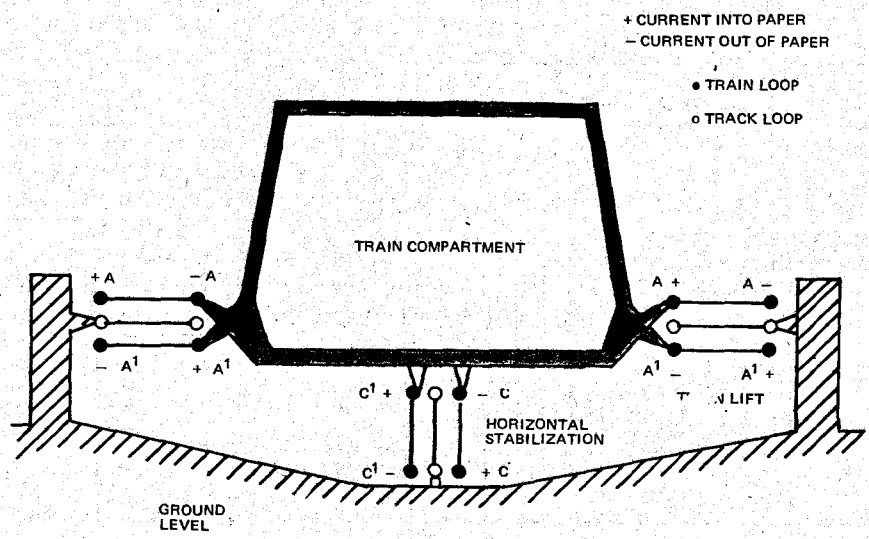

Fig. 9. Cross-section through train suspended by a null-flux loop arrangement of track.

MAGNETIC LEVITATION

above and below it. They also suggested using one group mounted loop, the pair being on the train as shown in Fig. 9.

Sufficient theory has been established for the inducting sheet and null flux methods to be compared. Powell and Danby published curves comparing each in 1971, see Fig. 10. Drag power is reduced to 680 kW for the same example as stated earlier for the conducting plate method. The lift/magnetic drag force ratio is claimed to be increased from nine for the flat sheet to 63 for the recent null flux arrangement. Tables of the characteristics of each are listed in a maglev review by Rhodes (see reading list).

Now the trend seems to be pointing toward vehicles having no power sources aboard. Reasons for this are that it is no easy matter to carry or transfer megawatt powers needed for propulsion at 660km/h and that more payload would be available. The price paid will be the increased cost of the permanent way. Improved ways to transfer power include running a train along the focal point of a continuous linear microwave antenna, electromagnetic coupling between the pickup on the train and the current carrying conductors on the track and, of course, greatly improved brush systems.

We have not discussed the design of propulsion motors that will be used, but it seems assured that they will be some form of linear motor. As both motor and suspension could be electromagnetic it would appear that both might be combined. Laithwaite has done just this. In a release made early in 1973 he proposed a scheme wherein 50Hz powered magnets lift and propel the vehicle.

It is at present uncertain whether maglev vehicles will carry on-board power or not — but one thing is almost sure — that is that it will be maglev vehicles, not air cushion vehicles that lead us into the forthcoming age of high-speed ground transport.

FURTHER READING

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"The Development of a Magnetically Suspended Motor for Altitude Control Devices" P. A. Studer, "Significant Accomplishment in Science and Technology", Goddard Space Flight Center, 1969, 225-229.

"Conversion of Measuring Values for Mass, Density and Flow into Proportional Frequencies with the Aid of Free Magnetic Suspension" T. Gast, IEE conf. pub. No. 43. June, 1968, 74-79.

See also Proc. I.E.E.E. Vol 61 May 1973 (contains a number of papers on magnetic levitation and associated subjects). ●

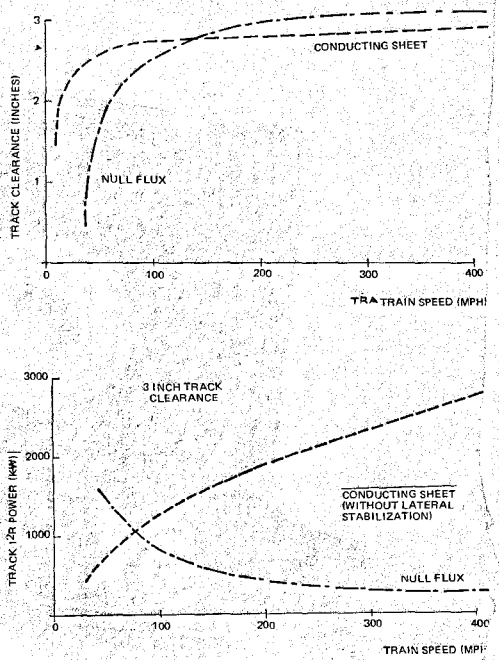

Fig. 10. Curves comparing expected performance of two possible repulsive superconducting maglev alternatives. (a) Lift with speed. (b) Drag power with speed.

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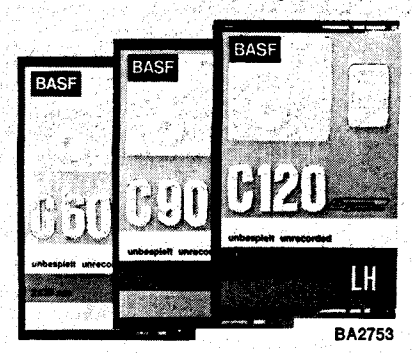

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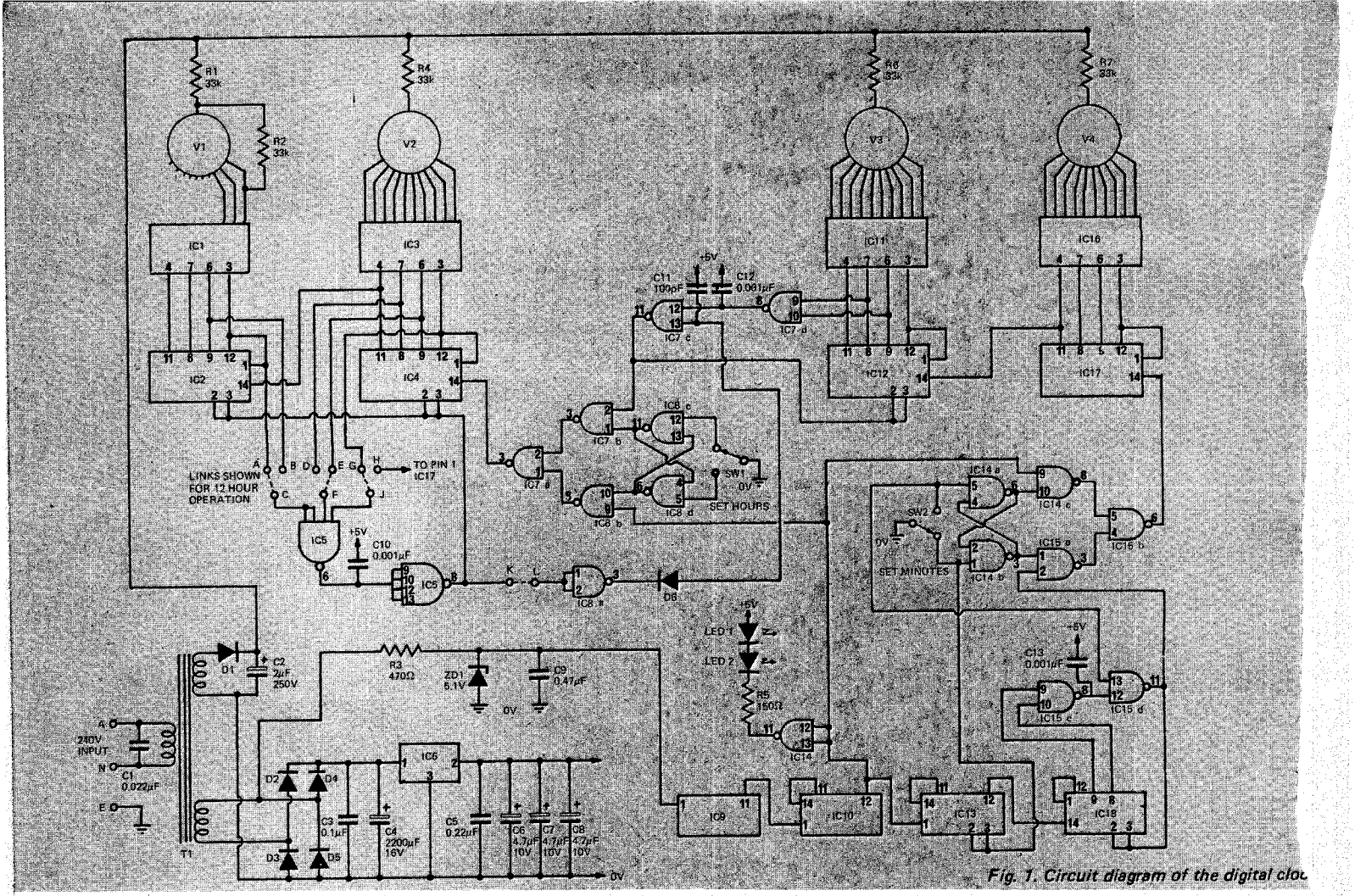

Fig. 1. Circuit diagram of the digital clo

HOW IT WORKS

The 6.3 volt secondary of T1 is bridge rectified to provide 9 volts dc which is then regulated to +5 volts by IC6. The 6.3 volt secondary is clipped by ZD1 to provide 50 Hz pulses which are the prime time reference. Capacitors C2 and C4 are filter capacitors, the rest of the capacitors used in the supply are to reject mains-borne noise which could cause spurious counts causing the clock to gain. These capacitors are essential if accuracy is required. Capacitors C6, C7 and C8 suppress switching transients produced in the TTL logic due to its high speed switching action.

The 50 Hz pulses from ZD1 are divided by 5 in IC9, and by 10 in IC10. This 1 Hz is used to 'set minutes', 'set hours' and to flash the LEDs for seconds indication. IC13 divides the 1 Hz by 10 and IC18 divides further by six, providing a one-pulse-per minute output. IC18 is reset via gates IC15c and IC15d.

Gates IC14a, b, c and IC15a, b select either the 1 PPM for normal operation or the 1 Hz for setting. Gates 14a and 14b are an RS flip-flop which prevents spurious pulses, due to contact bounce in SW2 affecting the clock during setting.

When SW2 is pressed, IC13 and 18 are held in the reset mode so that a full minute elapses after the button is released before the next pulse occurs. This allows accurate time setting.

Gate 14d is connected to the 1 Hz line and drives the LEDs. It acts as a buffer preventing undue loading on the output of IC10.

The minutes counter consists of a 7490 interconnected to divide-by-ten with BCD output with IC16 (a7441) to decode its output and drive the minutes display. The tens of minutes counter is arranged in the same way as IC 18 to divide-by-six. Again a 7441 drives the display.

Gates 8b, c, d, 7a, b and SW1 provide the 'Set Hours' facility by feeding 1 Hz pulses into the hours counters when the button is depressed, enabling the hours display to be set quickly to the correct time. The hours counter is again a 7490 interconnected to divide-by-ten with BCD output and decoded by a 7441, as is also the tens of hours counter.

Recycling at 24:00 hours is achieved by gates 5a and 5b. Gate 5a senses the attempt to change from 24.00 to 24.01 and resets both hours counters to zero, resulting in an actual change to 00.01. If the more conventional transition from 23.59 to 00.00 is desired, simply omit link H–J on the board.

The 24.00 to 00.01 change is preferable but this is not really important if you are not awake to observe it! The only disadvantage with this arrangement is that the hours must be set while the minutes are on an odd number, otherwise the display will not reset at 24.00. This problem does not exist with the 23.59 to 00.00 arrangement.

In he case of a 12 hour clock, IC5a looks for the transition to 13 hours. When this occurs the counter is reset to 00. However what is required is 01. To perform this D6 is connected to the input of IC7.When IC2 and IC4 are reset the input to IC7c is taken low. Capacitor C11 stores this for about 100 nanoseconds after the reset pulse disappears and hence causes a clock pulse to advance the hours from 00 to 01. If the set hours switch is used to drive the clock past 12 hours, 00 will be displayed as in this mode (time reset) the output of IC7c is disabled.

Resistor R2 is used to pull the supply voltage to the '0' of the tens of hours indicator below the tube striking voltage. This prevents the display having a leading zero, eg 01.35. If a leading zero is required simply omit R2. Note that the zero lead to the Nixie cannot be disconnected unless R2 is used as this would cause all the numerals to glow faintly.

NOTES

POWER SUPPLY CONNECTIONS TO THE ICs ARE NOT SHOWN ON THE CIRCUIT. CONNECTIONS ARE AS FOLLOWS.

	+5V	OV
IC1	PIN 5	PIN 12
IC2	PIN 5	PINS 6, 7, 10
IC3	PIN 5	PIN 12
IC4	PIN 5	PINS 6, 7, 10
IC5	PIN 14	PIN 7
IC6	PIN 2	PIN 3
IC7	PIN 14	PIN 7
IC8	PIN 14	PIN 7
IC9	PIN 5	PINS 2, 3, 6, 7, 10
IC10	PIN 5	PINS 2, 3, 6, 7, 10
IC11	PIN 5	PIN 12
IC12	PIN 5	PINS 6, 7, 10
IC13	PIN 5	PINS 6, 7, 10
IC14	PIN 14	PIN 7
IC15	PIN 14	PIN 7
IC16	PIN 5	PIN 12
IC17	PIN 5	PINS 2, 3, 6, 7, 10
IC18	PIN 5	PINS 6, 7, 10

FOR 12 HOUR OPERATION CONNECT THE FOLLOWING LINKS

A–C
F–E
G–J
K–L

FOR 24 HOUR OPERATION WHICH RESETS AFTER 23.59 CONNECT THE FOLLOWING LINKS

B–C
D–F

IF RESETING AFTER 24.00 IS REQUIRED ALSO CONNECT H–J

NOTE THAT FOR 24 HOUR OPERATION D6 and C11 ARE NOT REQUIRED

DIGITIME

ETI PROJECT 521

This digital clock project designed by Graham Bell features 12 or 24 hour operation.

DIGITAL clocks have always been fascinating devices but, until recently have been fairly expensive to build. Nowadays however the price of TTL logic is at rock bottom and such a clock is relatively simple to construct at a price within the capability of most experimenters.

There are in fact a number of integrated circuits on the market containing all the logic for a digital clock in one multiple device. These are expensive (around $30 each) and as they are P-channel MOS devices, are easily damaged by static electricity. If a TTL gate is destroyed accidentally it only costs 50 cents to a dollar to replace — depending on the IC — and such an eventuality is therefore not too traumatic. But a $30 MOS chip — ouch!

Standard TTL has therefore been used in this design and care has been taken to make the unit as flexible as possible, eg 12 or 24 hour operation, and immune to mains-borne noise or other spurious signals.

CONSTRUCTION

Many of the tracks on the printed circuit board are quite thin, therefore epoxy-glass laminate board is recommended to avoid track-lifting. For the same reason care should be exercised when soldering to small component pads. Use a light weight iron and solder quickly and cleanly.

Plastic TO-220-pack uA7805's are not always readily available whereas the TO-3 case version and the LM 309 are. For this reason the heatsink is drilled to accept both types of package. The electrical connections would be made via flying leads in the case of TO-3 versions.

Care should be exercised in orienting the Nixie tubes as some of the leads are terminated off-centre. A washer made from scrap printed circuit board will prevent damage to the glass seals and also helps to seat the tube correctly. Drill the washers to accept the leads as they emerge from the indicator tube. Some of the straps on the board go underneath IC's. These must be placed in position before the

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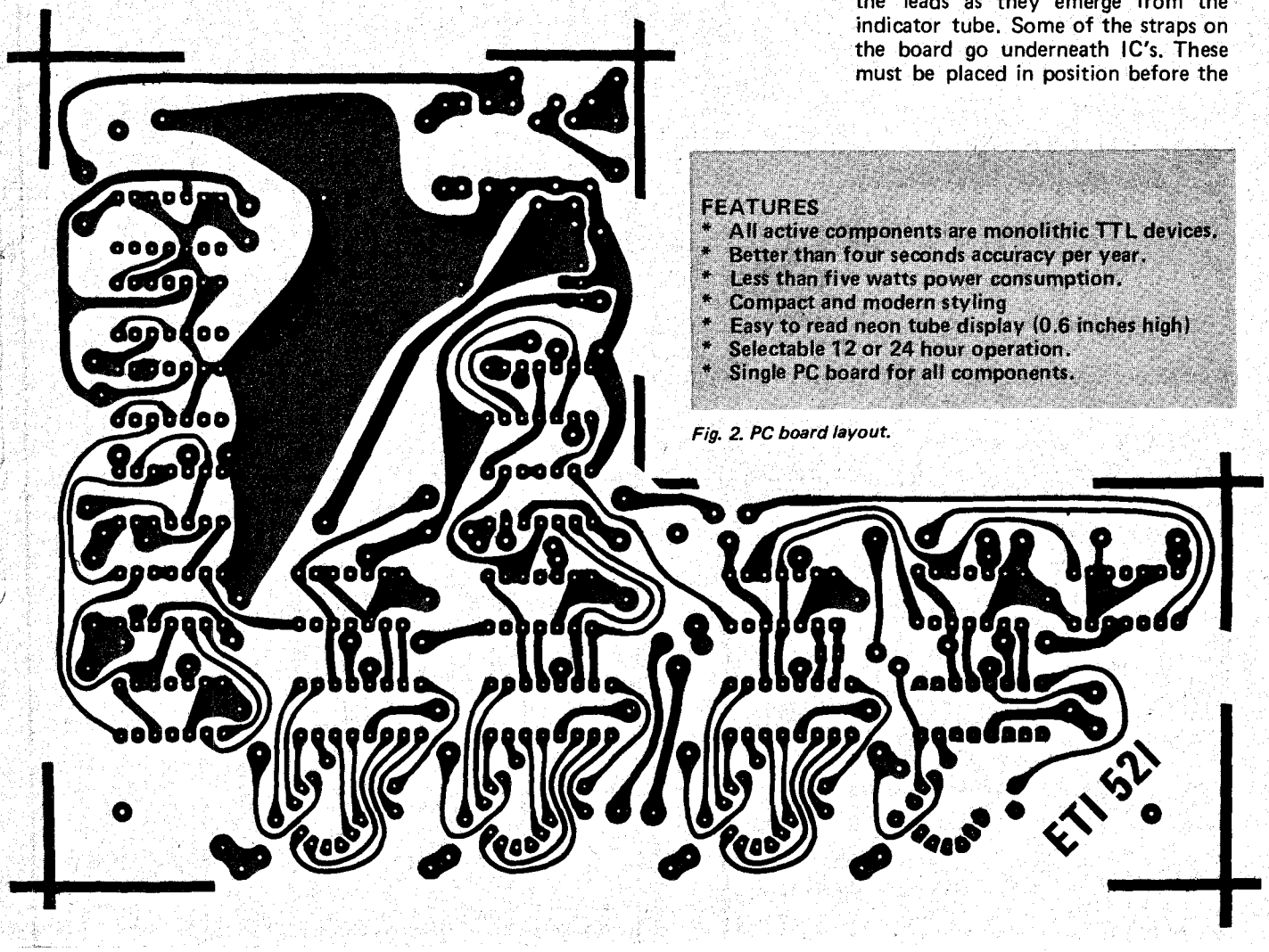
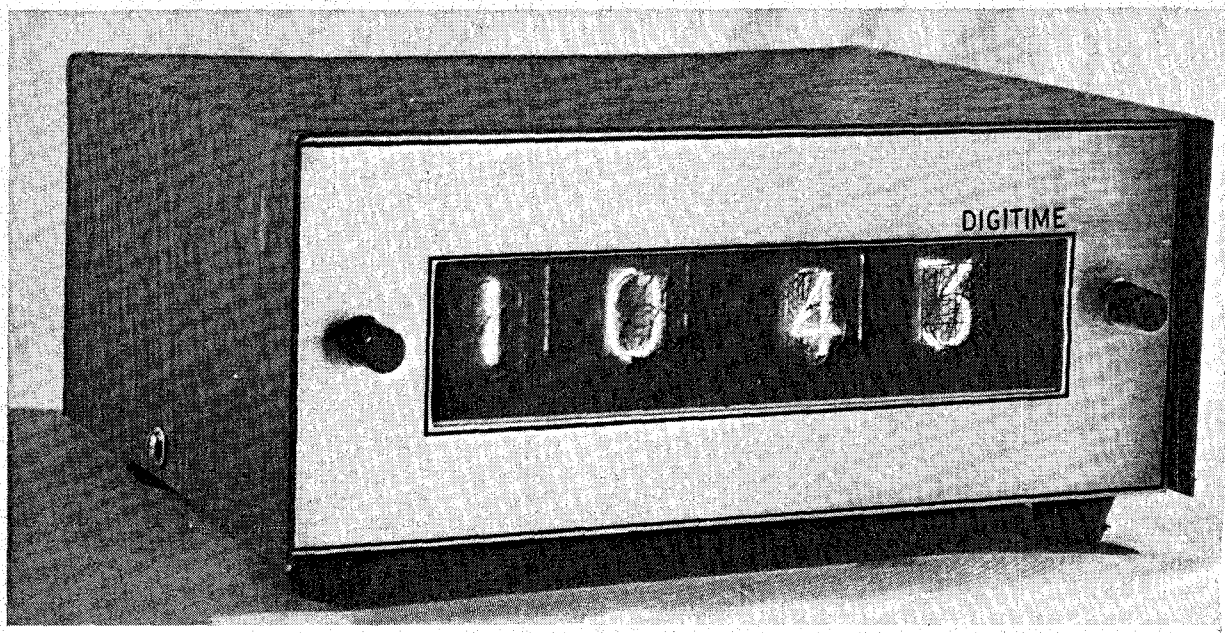


Fig. 2. PC board layout.



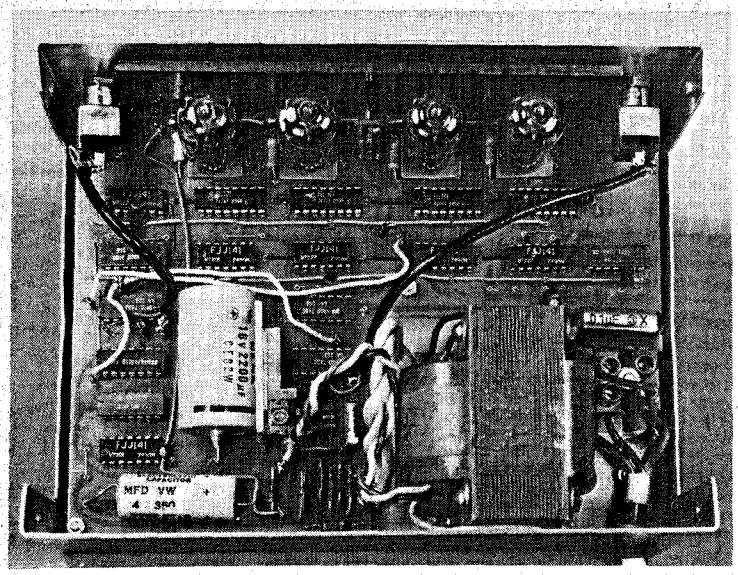


Fig. 3. Internal view of the clock showing the neat and compact construction.

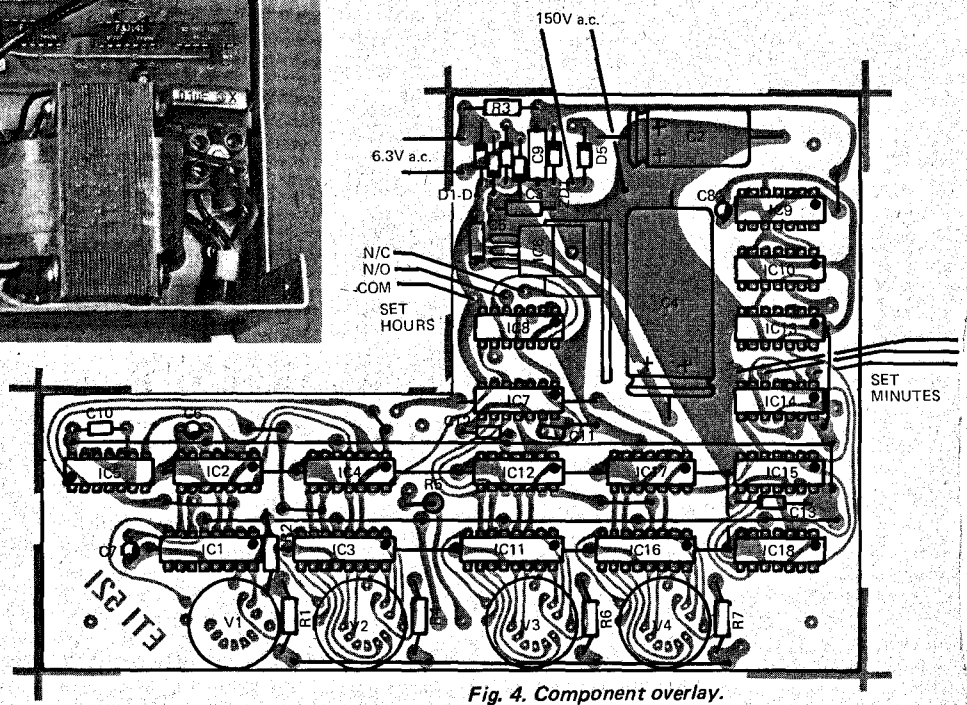


Fig. 4. Component overlay.

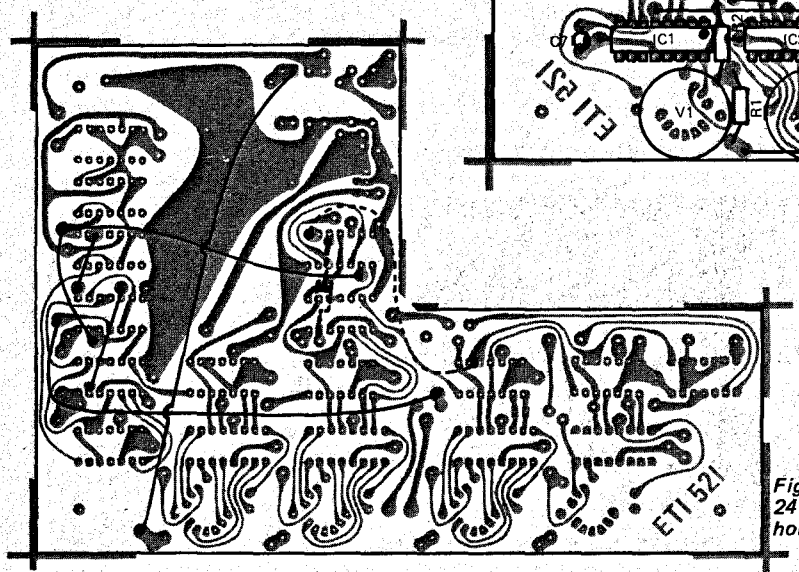


Fig. 5 linking on copper side of board for 24 hour operation (shown solid) and 12 hour operation (shown dotted).

IC's are soldered in place. All straps should be 0.2 mm PVC insulated wire (bell wire).

The earth wire of the mains cord should be terminated at a solder lug under a separate screw and the cord must be clamped upon entry to the case — NOT just knotted!

Make sure that all IC's are correctly orientated before soldering them in place. It is very difficult to remove an incorrectly placed IC without damaging the IC or the printed circuit board. Also ensure that all polarized capacitors are inserted the correct way round.

We found that if the time setting switches were mounted on the front of the clock, visitors could not resist pushing them — hence rear mounting may be preferred. Holes are provided for this in the metal work should you

PARTS LIST — ETI 521

T1 power transformer 6.3 V/1A, 150-0-150V/30mA (one side not used) Ferguson type PF619 etc.
V1,2,3,4 neon indicator tubes (wire in type) GNP-7, CD66, ZM1172,4,5 or similar
SW1,SW2 SPDT momentary contact push button switches
D1 diode EM404 or similar
D2-D5 diode EM401 or similar
D6 diode OA91 or similar
ZD1 Zener diode BZY88C5V1
LED 1,2 light-emitting diode 4403, FLV110, MV5025 or RL-2
IC1,3,11,16 integrated circuit 7441
IC2,4,9,10 integrated circuit 7490
12,13,17,18
IC5 integrated circuit 7420
IC6 integrated circuit 7805 (5V regulator)
IC7,8,14,15 integrated circuit 7400
C1 capacitor 0.022μF 250 volt ac working AEE Miniprint or similar
C2 Capacitor electrolytic 2μF 250 V
C3 Capacitor 0.1μF polyester
C4 Capacitor electrolytic 2200μF 16v
C5 Capacitor 0.22μF polyester
C6,7,8 Capacitor electrolytic 4.7μF
C10,12,13 Capacitor 0.001μF polyester
C11 Capacitor 100pF ceramic
R1,2,4,6,7 resistor 33k ½watt
R3 resistor 470 ohm ½watt
R5 resistor 150 ohm ½watt
PCB ETI 521
One red perspex filter 6" x 1¾" x 1/8", piece of matrix board (for mounting LEDs), metal box as per drawings, front panel, mains terminal block, 4 rubber feet grommett, earth lug, cord clamp, 3 core flex and plug, heat sink (to drawing) 4 by 1/4" brass spacers.

require to do this. For this reason also, the front panel will be supplied without holes for the switches. The holes are quite easily drilled if front mounting is preferred.

SETTING THE CLOCK

First, set the hours to read correctly and then set the minutes one or two minutes slow. Next, either wait for the 'pips' on the radio or use the telephone 'time' service. When you hear either the sixth 'pip' on the radio, or the third 'pip' on the phone, depress the 'Set Minutes' button until the correct time is displayed. In this manner the clock will read within a second or so of the correct time.

Releasing the button while the 1Hz pulse is 'HI' will cause a partial pulse to pass into the counter. This can be misleading. With practice it is easy to release the button when the LED's are off and avoid this problem. ●

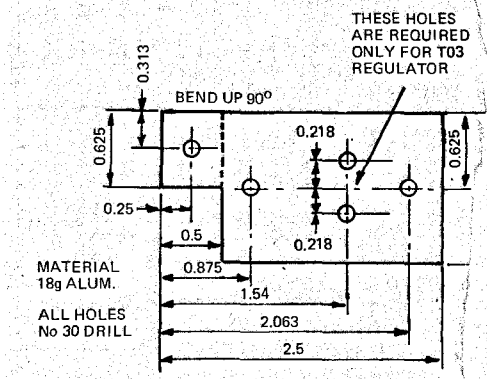


Fig. 8. Detail of heatsink for power regulator IC.

ERRATA

MASTER MIXER ETI 414. In the March 1973 issue windings details for coil L1 as given in Table 1 are incorrect. The number of turns should be 1000 not 100.

Fig. 6. Component side linking for 12 hour operation. This linking must be done before inserting ICs.

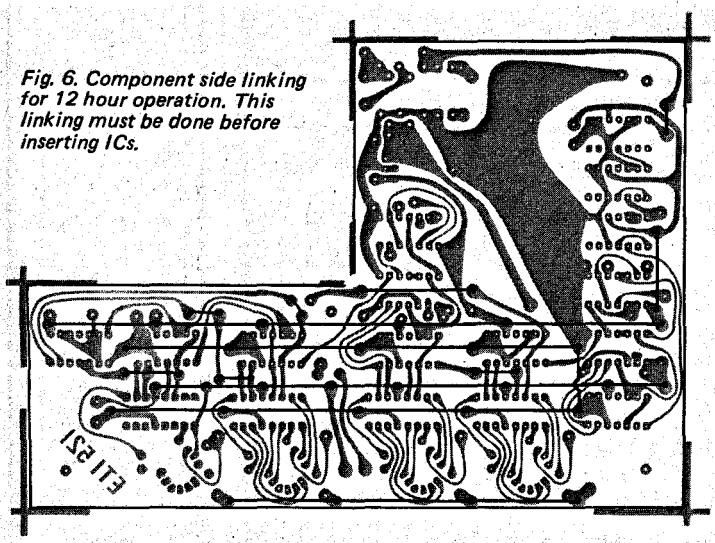
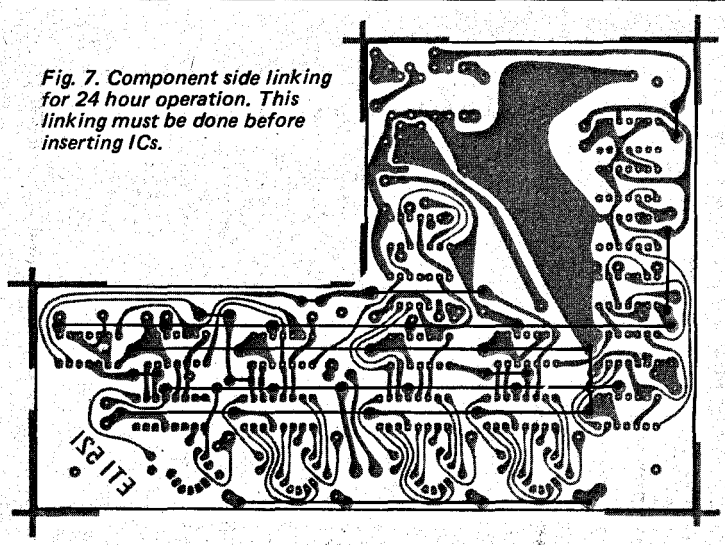


Fig. 7. Component side linking for 24 hour operation. This linking must be done before inserting ICs.



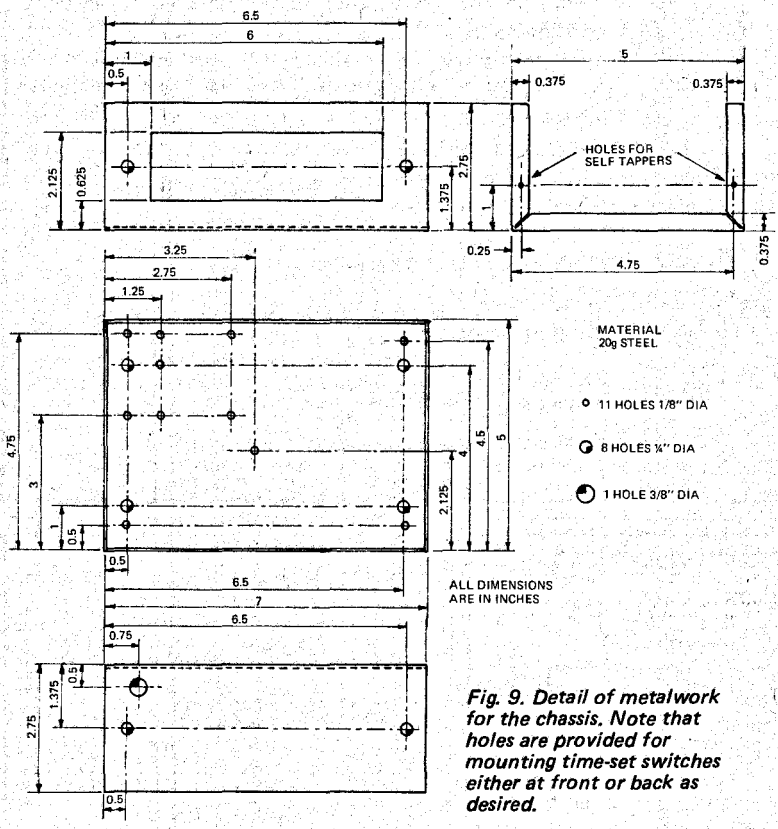


Fig. 9. Detail of metalwork for the chassis. Note that holes are provided for mounting time-set switches either at front or back as desired.

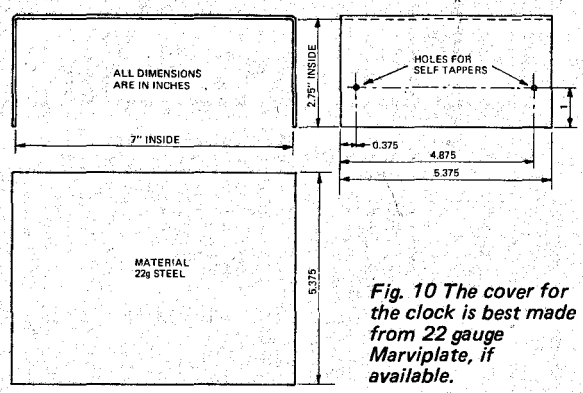


Fig. 10 The cover for the clock is best made from 22 gauge Marviplate, if available.

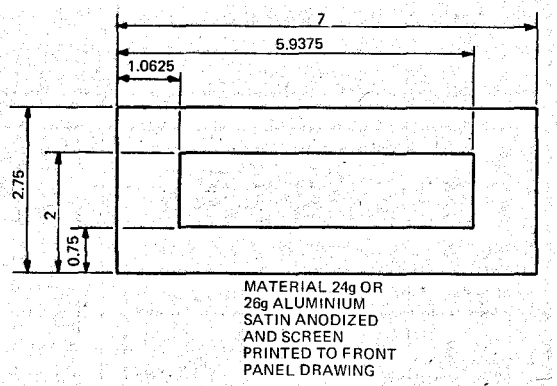


Fig. 12. Dimensions of front panel.

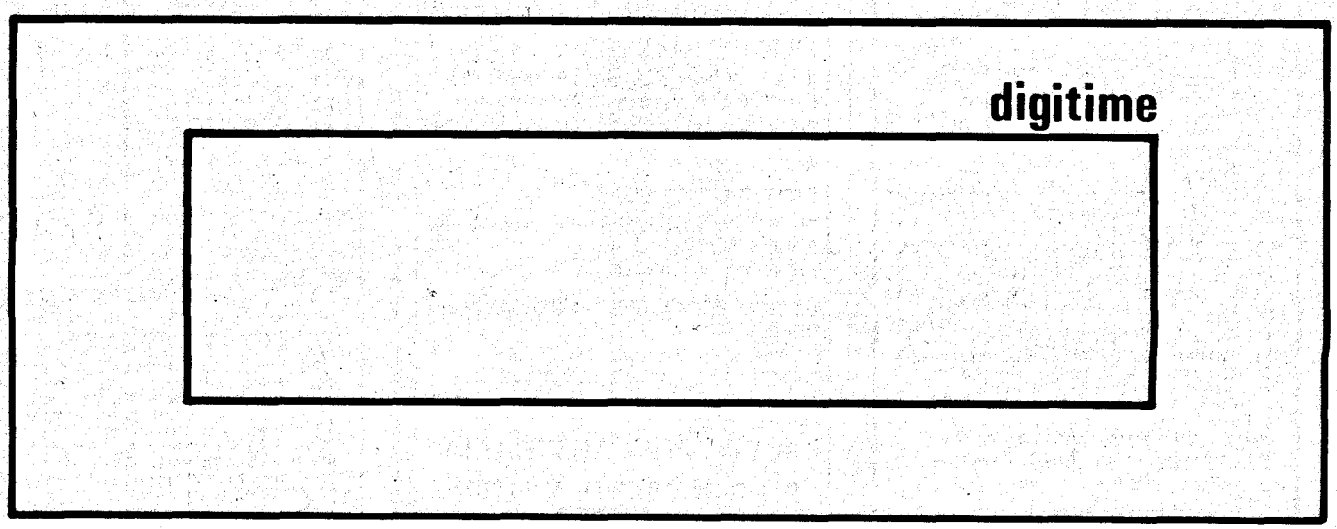


Fig. 11. Artwork for front panel.

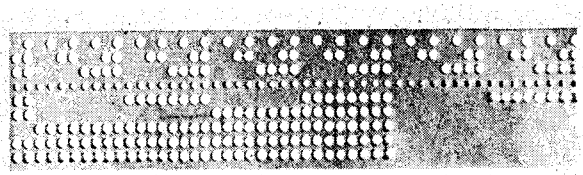
Badly punched tape doesn't faze the Facit 4001 tape reader

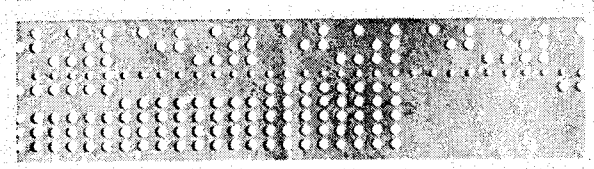
Look at these tapes.

One of them has pitch inaccuracy of +25%, the other of −25%. According to ISO standards, tolerance should not exceed ±0.5 over 50 characters. The majority of tape readers cannot cope with tolerances greater than this. But the Facit 4001 can.

It reads practically every tape, no matter how badly punched it is. Correctly. At a speed of 1000 characters per second. Even completely transparent tapes. Owing to dielectric sensing and capstan tape feed.

If you choose the Facit 4001 you will also get a tape reader that only needs servicing once a year.





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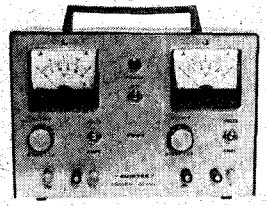

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This is similar to computing a golf score by counting only the best holes. The results look terrific but they don't correspond with reality.

You can avoid this sort of inflation by buying the new Harman-Kardon 630 receiver.

The 630 produces 30/30 RMS watts at less than 0.5% total harmonic distortion from 20Hz to 20kHz, both channels driven simultaneously into an 8-ohm noninductive load at standard line voltage.

Which is more than many 100-watt receivers can say, and that's why they don't. (If the power rating of a receiver isn't phrased exactly this way, you owe it to yourself to be suspicious.)

But the 630 not only gives you more power than so-called 100-watt receivers; it makes better use of the power.

The 630, like our 90-watt receiver (the 930), uses a unique system called "twin power."

Other receivers have only one power source, which lets them function perfectly well with quiet musical passages. But when a sudden tone burst comes along, one channel robs the extra power it needs from the other channel—weakening both and creating distortion in the process.

The 630 eliminates this in-fighting between channels by having an independent power supply for each. So no matter how difficult the musical passage, both channels can handle it flawlessly.

Of course, all of this has a price. Fortunately, it's a moderate one: $398.

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SETTING UP P.A. SPEAKER SYSTEMS

by Bogen Division of Lear Siegler Inc., Paramus, New Jersey.

THERE are four primary considerations when using cone or horn speakers as a part of a PA system. These are the power available to the speakers, the number of speakers, the type of speakers, and the placement and connection of speakers.

The first step is to survey the proposed installation and carefully determine how many and what type of speakers are needed. The following table may be of aid in this respect.

AMPLIFIER POWER	SPEAKERS NEEDED FOR INDOOR INSTALLATION	SPEAKERS NEEDED FOR OUTDOOR INSTALLATION
6 to 8 W	Two 8-in. speakers	One 12-in. speaker
15 to 18 W	Two 12-in. speakers	One trumpet
25 to 30 W	Four 12-in. speakers	Two trumpets
45 to 50 W	Six 12-in. speakers	Three trumpets
60 to 70 W	Eight 12-in. speakers	Four trumpets

There are several types of speakers available, and the choice of speakers depends upon five main factors:

1. Geometry and acoustical characteristics of the area to be covered.
2. Ambient sound level in which the speakers must operate.
3. Fundamental use of the system (i.e. – speech or music reproduction.)
4. Fidelity and intelligibility requirements.
5. Economic factors.

SPEAKER PLACEMENT

The most complex step in speaker installation is their placement and hookup. Conditions under which each system must operate vary so widely with each installation, that only the primary steps are given when considering speaker placement. For indoor systems, two kinds of placements can be used. The speakers may be positioned flat against the walls, and the axis of the speakers rotated so that they radiate energy at an angle from the wall. The speakers may also be positioned in the corners of a room. Variations from these two arrangements must be considered where there are alcoves, balconies, booths, dividing walls, and side rooms. In such cases, extra speakers must be set up to prevent dead spots resulting from unusual reverberations or blanking by obstacles.

For outdoor systems, the main considerations are direction of sound and the area to be covered. Here brute-force is generally used by employing highly-directive trumpets. Bear in mind that subjective loudness drops approximately 45% to 55% below the previous level each time the distance from the speaker is doubled. Also, directivity (amount of power concentrated along the speaker axis) increases with the size of the speaker horn.

SPEAKER CONNECTIONS

When connecting the speakers together, impedance matching and phase relation must be considered.

Efficient transfer of power from the amplifier to the speakers is the prime consideration in a sound system. The two methods of transfer of power are connection from the amplifier directly to the speaker voice coils, and connection from the amplifier to the speaker voice coils through a transformer. The first method is used when short runs of wire not over 200 feet in length and simple speaker arrangements involving low impedances are used.

The second method is used when the wire runs are over 200 feet, when there are complex speaker arrangements, and when it is desired to have less than 15% power loss in the transmission lines. The use of transformers also simplifies impedance

calculations and facilitates changes in complex speaker arrangements.

IMPEDANCE MATCHING WITHOUT TRANSFORMERS

For the most efficient transfer of power, it is important that the total speaker impedances match the output impedance of the amplifier. Single speakers should be matched as shown in Fig. 1.

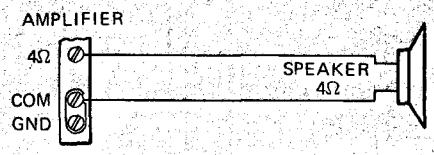

FIG. 1—SINGLE PA SPEAKER is connected like this. Just match the two impedances.

When there is more than one speaker in a sound system, calculations of total speaker impedance are based upon two formulas:

(a) For series connection of speakers, add the individual speaker impedances together to obtain the total matching impedance (see Fig. 2).

$$Z_T = Z_1 + Z_2 \ldots\ldots + Z_n$$

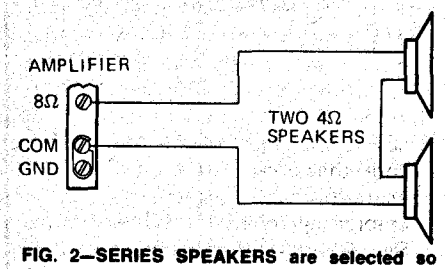

FIG. 2—SERIES SPEAKERS are selected so the sum of impedances matches amplifier.

(b) For parallel connection, add the reciprocal of the individual speaker impedances together to obtain the reciprocal of the total matching impedance (see Fig. 3).

$$\frac{1}{Z_T} = \frac{1}{Z_1} + \frac{1}{Z_2} \ldots\ldots\ldots \frac{1}{Z_n}$$

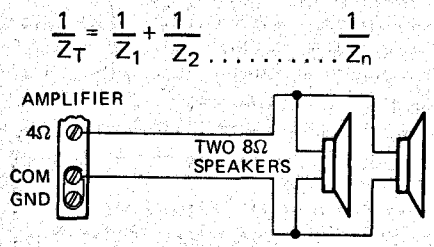

FIG. 3—PARALLEL SPEAKER connections tend to cause excessive line losses.

It is generally not advisable to use more than two speakers in parallel. Operation with less than 4 ohms impedance will result in excessive line losses.

(c) For series/parallel connections, combine the two formulas as the speaker connections indicate. For example, in Fig. 4. apply the series formula for A and B, then for C and D. Take the results of this and apply the parallel formula to obtain the final matching impedance:

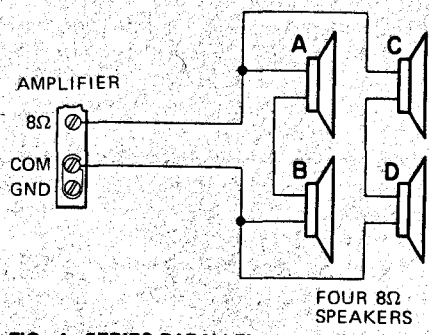

FIG. 4—SERIES-PARALLEL connections may be used to gain desired power distribution.

$$A + B = X \qquad (1)$$
$$C + D = Y \qquad (2)$$
$$\frac{1}{Z_T} = \frac{1}{X} + \frac{1}{Y} \qquad (3)$$
$$Z_T = \frac{XY}{X+Y} \qquad (4)$$

POWER DISTRIBUTION WITH TRANSFORMERS

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 4 ohm speaker will be twice that of the 8 ohm speaker.

In parallel systems of speakers, all with the same voice coil impedances, equal power consumption will result. When speakers of different impedances are connected in parallel, the smaller impedance speaker will receive the greater power. If one speaker is 8 ohms and one is 16 ohms, the 8-ohm speaker will consume twice as much power as the 16-ohm speaker.

When operating speakers on voice coil impedance (without transformer), use as heavy a wire as possible. Speaker cable runs of 100 feet or over should be at least No. 16 wire. Runs from 50-100 feet should be No. 18 wire or larger.

IMPEDANCE MATCHING WITH TRANSFORMERS

The proper use of transformers with speakers far from the amplifier prevents comparatively large power losses in the transmission lines. In complex installations having large numbers of speakers, the use of transformers simplifies power distribution.

Constant-voltage transformers are most commonly used for this purpose, though impedance-matching transformers may be used in some sound installations. The constant-voltage transformer has its secondary tapped for different values of power (watts) for the speaker. The primary matches the constant voltage line, which is either 25 volts or 70 volts.

CONSTANT VOLTAGE SYSTEM

The constant-voltage system was developed particularly for use in large multi-speaker installations, but that does not prevent smaller installations from enjoying its advantages.

The constant-voltage method greatly reduces the amount of computation necessary to determine the proper transformer taps when varying sound levels are required. It also permits the addition to, or changing of, an existing system without recalculation of the total impedances and the power required.

A favorable load condition exists if the total power consumed by the loudspeakers is always less than or equal to the amplifier rating.

When the constant voltage transformer taps are marked in watts:

1. Choose the transformer with a matching secondary (8-ohm secondary for an 8-ohm speaker).
2. Select the power tap desired, and connect to speaker.
3. Connect the constant-voltage line to the primary.

If the transformer is marked in impedances, the required power can be determined by applying the formula:

$$Z = E^2/P$$

Where Z = Required transformer impedance in ohms, E = Amplifier output voltage (25 or 70 volts) and P = desired power at the speaker in watts.

MISMATCHING SPEAKER TO AMPLIFIER

Mismatching upward (connecting an 8-ohm speaker to the 4-ohm output of an amplifier) will decrease the power delivered to the speaker. Power loss will be about proportional to the upward impedance mismatch (50% when connecting an 8-ohm speaker to a 4-ohm amplifier tap). Mismatching cannot ordinarily damage a well-designed amplifier.

As a general rule, no serious frequency response deficiency will be noted if upward mismatches up to about five-to-one ratio are used.

Downward mismatching (connecting a 4-ohm speaker to an 8-ohm amplifier tap) should be avoided. It will reduce the amplifier power output and overload the output tubes or transistors, seriously affecting their life and performance.

PHASING SPEAKERS

When more than one speaker is used in a sound system installation, it is advisable to phase the speakers to reduce the cancellation effect. Speakers out of phase lose up to

SETTING UP P.A. SPEAKER SYSTEMS

one-half of their normal volume and operate with *degraded* tone quality and increased distortion.

For speakers facing in the same general direction, the speakers are in phase when their respective diaphragms move outward and inward at the same time. With two speakers facing each other, proper phasing is achieved when the diaphragm of one speaker moves outward as the diaphragm of the other speaker moves inward.

Phasing is done by checking the polarity of the speaker terminals with respect to the movement of the speaker diaphragm, and connecting the speakers to produce the diaphragm movement or phasing desired. With loudspeakers of the same make and model, the respective diaphragms should move in the same direction when the terminals are connected in the same manner, but it is safer to check the polarity.

Where different speakers are used, carry out the following procedure to determine the diaphragm movement with respect to the speaker terminals for speakers connected in parallel:

1. Connect one lead from a 1.5-volt dry-cell to one voice coil terminal of the speaker.
2. Momentarily touch the other lead from the dry cell to the other speaker terminal.
3. Observe direction of cone or diaphragm movement (either inward or outward) when the circuit is closed.
4. Note this direction of the movement on a slip of paper.
5. Mark the terminal connected to the positive pole of the dry cell if the movement is outward, mark the terminal connected to the negative pole if the movement is inward.
6. Repeat steps 1 through 5 for other speaker or speakers to be checked.
7. Connect the marked and unmarked terminals according to the manner of electrical arrangement shown in Fig. 5 if the speakers are facing in the same direction. If the speakers face each other, make connections as shown in Fig. 6.

In simple sound systems, it may be easier to check phasing by listening to a low audio frequency while alternating the speaker leads. The human ear can usually detect when the low frequency sound is at the higher volume, indicating that the speakers are properly phased.

BALANCED LINE CONNECTIONS

In most sound installations, unbalanced speaker lines will provide satisfactory performance. A typical unbalanced line installation for a 25-volt system is shown in Fig. 7. Two-conductor unshielded cable is normally employed in such installations. One conductor is connected to the 25-volt terminal on the amplifier output strip. The other wire goes to the common terminal, which is then connected to ground.

However, in more elaborate systems where input lines are run in close proximity to the speaker lines for extended distances, currents in the speaker lines may be picked up by the

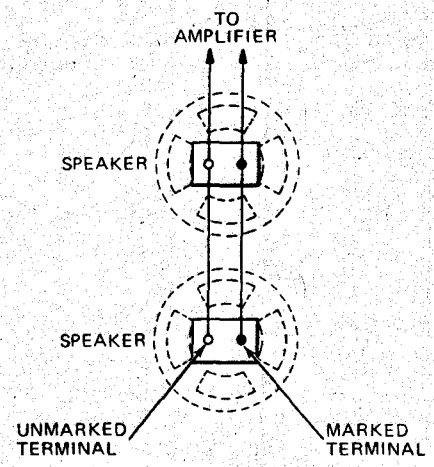

FIG. 5—PA SPEAKERS facing same way are phased with like terminals wired together.

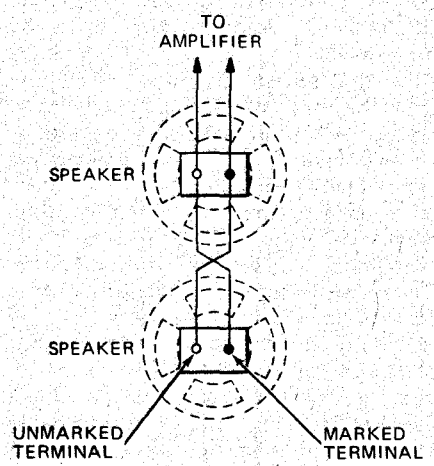

FIG. 6—SPEAKERS FACING EACH OTHER have line transposed for in-phase operation.

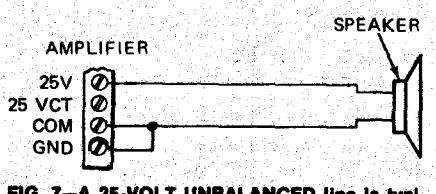

FIG. 7—A 25-VOLT UNBALANCED line is typical. Balanced lines are for special cases.

input lines. When these stray currents are fed back to the amplifier, hum and crosstalk will be introduced into the system, or the amplifier may oscillate.

For this reason, balanced line connections are recommended for installations in which long input and speaker lines are run close together. A balanced line is obtained by under-grounding the common terminal, leaving the outputs floating. In a balanced line, any current which is developed in one side of the line is offset by an equal and opposite current in the other side. This greatly reduces the possibility of inducing stray currents in nearby input lines.

In some balanced line installations, it may also be necessary to connect the appropriate centre-tap terminal to ground, and to ground the amplifier chassis.

If hum or other pickup is encountered with a balanced line as described above, it may be necessary to run a shielded two-conductor cable to the speakers and to ground the shielded two-conductor cable to the speakers and to ground the shield at the amplifier end.

SOUND COLUMN SPEAKERS

Sound columns are designed for sound reinforcement in theatres, auditoriums and arenas where it is necessary to cover a large area with a minimum number of speakers. A sound column consists of six or more cone loudspeakers enclosed in a rectangular cabinet lined with acoustic material. Depending on the size and type of cone speakers employed, the output rating of a sound column may range from 25 to 200 watts. The terminal strip and sometimes a plate for mounting a line-matching transformer are located on the rear panel.

The arrangement of the speakers in the column is such that their acoustic output adds up in the forward direction, so that the effective throw of the sound column far exceeds that of the individual cone speakers. The effective throw or maximum distance at which sound from the column is distinctly audible is usually between 100 and 200 feet.

Because of its configuration, the sound column produces a highly directional beam pattern, which permits the sound to be aimed over a well-defined area of the installation site. Since about 90% of the acoustic output of the column is confined to this pattern, there is virtually no random sound available to cause reverberation or reflection. Consequently, a sound column can be properly directed to cover a hall or section of a hall most effectively and to keep harmful reflections away from the floor and ceiling.

In addition, the geometrical configuration of the speakers in the column produces a sound dispersion pattern which is quite broad in the horizontal plane but much narrower in the vertical plane. In a typical sound column, the horizontal dispersion pattern is 120°, which is a great deal more than that of the individual

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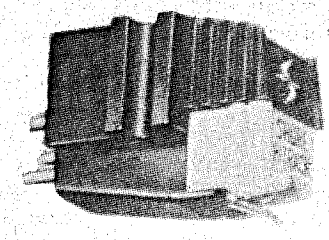

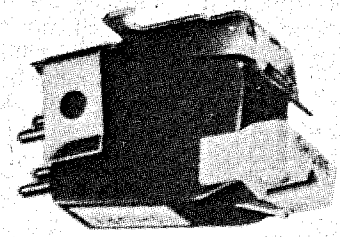

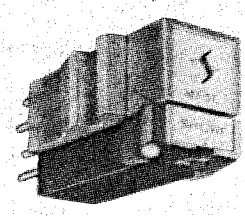

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SETTING UP P.A. SPEAKER SYSTEMS

speakers. However, the cumulative effect of the in-line speakers produces a vertical dispersion pattern of approximately 25° as shown in Fig. 8.

PLACING SOUND COLUMNS

A typical sound column installation is shown in Fig. 9. The sound column is placed in the general vicinity of the original sound source (singer, speaker), as close as practicable to the source. Having the loudspeaker sound originate near the original source provides a more natural effect for the audience, and avoids confusing the performer.

The column is placed so that the microphone is below and slightly behind the sound column, to minimize feedback. The sound column is oriented so that its vertical distribution will deliver nearly equal minimize feedback. The sound column is oriented so that its vertical distribution will deliver nearly equal loudness to all listeners, from front to back, except those who are within the effective range of the speaker's voice.

A sound column can be aimed quite accurately at this point by the light reflection method. Attach a small mirror to the face of the column centre. Standing at the aiming point with a light directed at the sound column, have the column adjusted for maximum light reflection from the mirror.

CONNECTING SOUND COLUMNS

One or more sound columns may be connected to an amplifier in a sound system. The columns are normally connected in parallel as shown in Fig. 10.

Sound columns normally have an impedance rating of 16 ohms. If only one sound column is used, connected the amplifier leads to the 16-ohm output terminal. For two sound columns in parallel, connect the lead to the 8-ohm terminal.

There you have it, a quick guide to PA speaker installation — use it to simplify your next PA job. ●

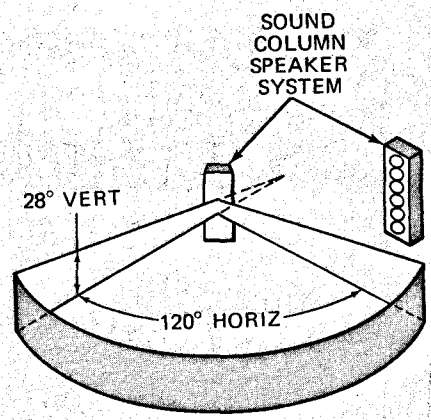

FIG. 8—RADIATION PATTERN from a vertically oriented sound column is horizontal.

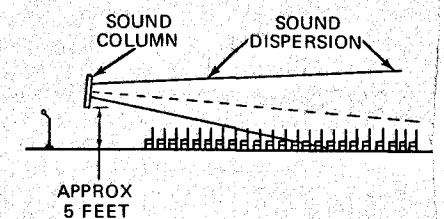

FIG. 9—HOW SOUND COLUMN IS PLACED for most effective coverage of an audience.

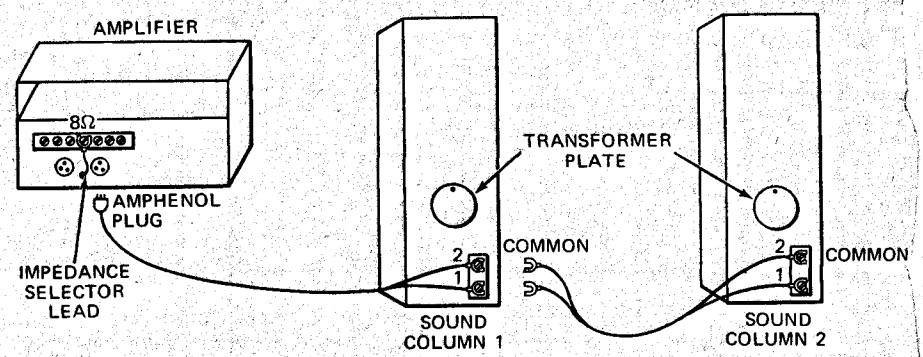

FIG. 10—ONE WAY to connect sound columns to PA amplifier system. Here two 16-ohm columns are in parallel across the amplifier output adjusted for an 8-ohm load impedance.

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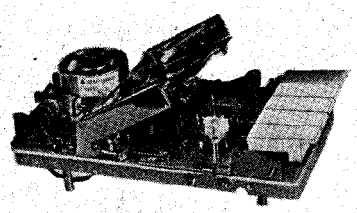
STEREO CASSETTE DECK



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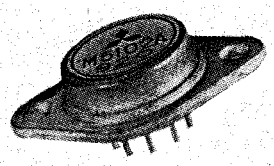

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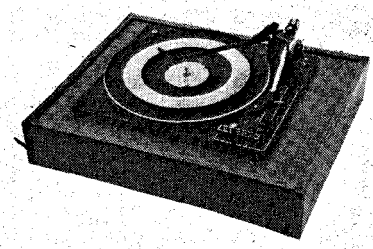

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8J	8"	8, 15	12.0W	75 – 7000	$7.16
8SI	8"	3.5, 8	6.5W	105 – 8000	$5.93
12J	12"	8, 15	12.0W	65 – 7000	$10.22
Oval					
64SI	6" x 4"	8, 15	5.5W	105 – 6500	$5.09
75SI	7" x 5"	8, 15	6.0W	105 – 10,000	$5.44
96SI	9" x 6"	8, 15	7.0W	95 – 7500	$5.85
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64SIX	6" x 4"	8, 15	5.5W	105 – 14,000	$6.04
6JX	6½"	8, 15	10.0W	35 – 14,000	$7.16
75SIX	7" x 5"	8, 15	6.0W	105 – 14,000	$6.50
8JX	8"	8, 15	12.0W	35 – 14,000	$8.60
96SIX	9" x 6"	8, 15	7.0W	65 – 14,000	$6.85
12JX	12"	8, 15	12.0W	35 – 14,000	$11.50
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3TC	3½"	8, 15	15 R.M.S.	5000 – 18,000	$4.07
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PT5579	6.3V	1A	$3.69
PT2150	6.3V or 12.6V CT	2.5A or 1A	$4.60
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PT5721	37.5-0-37.5V	750mA	$9.26
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NEW MICROWAVE RECORD

As announced last month, Dick Norman VK2BDN and Bill Cox VK2ZAC set a new distance record for the 2300 MHz band of 53.5 miles.

This record has since been broken by the same team and it now stands at 100.5 miles. On the weekend of 19th and 20th May, Dick and Bill set the new record from portable locations. VK2BDN was located at Mount Gibralter near Bowral, 2830 feet above sea level and VK2ZAC at Mt. Kulmura, 1180 feet above sea level.

The path is not an optical one, the curvature of the earth interfering with it. Despite this, signals were R5 S8 with some fading, signals becoming strong and noise free at times.

Equipment used was the same as listed last month. Briefly:— 4ft dish antennas used at both sites, approximately 2 watts output on 2304 MHz, Diode mixer converters, NBFM modulation.

Both VK2BDN and VK2ZAC intend to continue this work in the spring and summer months with a view to extending the distance beyond 200 miles.

OSCAR NEWS

By the time you read this, OSCAR 6 will have successfully completed over 3000 orbits — a remarkable achievement for such a project and a credit to all responsible.

The heavy load on the satellites power supplies during weekends has necessitated changes in the commanded ON times. The new schedule allows for the satellite translator to be on Thursday, Saturday and Monday night, and Friday, Sunday and Tuesday mornings (local time), thus giving the solar cells adequate time to recharge.

OSCAR 7, due for launch next year, will contain a wider range of equipment than OSCAR 6, it will also have a greater power output which will extend both the range and versatility of the experiments which can be carried out.

Those who wish to keep in close contact with current satellite developments should consider subscribing to the AMSAT Newsletter. Their address is Membership Committee, AMSAT, P.O. Box 27 Washington DC 20044. USA.

These notes were supplied by Alan Hennessy VK2RX, the NSW state OSCAR Co-ordinator.

ADVANCED CONTEST

Contests of one sort or another are an established tradition in amateur radio. However, the concept of a contest to encourage the use of advanced communications techniques and those propagation modes which are rarely exploited is quite a new one.

Originally postulated by David Tanner, VK8AU (now VK3AUU) in 1971, the contest set out below is a modification of David Tanner's idea.

Basically it is designed to encourage use of marginal forms of VHF and UHF communications by the simple expedient of disallowing contacts via such propagation modes as Sporadic-E, Transequatorial and F2 propagation, ducting etc. and prohibiting use of net channels, repeaters and translators for claiming points. In order further to encourage state of the art techniques, minimum distances are specified, these being based on the normal range of 'beginner' type stations.

The contest is sponsored by 6 UP magazine and further details can be obtained by writing to the Editor, Roger Harrison, at 47, Ballast Point Rd. Birchgrove, 2041.

As a token of its belief in the value of this contest, Electronics Today International has donated a Dick Smith Electronics purchase voucher to the value of $50 that the winner may spend on components or equipment of his choice.

RULES

1. DURATION 0000hrs 16th July to 2400hrs 5th August 73. (All times EAST).
2. There is one division ... Transmitting, Open.
3. All Amateur Stations may enter, whether fixed, portable or mobile.
4. All VHF and UHF bands may be used, but cross-band contacts are prohibited. Cross-mode contacts are permitted.
5. Only one contact per band per station is allowed for each calendar EAST day.
6. Entrants must operate within the terms of their licences.
7. Before points may be claimed for a contact, serial numbers must be exchanged. The serial numbers of five or six figures will be composed of RS (telephony) or RST (telegraphy) report plus three figures, commencing at 001 for the first contact and increasing by one for each successive contact.
8. On the 52MHz band, contacts via the modes generally referred to as sporadic E and transequatorial propagation will be disallowed. The Editor (of 6UP) reserves the right to adjudicate doubtful cases. Contacts over distances below 50 miles on the bands 52 to 450MHz will be disallowed as will contacts below 25 miles on bands 576MHz and above. Contacts on net frequencies or through repeaters and on translators, including satellites, will be disallowed.
9. Scoring for all contacts will be based on mileage multiplied by a factor dependent on the band being used, as follows: The maximum score allowed for an EME contact will be 2000 points.

BAND	FACTOR or MULTIPLIER
52MHz	1
144MHz	2
432MHz	4
576MHz	6
1215MHz	12

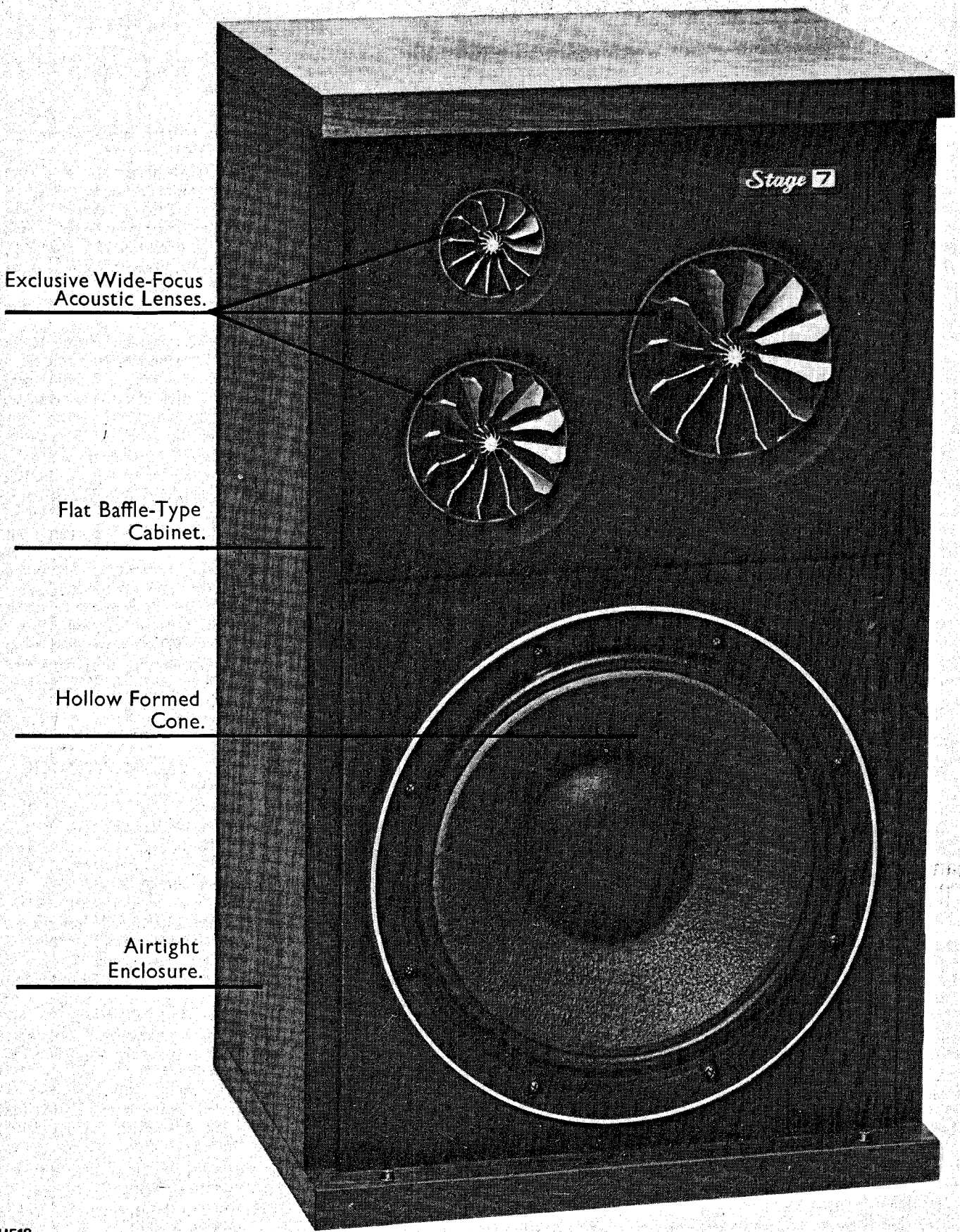
Each log entry must show the claimed mileage and score. In the event of two stations disagreeing on mileage and the average of the two estimates will be taken.

10. All logs must contain the following information: Date and time (EAST), Band, Emission, Power, Call sign worked, Serial No. sent, Serial No. received, Distance, Points claimed.
11. Entries and logs should be forwarded to reach the Editor (of 6UP) on or before Friday, 14th September, 1973.

Send entries to:

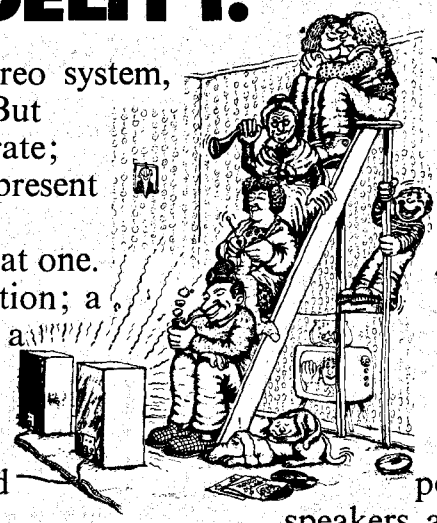
The Editor, 6UP,
47 Ballast Point Rd.,
Birchgrove 2041 NSW.

THE SILVER WHIRLY THINGS ARE CORAL'S WIDE-FOCUS ACOUSTIC LENSES.



LH518

IF YOUR SPEAKER DOESN'T HAVE THEM, YOU COULD BE GETTING A PRETTY NARROW VIEW OF HIGH FIDELITY.



You're a prisoner of your stereo system, and you don't even know it. But it's an easy matter to demonstrate; where do you sit to hear your present system at its best?

You know the answer to that one. There's virtually only one position; a narrow area at the apex of a triangle formed by you and your speakers. Move back beyond it, against the wall or out to the corners and the sound starts to blur.

That's why we say you could be getting a narrow view of high fidelity. You're restricted, terribly, because many speaker systems send the high frequencies out in a narrow cone.

The cone doesn't reach the corners of the room, and consequently your seating position is ruled by where the cone of high frequency sound can reach.

What the acoustic lenses of the Coral Stage Series do is to open out the high frequency cone so the full quality can reach you wherever you're sitting. It makes it a lot easier to entertain, and you know that so long as the ears are up to it, everybody in the room can hear true stereophony, or even quadrophony, as it was meant to sound.

Take the Coral Stage 7, for instance. It can give you frequency response from 25–20,000 Hz. It can give you a clear, undistorted bass from a 12″ (305 mm) hollow formed cone made of specially sensitive chemical fibre pulp. There's a 5″ (127 mm) mid-range speaker, and to give you all the elusive high frequencies, a 3½″ (89 mm) tweeter and 2″ (51 mm) super tweeter.

You notice we've removed the speaker grille.

Look closely. Other speaker manufacturers fall short of this kind of workmanship. The grille's a fixture, so they don't worry too much about a poorly-finished baffle, ugly screws or bits of insulation poking round the speakers.

Coral worry. With us it's a point of honour to finish your speakers as though you fully intended to play them exposed, like this. We've even made the grille removable, to give you the opportunity.

Throughout the Stage Series, the woofer is set into a polished walnut baffle, flat on both sides, to eliminate acoustic bounce. The acoustic lenses on mid-range, tweeter and super tweeters stand proud of a toning fabric panel.

And the workmanship continues, beyond what you can see, ensuring that the enclosure is completely airtight, to ensure low-frequency damping and minimal vibration distortion, even under high input.

If you think that all this is gilding the lily, look at it from our point of view. We're new here. We know it doesn't matter to you that we're the world's second biggest manufacturer of loudspeakers. Or that we're getting ready to offer one of the most comprehensive ranges of high fidelity speakers to be found in Australia. So we have to produce a better speaker than you're used to, both in appearance and performance.

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RH518

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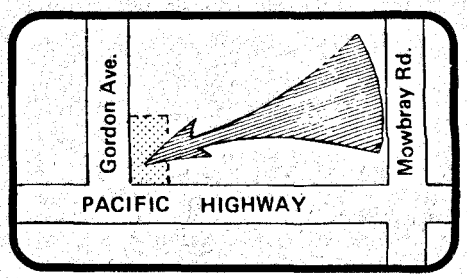

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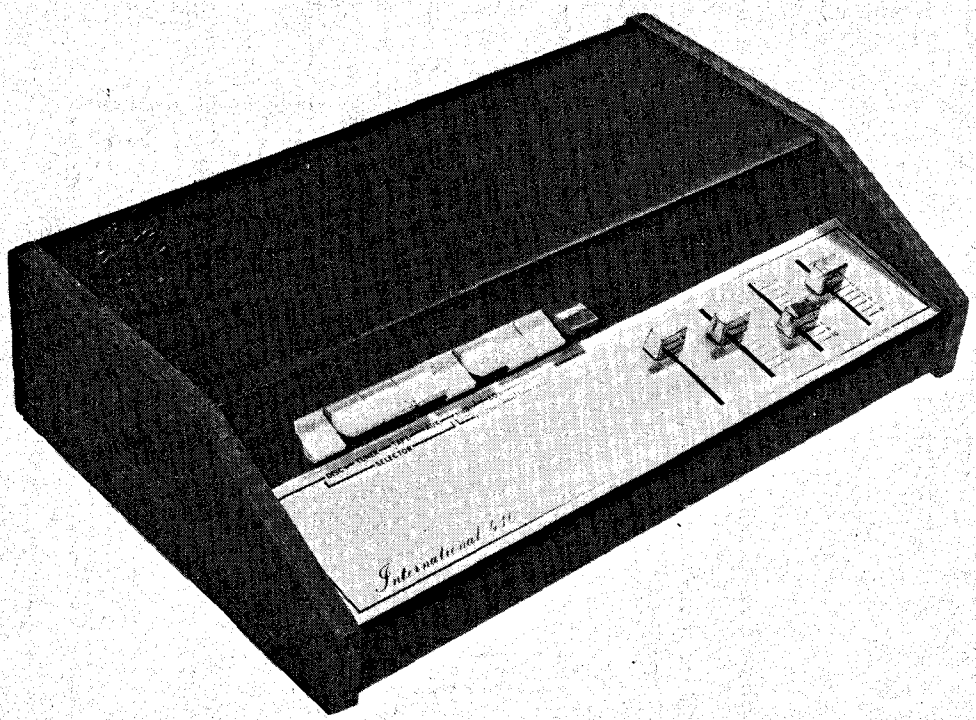
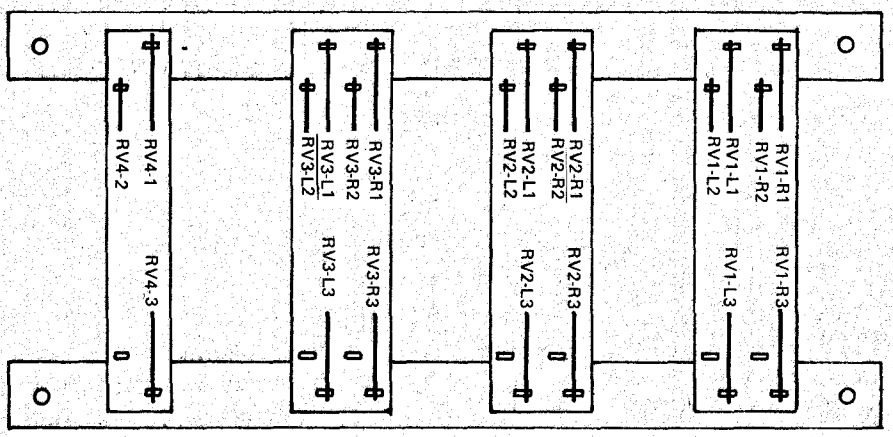
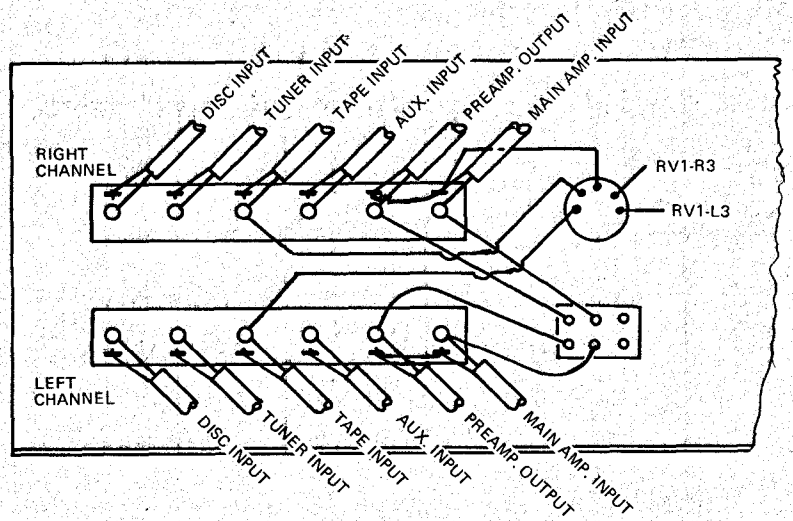
INTERNATIONAL 416 AMPLIFIER PART II



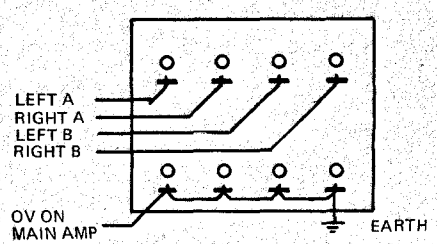
ETI PROJECT 416



Rear view of wiring to the slide potentiometers.



Wiring to rear panel connectors. (Panel shown shorter to save space).



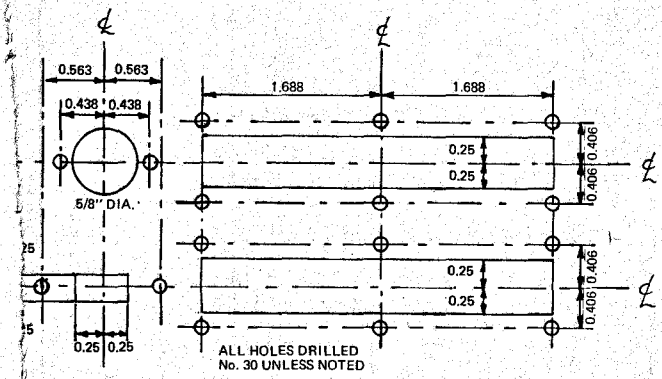
FULL details of the main and pre-amplifier printed circuits for the ETC 416 amplifier were published last month. This month we provide details of the metal and wood work and instructions on assembling the entire unit.

CONSTRUCTION

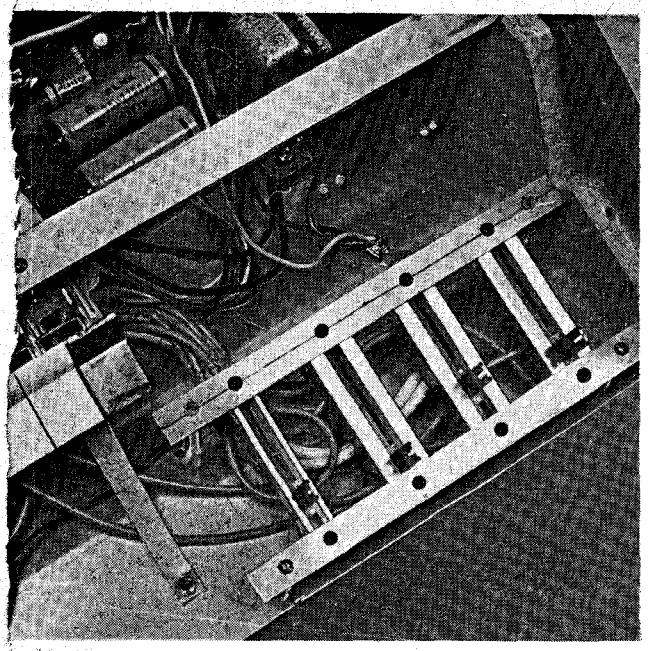
Begin by assembling the socket and terminal panels to the rear panel of the amplifier as shown in the photograph on page 77 of last month's issue. The transformer has flying leads and it is therefore necessary to mount it on four ¼ inch long spacers.

Now mount the completed pre-amplifier by four ¾ inch spacers. Then screw the power-amplifier IC's to the back panel and support the printed circuits board on the base by means of two ¼ inch spacers.

The McMurdo piano-key switch assembly is then mounted underneath

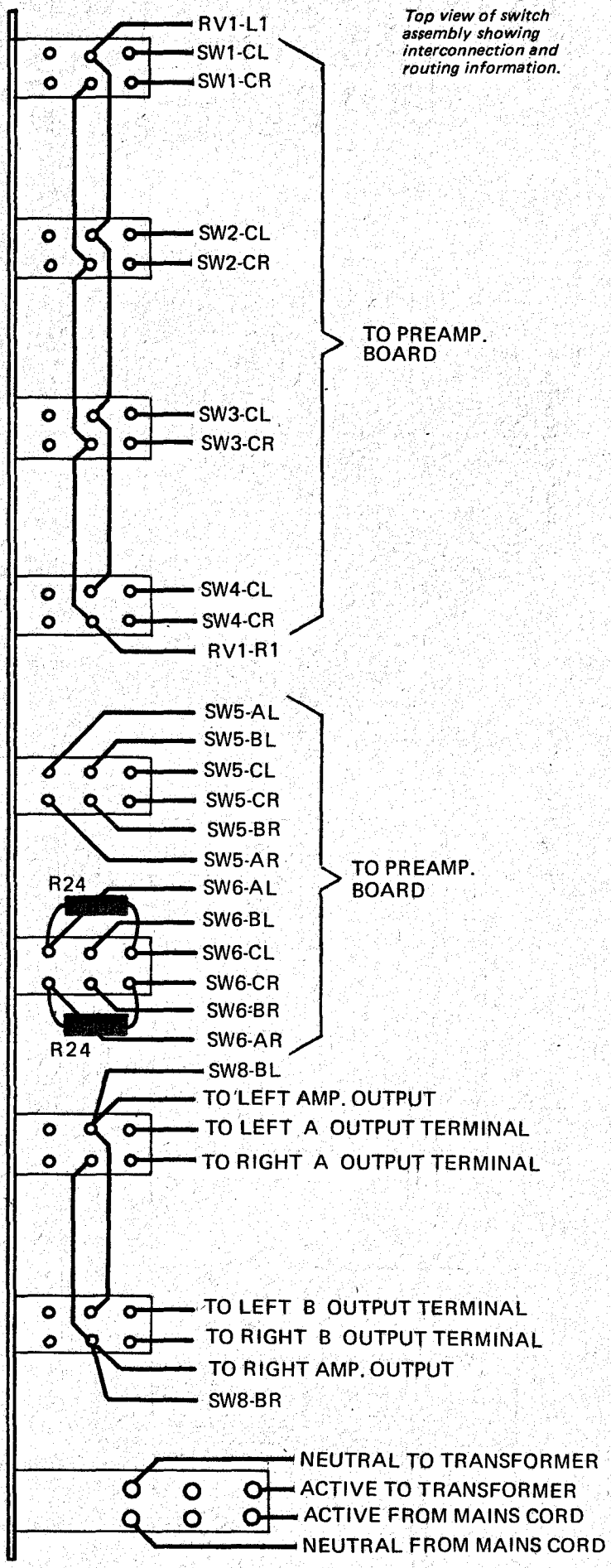


Enlarged view of holes in rear panel.

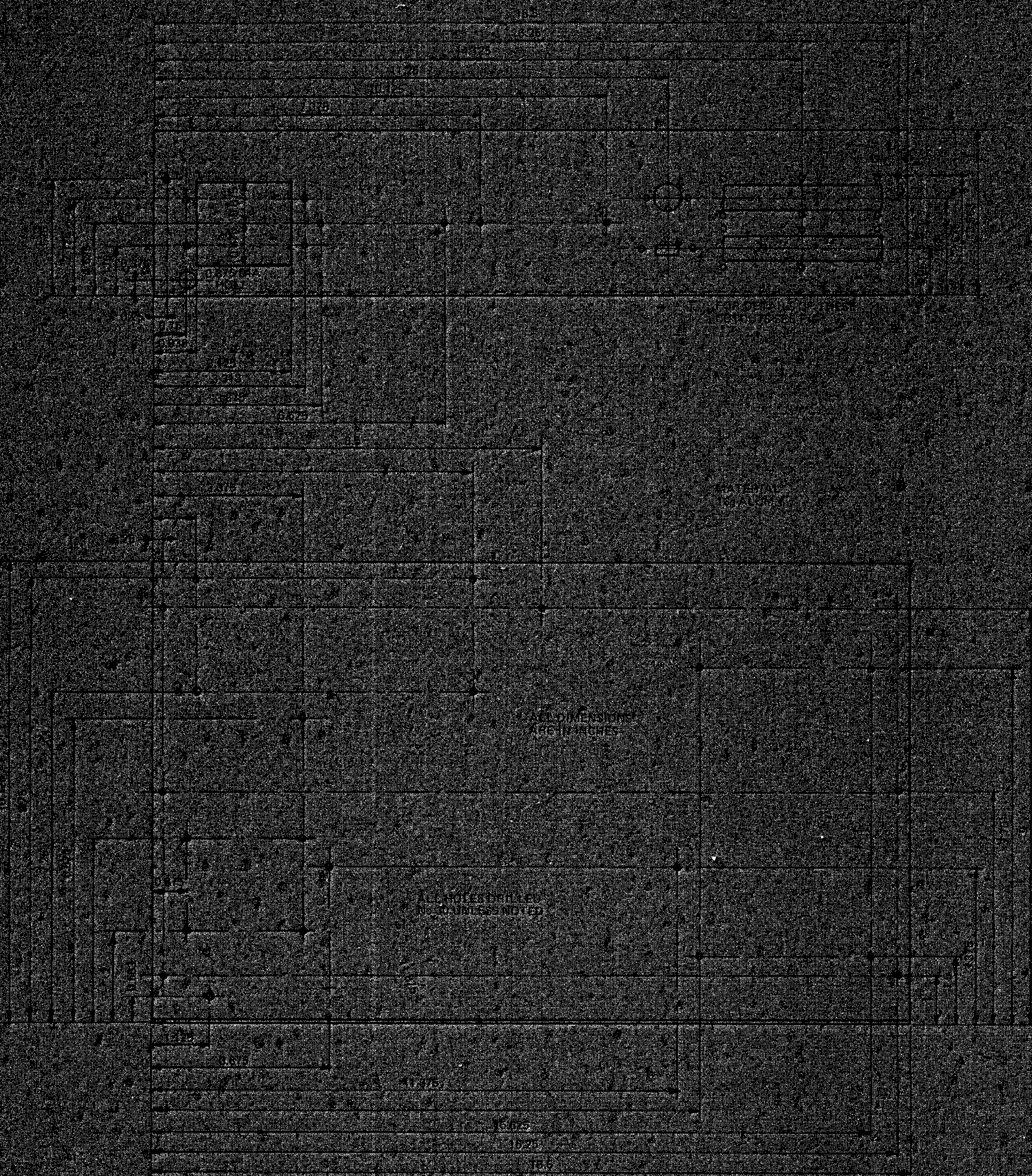


Detail of potentiometer mounting. Note also the screw passing through the switch support bracket, sw spacer, McMurdo switch, another spacer and the support bracket.

Top view of switch assembly showing interconnection and routing information.

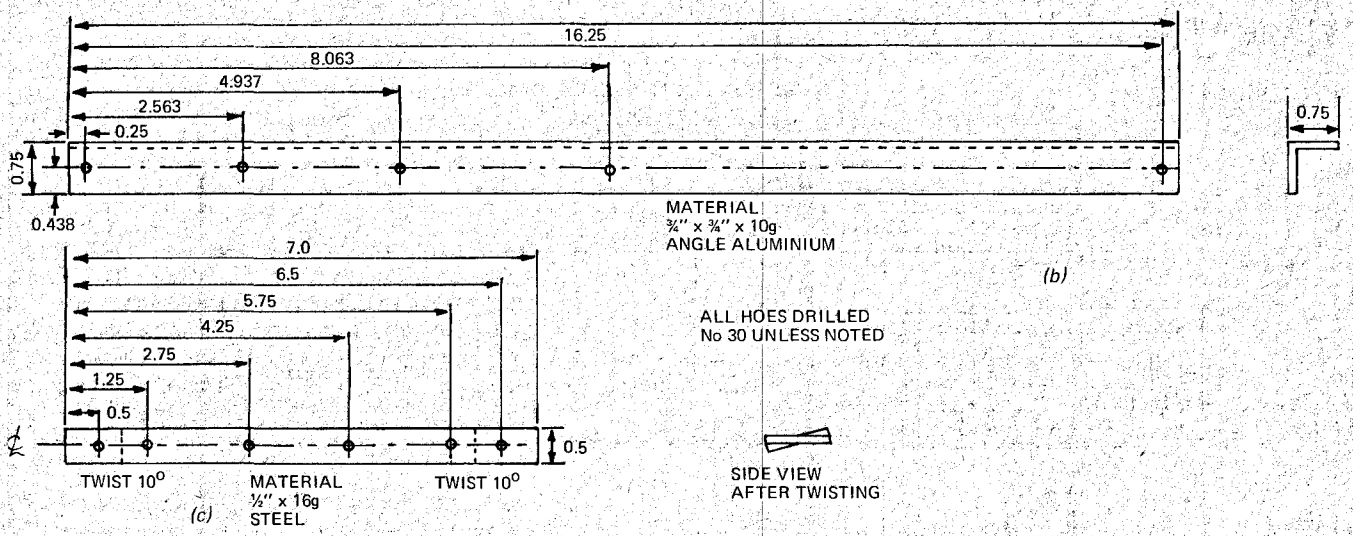


INTERNATIONAL 416 AMPLIFIER

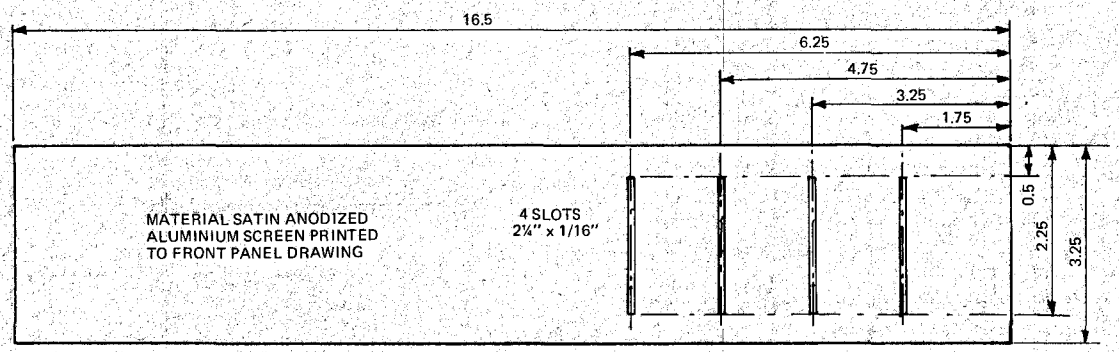


Details of baseplate and back panel which is bent up from a single piece of 16 gauge aluminium.

Front panel dimensions.



(a) switch bracket support (1 off) (b) switch support bracket (1 off) (c) potentiometer support bracket.



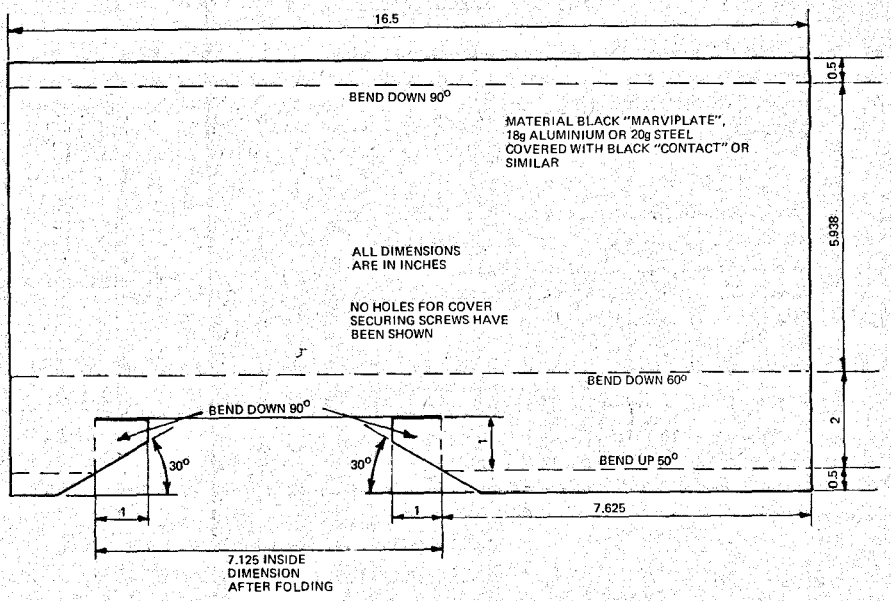
Measurements of front panel which should be satin-anodized and screen printed as shown by artwork.

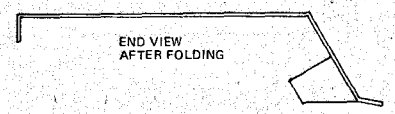
switch support bracket, by three spacers ¾ inch long, making sure that the orientation is correct by using the top panel as a guide. A 1½ inch screw should be used through the centre spacer and a further ¾ inch spacer fitted on the bottom side of the switch support bracket (see photograph). The lower spacer and screw are secured to the chassis-mounted bracket whose purpose is to prevent the switch support bracket from flexing when the switch is operated.

Mount the slide potentiometers onto their support brackets and then fit the assembly to the base by 1½ inch spacers at the rear, and 1 inch spacers at front.

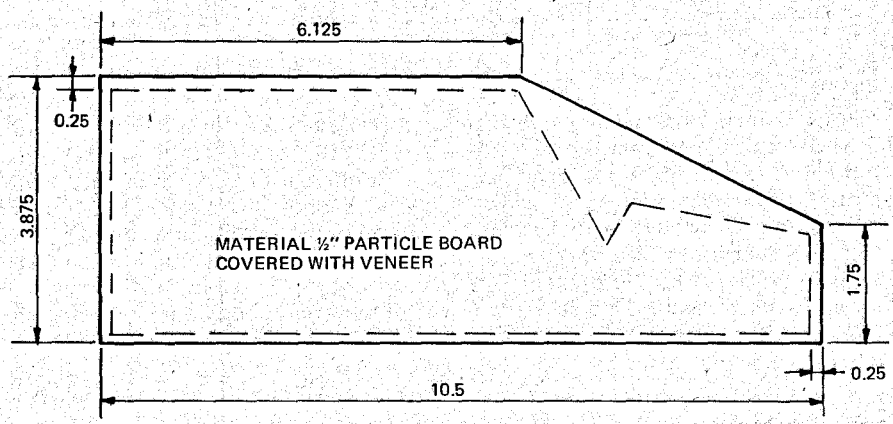
The unit is now ready for interconnection and this should be carried out with reference to the switch and potentiometer wiring diagrams. Each lead is given a number on these diagrams and is connected to the point having the same designation on the pre-amplifier board.

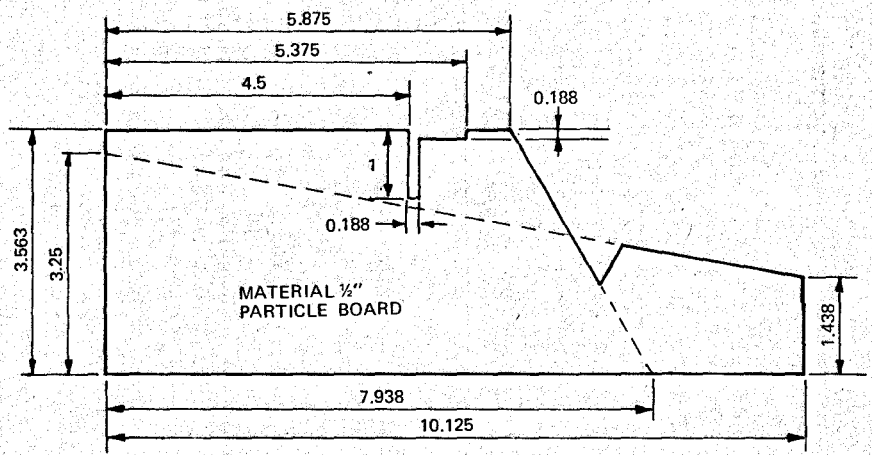
Note that all leads going to the potentiometers and switches should be shielded. Further, to prevent earth loops, make sure that the shields are





Detail of the top cover.



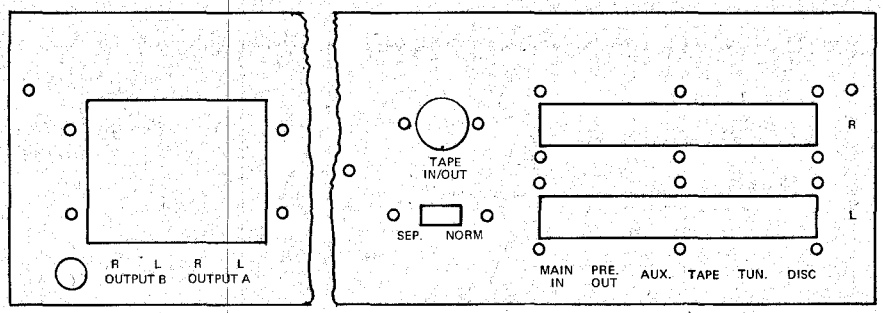


Dimensions of particle board side panels which are covered with veneer. Top: Outer panel, Bottom: inner panel.

INTERNATIONAL 416 AMPLIFIER

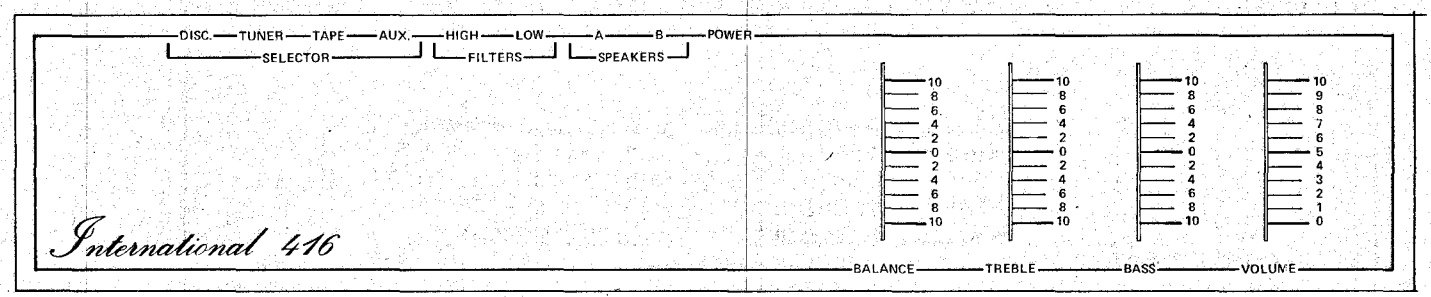
connected at one end only — preferably the amplifier end. The only exception to this rule is the lead connecting the output of the pre-amplifier to the input of the main amplifier, which as pointed out last month provides an earth for the first stages of the main amplifier.

A further point worth noting is that leads may be connected to the top of the board via pins inserted through the board, or direct to the underside of the board as we have done. The latter procedure, although looking neater, requires that the leads be fitted to the boards before they are screwed in place. ●



Wording on rear of back panel. (Panel shown shorter to save space).

Front panel artwork.



Announcing the second Cassette Revolution

TDK

ED
EXTRA-DYNAMIC

The audio tape with

MAGNETITE*

*

mag·net·ite (mag′nə·tīt) *n.* A massive, granular, isometric, black iron oxide, Fe_3O_4; lodestone; an important ore of iron. [<MAGNET + -ITE¹] — **mag′net·it′ic** (-tit′ik) *adj.*

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.

ED is capable of reproducing satisfactory signals from 20 to 23,000Hz; far in excess of all but the most advanced laboratory recording systems. The noise level and harmonic distortion is so low, and the level or recording possible without distortion is so high, that hiss reduction systems involving boosting and filtering are not necessary.

From the suppliers' point of view, ED is the tape you have been waiting for because it is a top performance tape that you can recommend to every cassette user. The problems of excessive high headwear, frequency response, in relation to low frequency response, as well as bias and erase problems encountered in Chrome based tapes, does not exist with TDK ED. In spite of its high performance it requires only normal types of bias and erase. Its frequency response is virtually flat from the lowest to highest frequency. It will make even low priced recorders sound greater than they do with TDK SD.

Owners of recorders without hiss reduction systems, or tone controls, can now enjoy recording at very high levels without distortion and leave the spurious noises of their recorders behind on playback. In ear tests on the top high fidelity equipment available in Australia with monitor speakers, listeners have not been able to tell the difference between original sound and playback using these remarkable TDK ED cassettes with the Magnetite formula.

Because the demand in the U.S.A. has been unprecedented since the announcement of ED in October, 1973, limited quantities are available at present. Order early and make sure that your customers are not disappointed. Available in C40 — $3.80, C60 — $4.80 and C90 — $6.90 recommended list.

TDK also manufacture the famous SD (Super Dynamic) tape in both reels and cassettes and TDK low noise tape in reels and cassettes, regarded as the best value for money of any tape manufactured in the world. Make sure your customers buy the tape that brings satisfied customers back for more.

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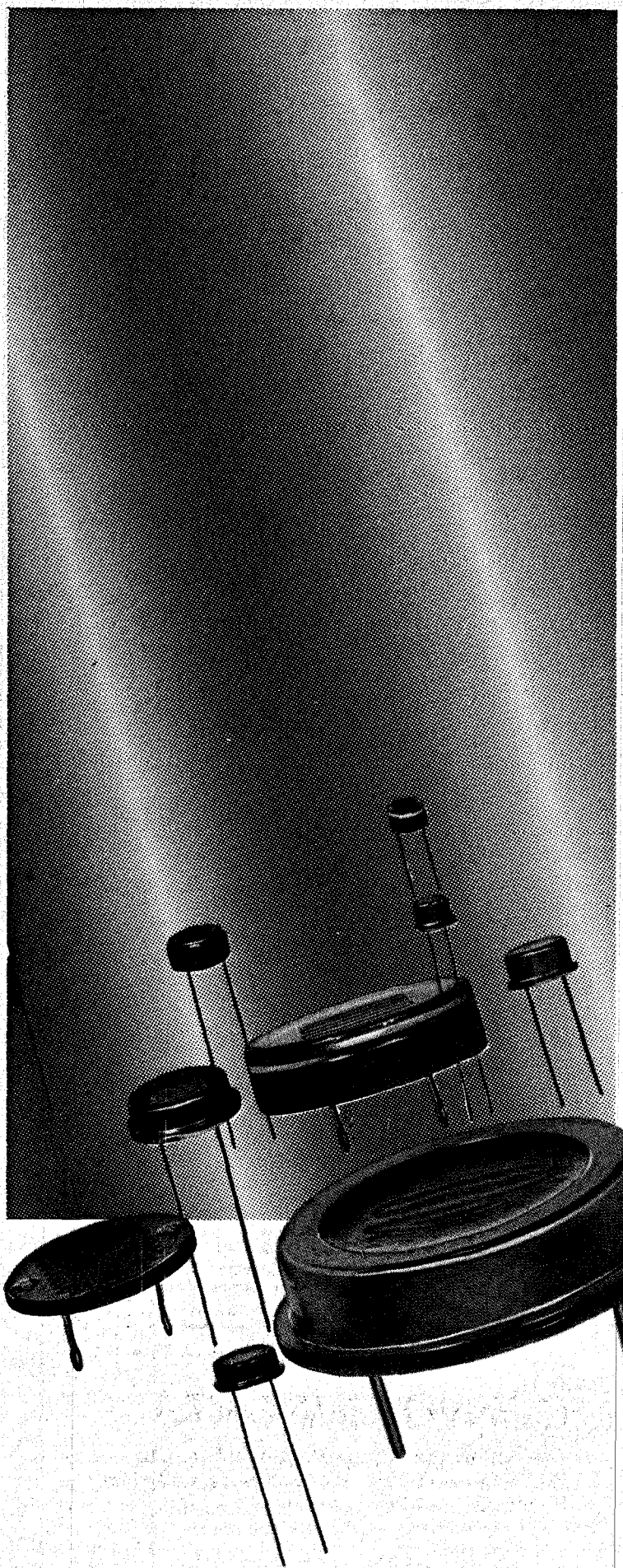


A comprehensive range of **Moririca photoconductive cells and devices** designed for a multitude of applications are readily available. The range includes cadmium sulphide and cadmium selenide types together with a variety of photocell lamp modules and sophisticated resistive and sensing devices as outlined below. These cells feature high sensitivity, fidelity and power dissipation coupled with fast spectral response inclined more towards infra-red than visibility. Contactless, non-mechanical construction of photocell lamp modules completely eliminates noise and mechanical wear so that a lengthy, silent operating life is ensured.

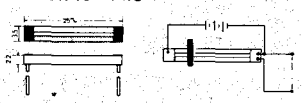
Moririca **high power photocells** find application in card reading, automatic weighing and paper money exchanging machines . . . also auto-stop devices, photoelectric relays, alarm devices, floating indicator lamps, road beacons and automatic light switches. **High sensitivity cells** are to be found in camera electric eye mechanisms, photoelectric type toys and the like whilst **photocell-lamp modules** are suited for use in non-contact switches, vibration circuits, delayed relays, protective circuits, etc. The Moririca range has almost unlimited application in today's Professional equipment technology.

Photentiomatic (photo-potentiometer). Functions as a potentiometer controlled by light in which output voltage changes according to shifting a slit of admitting light. No mechanical contact construction results in quiet, long-life operation. It offers excellent resolution and high convertible ratio from input to output voltage.

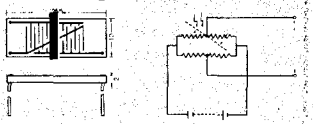
Photobridge (displacement detector for servo mechanisms). Designed for use in displacement detector circuitry in which element resistance is controlled by the relative position of a light admitting slit. Amongst its features are simple adjustment of the light beam and setting point, minimal effect from temperature and light level differences, extended service life and no mechanical noise.

Selenium photovoltaic cells are also available in disc or rectangular form. They are of humidity proofed construction, withstand mechanical vibration and are shortcircuit resistant. Typical applications include use in light meters and colour meters.

Photentiomatic

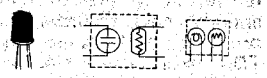


Photobridge



Photocell Lamp Modules

MCN **MCL**



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AC 73

NUMBERS

by Ronald Froom

"God made the integers: all else is the work of man" – Leopold Kronecker

THE concept of number belongs to societies which have reached a certain level of sophistication. Certain very primitive and illiterate societies – the early Australian aboriginals or the Kalahari bushmen for example, go no further than – ONE, the individual (me) – TWO, the two sexes (us) – and MANY. Even the ancient Greeks, with their insatiable curiosity about the world around them, stopped their numbering system at 10,000, all greater numbers being considered infinite!

It is probable that the evolution of highly organized societies, where taxes and revenue (in terms of corn, animals, gold, etc.) made necessary some form of accountancy, and man began to be aware of numbers and of the necessity of recording them. The ancient Egyptians, the Babylonians, the Maya and other such civilizations evolved, at a very early state in their evolution, a satisfactory system of recording the number of things, but did not evolve a system of recording that was adaptable to arithmetical operations on the numbers thus recorded.

An important step forward was made when it was realized that numbers could be used not only to record but also to calculate. Since the systems of recording numbers did not permit direct arithmetical operations, it was necessary to invent a calculating device. This gave rise to the first computer – the abacus. Invented independently in Rome, China and Japan, in slightly differing forms, this simple device of beads on wires permitted the operations of addition, subtraction, multiplication and division. Even today a skilled abacus operator can add up a column of figures more rapidly than can be done on an electric desk calculator, and if one considers the time taken in punching cards and preparing an appropriate program, much more rapidly than an electronic computer!

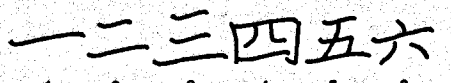
The Roman abacus merits closer study as it demonstrates several principles common to all methods of calculation.

The Romans had no numerical symbols, but used letters of the alphabet to represent numbers: I, V, X, L, C, D, M, ↀ. It will be seen that each symbol is alternately five times as large and twice as large as the one preceding it: 1, 5, 10, 100, 500, 1000, 5000. This apparently clumsy system becomes clear if it is realized that the letter symbols represent the position of the beads on the abacus, as shown in Figure 1.

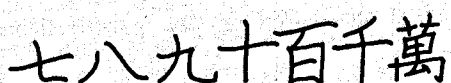
A feature of Roman numbers that has puzzled many is the use of the combinations IV, IX, XL, XC, CD, CM, etc. to represent 4, 9, 40, 90, 400, 900, etc. This is because in carrying out additions and subtractions on the abacus, it is simpler to add, say 4, by adding 5 and subtracting 1, than by the direct operation.

The Roman system of numerals therefore is well adapted to *recording* the results of calculations performed on a computer (the abacus) but does not, of itself, permit any arithmetical operations upon the numbers thus recorded.

The ancient Chinese numerals are similar in concept; they represent the result of operations on the Chinese abacus, which differs from the Roman in certain details. The numerals are:

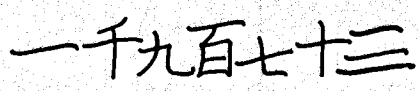


1 2 3 4 5 6



7 8 9 10 100 1000 10000

To write any given number, combinations of these signs are used, for example, the date 1973 would be written:



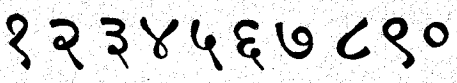
or (1 x 1000) + (9 x 100) + (7 x 10) +3

Here again direct arithmetical manipulation of these numbers is impossible.

The great breakthrough in numbers was achieved by the ancient Hindus, who realized two fundamental parameters of any numbering system:

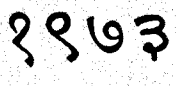
– the use of a sign to indicate zero – a radically new conception that none of the earlier systems had considered;
– the concept of positional notation, that is to say, that one can express any number by a very small number of signs (in fact 10) the signs being given a significant value by their *position* in the mber as written.

The original Hindu signs were:



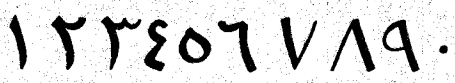
1 2 3 4 5 6 7 8 9 0

which are sufficiently close to our own figures that several of them can be recognized at once. Here, the year 1973 would be written



exactly as we do.

From India these numerals were taken over by the Arabs, who wrote them:



1 2 3 4 5 6 7 8 9 0

and it is from these characters that our "arabic" figures that we use today were derived.

With the invention of the arabic (or Hindu) numerals, man was enabled to carry out arithmetical operations directly on numbers as written, without the intervention of any mechanical assistance.

This state of affairs continued right into the seventeenth century, when, evolving scientific knowledge required calculations of greater complexity to be performed than were practicable (though still possible) without the assistance of some device – hence the evolution of logarithms, the slide-rule, mechanical calculators, and now the electronic computer.

Inherent in any numerical system using positional notation is that of a "base".

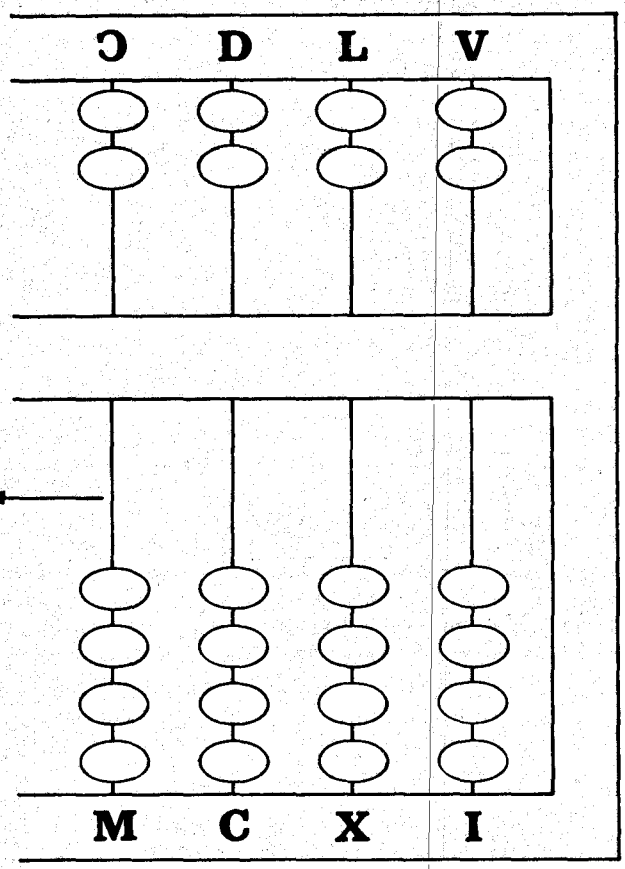


Fig. 1

the abacus can be extended in this direction to cover the size of the largest number required

This is the number that corresponds to the number of different numerical signs used. Since man has ten fingers and ten toes, it has been usual to use the number ten as a base, since counting on the fingers is one of the most primitive and fundamental ways of expressing numbers.

As we have previously shown (using as a base the number 10) the digits in any number beyond 10 are given a significant value by their *position* in the number.

Thus by using the nine numeric signs, 1, 2, 3, 4, 5, 6, 7, 8 and 9, together with the zero, we can express any number we like. For example 1973 = (1 x 1000) + (9 x 100) + (7 x 10) + (3 x 1); we know that the 1 represents 1000 solely because it has three whole digits to its right.

With this principle established, we can carry out any desired arithmetical operation upon our numbers. It must, however, be borne in mind that basically *there are only two arithmetical operations possible — addition and subtraction.* Multiplication, division and the extraction of roots are all, in the ultimate, dependent on addition and subtraction. We cannot multiply two numbers together without having first committed to memory a "multiplication table" which gives the results of all possible combinations of multiplication from 1 x 1 to 10 x 10. The expression 5 x 7 = 35 is merely a convenient shorthand version of

5+5+5+5+5+5+5 = 35

or

7+7+7+7+7 = 35

Note here the principle of commutation, it does not matter whether we write 5 x 7 or 7 x 5, the result is the same. For some types of calculation, however, this law is not valid and care must be taken to perform the operations in the correct order. This aspect, however, is outside the scope of this article and may be ignored.

The smallest base that can be used is 2. Here only two symbols, 1 and 0, are used. But with just these two symbols we can express any number no matter how big.

In this system, known as 'binary notation', each successive symbol to the left of the first digit — which can only be a '1' or a '0' — is increased by a factor of two.

Thus the binary number 1011 is represented by 11 in decimal notation.

Starting from the left, the first digit represents 1, the second 2, the third 0, and the fourth 8, hence binary 1011 equals decimal 1 + 2 + 0 + 8).

Were the binary number to be 1110 then the decimal equivalent would be 14, (0 + 2 + 4 + 8).

Table 1 shows binary/decimal equivalents from decimal 0 to decimal 15. The table can be extended indefinately. Just remember that each digit to the left has twice the weighting of its neighbour to the right. Thus the weighting of succeeding digits are from the right to left, 1, 2, 4, 8, 16, 32, 64, 128, 256, 512, 1024 etc — the number 1024 would in binary notation appear as 10000000000, 1025 would be 10000000001.

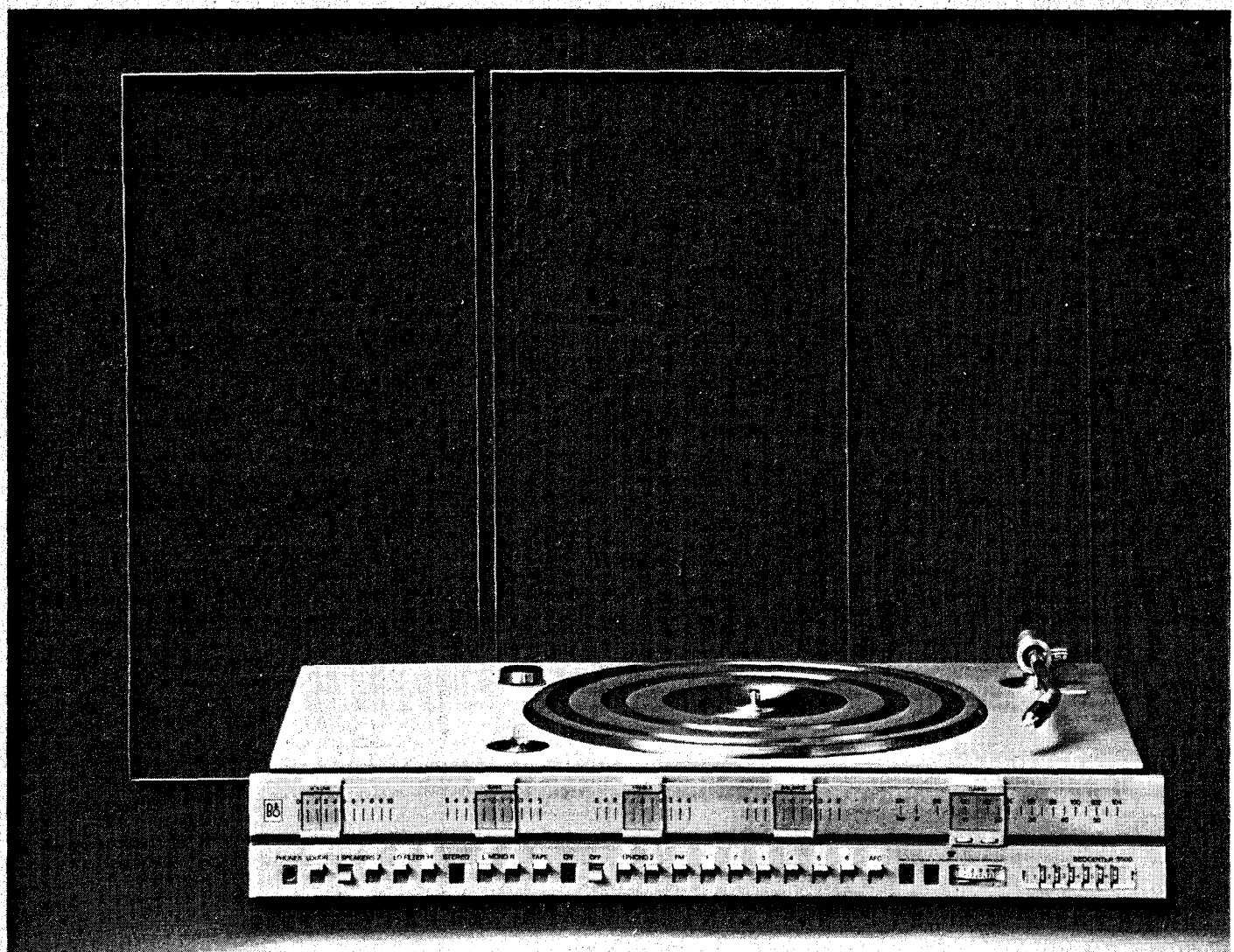
The date 1973 becomes 11110110101 in binary notation (1x1) + (0x2) + (1x4) + (0x8) + (1x16) + (1x32) + (0x64) + (1x128) + (1x256) + (1x512) + (1x1028).

There is no absolute reason why 10 (or 2) must be chosen as the base for our numbering system. For certain purposes, a system based on 8 (octal system) has distinct advantages. Such a system would give us the number sequence shown in the octal column of Table 1. (The octal system is described in greater detail later in this article).

It is important to realize that although the *number recorded* may appear strange, *the number of objects it represents* remains the same.

At this point, many readers will be asking why anybody in their right mind would willingly forgo the conciseness of decimal notation for the apparant obscurity of the binary system.

Continued on page 87



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NUMBERS

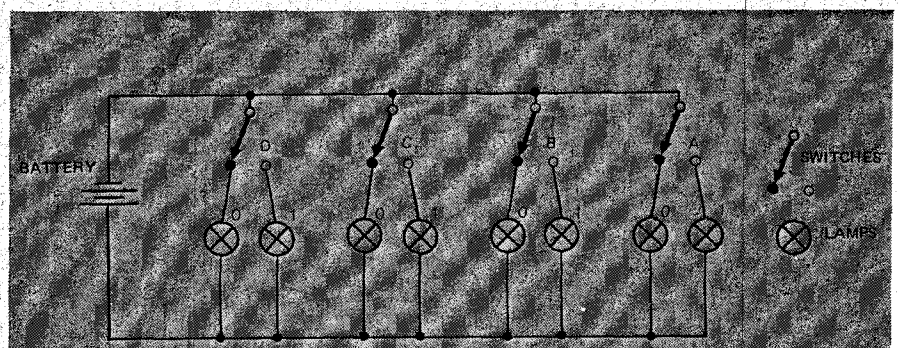

Fig. 2. This arrangement of four switches may be used to represent the decimal numbers 0 to 15 in binary notation.

TABLE 1

Table 1. Comparison of decimal numbers from 0 to 15 in binary and octal. Letters A to D refer to switches shown in Fig. 2

	DECIMAL	BINARY	OCTAL
One switch	0	0 0 0 0	0
	1	0 0 0 1	1
Two switches	2	0 0 1 0	2
	3	0 0 1 1	3
	4	0 1 0 0	4
Three switches	5	0 1 0 1	5
	6	0 1 1 0	6
	7	0 1 1 1	7
	8	1 0 0 0	10
	9	1 0 0 1	11
	10	1 0 1 0	12
Four switches	11	1 0 1 1	13
	12	1 1 0 0	14
	13	1 1 0 1	15
	14	1 1 1 0	16
	15	1 1 1 1	17
Weight	$10' 10^0$	$2^3\ 2^2\ 2^1\ 2^0$	$8' 8^0$

The answer to this lies in the capabilities and limitations of electronics to perform mathematical operations.

At present the simplest and least ambiguous device that is suitable for our requirements is a basic on/off switch. It has two stable states – it is either 'on' or it is 'off'.

A device such as this fits in perfectly with the binary system, the 'on' state representing a '1', the off state '0'.

Four switches, interconnected as shown in Fig. 2 may be used to represent the (decimal) numbers 0-15 in binary form.

Each switch represents one binary digit – thus decimal '0' would be represented by all switches being in the 'off' (0) positions. Decimal 5 would have switch D at '0', C at '1', B at '0', and A at '1'. (note that the '0' lamps shown in the circuit are only necessary to avoid possible ambiguity – i.e. the '1' light need only be off to represent a '0' – but there is always the possibility that absence of light is due to a blown bulb rather than an intentional '0')

The number of switches may be increased as desired to cover any range of numbers. Thus five switches will cover 0-31, six switches 0-63. In other words, where 'n' equals the number of switches the range of numbers covered equals 2^n-1

For example when n = 8

$2^n = 2^8 = 256$

i.e. eight switches will represent numbers from zero to 255.

In a computer these switches are replaced by transistors which perform the same function electronically. Transistor switches may be packed into an amazingly small area (5000 per square millimetre), they require very little power and are very fast acting.

The computer may therefore be constructed to handle vast quanties of data in a very short space of time.

The binary numbering system is essential to electronic computation because at present there are no known devices or circuits which exhibit more than two stable states and are as simple and unambiguous in operation as the transistor switch.

Although it is possible to construct a computer working strictly in binary notation, such a device would be unnecessarily complex and occupy too much space. What is more suitable is a system of numbering based on a number which is an integral power of 2. Such a system is the octenary. Its base, 8, is sufficiently close to our usual base 10, to give numbers of a reasonably concise format and, at the same time, the numbers 0 to 8 can easily be expressed in binary form, thus:

0, 1, 10, 11, 100, 101, 110, 111, 1000

0, 1, 2, 3, 4, 5, 6, 7, 8

For an octal number, the weighting for successive positions are:

1, 8, 64, 512, 4096, 32768, . . .

So that we can have a number composed of, say:

$8^0, 8^1, 8^2, 8^3, 8^4, 8^5$ . . .

Each position of which can easily be expressed in binary notation using a maximum of three binary numbers for each position.

Taking the date, 1973 as our example, we get, in octal notation:

1973 = 3665

or

$(3x8^3)+(6x8^2)+(6x8^1)+(5x8^0)$

which can be transcribed into binary – octenary notation as:

1973 = 011 110 110 101.

It may be thought that such a system is cumbersome, but although for relatively small numbers it is more complex than other forms of notation, when dealing with very large or very small numbers, such as are frequently met with in computer calculations, a considerable economy in memory cells results.

The foregoing analysis shows that the representation of a physical number may differ according to the system of numeration employed, however it is the number itself that is fixed and not the group of numerical signs by which it is represented.

So far we have considered numbers in the abstract as being the numerical representation of phsyical magnitudes. However, as will be seen below, numbers have an independent existence of their own with some odd and surprising properties. Henceforward in this article we shall only consider numbers written in our normal decimal notation.

Continued on page 89.

NUMBERS

Let us first of all consider whole numbers (integers) only and see what *kinds* of numbers may exist. The first category is that of *odd* and *even* numbers. Starting from unity the numbers are alternatively *odd* (that is, cannot be divided exactly by 2, but always leave a remainder of 1) and *even* (which can be divided exactly by 2). Simple manipulation of those numbers show the following properties.

- the sum of two odd numbers is an even number, e.g. 9+5 = 14;
- the sum of two even numbers is an even number, e.g. 8+6 = 14;
- the sum of an odd and an even number is an odd number, e.g. 9+4 = 13;
- the product of two odd numbers is an odd number, e.g. 7x9 = 63;
- the product of two even numbers is an even number, e.g. 8x6 = 48;
- the product of an odd and an even number is an even number, e.g. 9x8 = 72;
- the division of two odd numbers, if an exact solution exists, will be an odd number, e.g. 63/9 = 7;
- the division of two even numbers, if an exact solution exists, may be either an odd or an even number, e.g. 48/6 = 8; 72/8 = 9;
- division of an odd number by an even number, will not give an exact solution.

It can thus be seen that straight away we have found some regular patterns in the relationship between the odd and the even numbers.

A second division of numbers is that of *prime* and *factorial* numbers. A prime number is a number which cannot be divided exactly by any other number except unity. Thus 1,2,3,4,5,7,11,13,17,19,23,29,31 . . . are all prime number.

Since the prime numbers cannot by definition be divided exactly by 2 they are all, with the exception of 2 itself, odd numbers, but all odd numbers are *not* primes, e.g. 9 = 3x3; 15 = 5x3; 21 = 7x3, etc.

Since Leibnitz in the seventeenth century mathematicians have tried to establish two formulae:

- a formula permitting one to determine whether a given large number is a prime or not;
- a formula permitting the calculation of the series of prime numbers up to any desired value.

So far neither of these goals have been reached and the problem, which appears so simple at first sight, has resisted all attempts at solution.

The series of numbers, 0, 1, 2 . . . extends up to infinity, since no matter how large a number we may choose, there is always the possibility of augmenting its value by 1 and thus obtaining a new and larger number.

If we now consider numbers such as $\frac{1}{10}$ $\frac{1}{100}$ $\frac{1}{1000}$ etc a whole infinity of such numbers can be inserted between any two integers in the series 0, 1, 2, 3, . . . These numbers also have their peculiar properties and may be divided into two main categories:

- decimal fractions which have a definite and exact value. Thus 10/4 = 2.50000 . . . with no doubt as to its exact equivalence;
- recurring decimals, which, no matter how far the process is extended a final and exact result is never reached:

e.g. 10/3 = 3.33333 . . .
10/9 = 1.11111 . . .
10/7 = 1.42857142857142857 . . .
and so on for ever.

It must be realized that between any two consecutive whole numbers there are a whole infinity of numbers which can be represented exactly, and equally a whole infinity of recurring decimals.

Finally, in our classification of numbers there come the real "wild men". These are called "irrational numbers" or "surds" and are represented by decimals that *neither come to a final result* nor *recur*. This means that we can approach the value of the number to any desired degree or precision by taking into account an appropriate number of decimal points, but can never reach a final result. To complicate the issue, many of these numbers represent physical magnitudes which have a real existence.

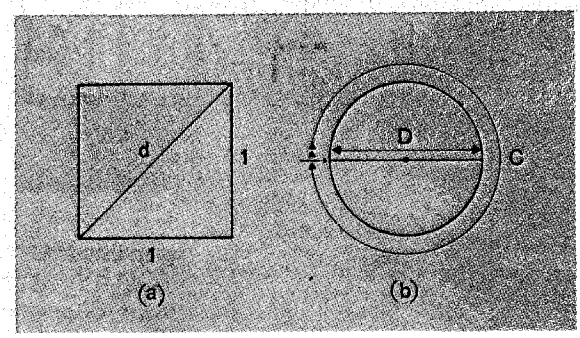

Fig. 3

Figure 3 shows two examples of these numbers. Figure 3(a) shows a square, the side of which is 1 unit, with its diagonal. Now, according to the theorem of Pythagoras concerning right-angled triangles, the length of this diagonal is given by $d = 1^2 3 1^2 = 2$. But although the diagonal of this square has a physical existence, there is no finite number capable of representing 2, the best we can do is to write 2 = 1.4142 . . . out to infinity.

This means that although the length *d* on the figure is a definite physical magnitude it is not possible to express its value *exactly* in our system of numeration.

Again, in figure 3(b) we have a circle and its radius. The length of the diameter *D*. is known, and the circumference *C* of the circle is a physical magnitude which has a real existence. However, if we wish to express the ratio of the circumference *C* to the diameter *D*. we obtain the well known relationship:

$C = \pi D$

where $\pi = 3.14159$ . . . and to infinity.

This number can never be expressed exactly in our numerical notation but can only be expressed to a desired degree of accuracy by taking into account the appropriate number of decimal points in the expression for π.

It will now hardly come as a surprise to know that between any two subsequent numbers in the series 0, 1, 2, . . . there can exist a whole infinity of such surds, none of which is capable of exact representation using our numbers.

Other categories of numbers exist: negative numbers, imaginary numbers, complex numbers, vectorial numbers, which are not dealt with in this simple exposition. Nevertheless, it is hoped that it has been made clear that a series of conventional signs, designed initially to represent simple physical magnitudes have come to have a curious life of their own, divorced from their primitive functions, the study of which provides a fascinating field to the inquiring mind. ●

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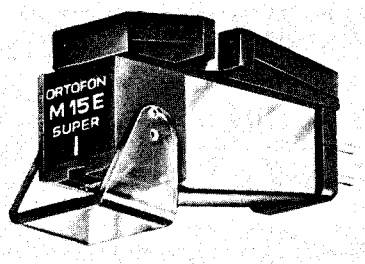

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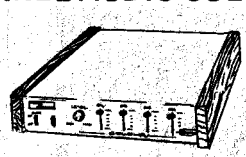

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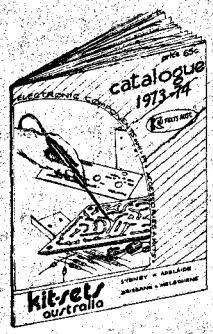

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BG-GO 7-73

PERSONAL CALCULATORS

(Continued from page 33)

The Facit model 1135 is a 16 digit-three memory machine ideally suited to high-speed office work.

The HP-80 pocket-sized calculator replaces many of the cumbersome tables presently used in making financial calculations. The nine-ounce calculator has a solid-state memory similar to those used in computers, and its capability extends far beyond simple four-function machines.

Electronic replacements for the adding machine have much greater capability whilst providing a permanent printed record of the calculation

blanked, destroying the result. Again it is preferable that the machine displays a result and indicates that overflow has occurred. Some machines overcome this problem by having 16 digit working registers for an eight-digit display; with either method some indication as to the number of zeros to be added at the end, or a switch allowing the other eight-digits to be selected for display is necessary.

Another desirable feature in a four-function calculator is the ability to perform all four functions on a constant. Thus to convert inches to millimetres it is necessary to multiply by 25.4. By storing this as a constant, the need to enter it for each calculation is eliminated.

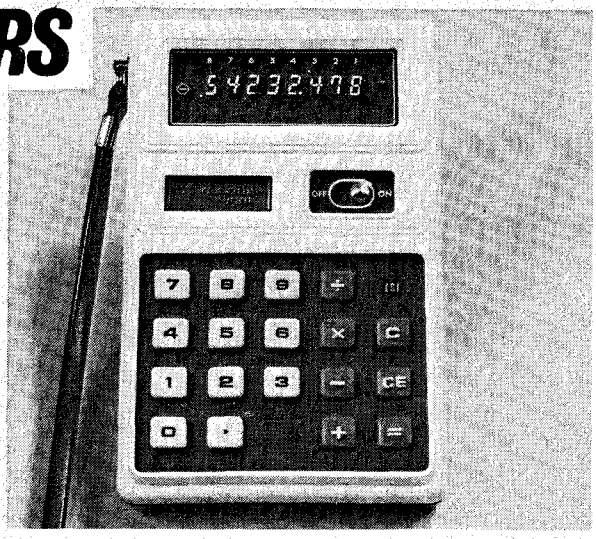
The machine should also have separate 'clear entry' and 'clear all' keys. The 'clear entry' key allows the last incorrect entry to be cleared without destroying a previously accumulated result, whilst the 'clear all' key should clear every register except the memory.

CALCULATORS FOR FINANCE

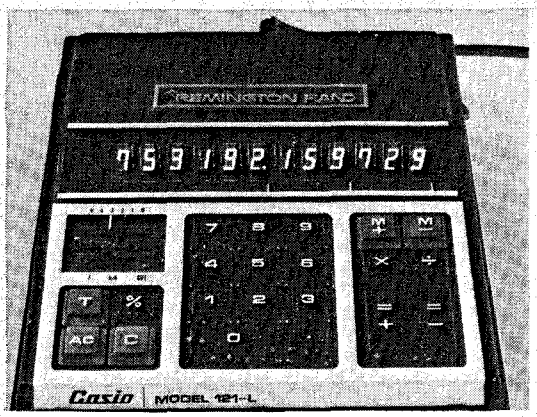
Where a calculator is to be used for financial calculations the decimal point position should be selectable, and floating point operation should preferably be possible. Operation with a constant should be a standard feature. In addition, it should have 'Percentage' and 'Exchange' keys. The percentage key automatically divides the displayed number by 100 and thus simplifies percentage calculations by non-skilled personnel. The exchange key reverses the order of two previously entered numbers. Thus if after a series of calculations you required to take the reciprocal of a number you would punch ÷ 1 exc ±. This sequence would divide the number into one, thus giving its reciprocal.

PERSONAL CALCULATORS

The Toshiba 0801B



The Panasonic 880 from National features a perfect overflow system and very attractive styling.



The Casio model 121–L has a totalizing memory, floating or fixed point operation and round up or truncate of decimals.

The MITS 1212 has fixed point operation 2 or 4 with a full 12 digit display.

In a business environment, calculators are required to operate at speed, such as was the case with the older mechanical adding machines. Speed requires a large key format in a well laid-out keyboard. Pocket calculators with their tiny keys are not suitable.

Additionally, for serious office work, a permanent record of the steps used throughout the calculation is usually required for later checking. There are many excellent machines available with printers in the under $500 range. For personal use the Hewlett Packard HP-8C is programmed to solve practically any financial problem (see scientific calculators later in this article).

MEMORIES

Before passing on to discuss calculators for use in mathematics, we will discuss memory function, for these are desirable in both mathematical and financial calculations.

The prime purpose of a memory is to store an intermediate result for later use. A full memory should have keys for adding or subtracting numbers to the memory contents, a 'memory recall' key for bringing the contents back to the display, and a separate 'memory clear' button.

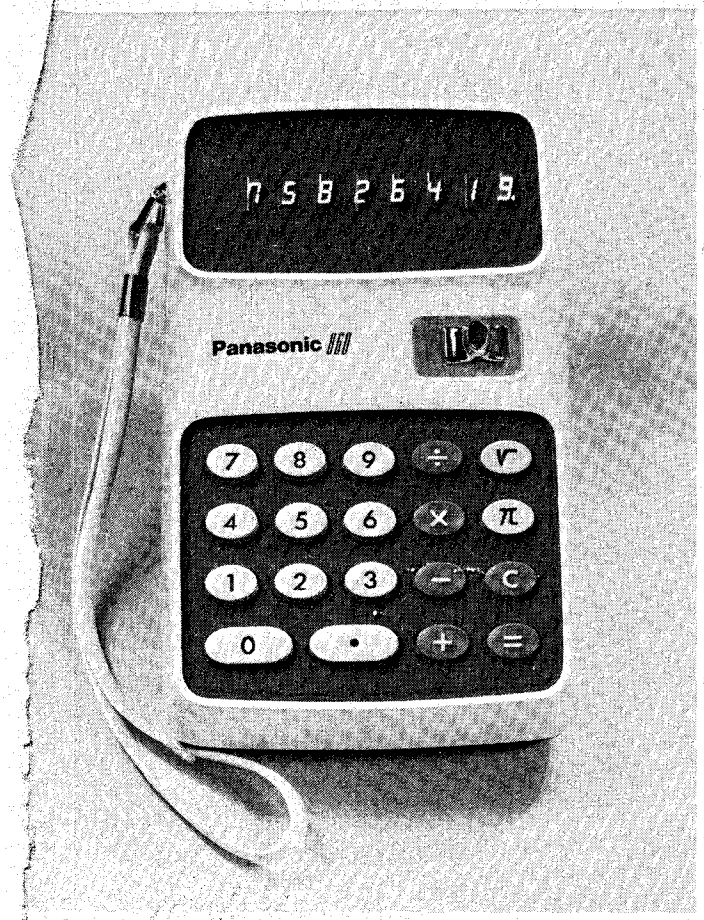
In business calculators a full memory is not always provided. Sometimes an automatically totalizing memory is used, with a 'T' key provided to bring back the contents to the display. This type of memory cannot store any one number for later use, and quite often can only be cleared by the 'clear all' key. The more expensive business machines may have a totalizing memory and a further full memory. This type of machine is very versatile.

CALCULATORS FOR MATHEMATICS

For mathematic problems the requirements are quite different. Floating point is absolutely essential, as is proper overflow operation (described earlier) which, if not correct, can destroy half an hour's previous calculations. Constant operation and a full memory are also highly desirable.

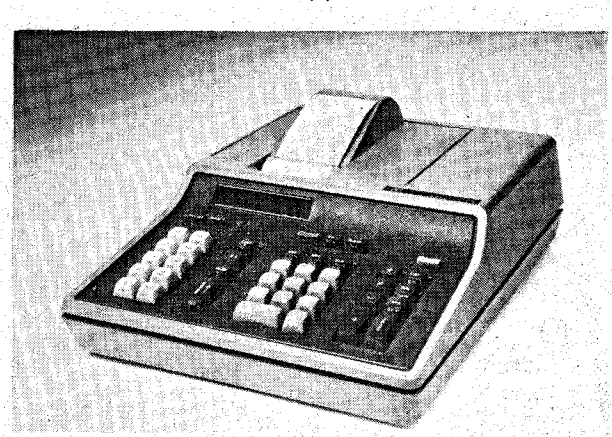
The next most important feature, available only on a few machines, (eg Casio 121, Facit 1134, MITS 1440 and National J 8600) is the capability of calculating square roots. The only other way of obtaining square roots is to use tables or Newton's approximation. The last is accurate but time consuming.

For problems requiring capabilities



The recently released Panasonic 860 from National has square root and pi keys, nickel-cadmium batteries and charger.

Hewlett-Packard's HP-45 battery-powered scientific calculator.



Hewlett-Packard's HP-46 desktop scientific calculator, with printer.

beyond those described above, the only alternative is the so-called 'Scientific Calculator'.

SCIENTIFIC CALCULATORS

The scientific calculator is organised in a completely different way to the extended four-function machines described above. The display is organized so that numbers are represented in scientific notation wherever the number exceeds a certain number of digits. Scientific notation is the system of representing numbers by a one whole number and decimal system and a power-of-ten multiplier. For example one gauss equals 0.006452 lines per square centimetre. This would be represented in scientific notation as 6.452×10^{-3} and would be entered in the calculator as 6.452 –03, the last two digits representing the exponent. Thus numbers within the range 10^{-99} to 10^{+99} are quite readily handled by such machines.

These calculators also have keys allowing trigonometric, logarithmic or other transcendental functions to be performed. Such calculators therefore have all the capability of a slide-rule but much higher accuracy.

During the production of this article, Hewlett Packard announced that their HP-35 scientific calculator which formerly sold at $435 (inc tax) has been reduced in price to $266 (inc tax). This puts the machine well within the reach of the engineer, and mathematician, and it is undoubtedly the most powerful machine for the money available today. In addition, a new machine – the HP45 – has been introduced. This has 40-function capability, four-register stack operation, and nine addressable memories – a truly powerful calculator. It is the same size as the HP-35 (will fit in a shirt pocket) and sells for $356 (tax paid)!

A desk top model (HP46) having the same capability as the HP45 has also been introduced. This machine has a built-in printer.

To summarise, before buying make sure you understand what your requirements are, and what a particular brand of calculator will do. This involves actually performing calculations on a machine and comparing one against another. Choose carefully, for a calculator is an expensive but very worthwhile tool.

(Turn to next page)

CALCULATORS CURRENTLY AVAILABLE IN AUSTRALIA

Company	Model	Price	No. of Digits	Type of Display	Memory	Constant	Percentage	Exchange	Square root	Floating point	Fixed point	Round Up	Round down	Distributor	Size mm	Power AC	Power DC	Power Nicad
Advance	Mini-Executive	$87	8	LED		✓				✓	2			Jacoby Mitchell		A	✓	A
Canon	LE80	$155	8/16	LED		✓				✓				Canon (Aust)	83x146x36	A	✓	✓
	LE80M	$190	8/16	LED	✓	✓				✓					83x169x36	A	✓	✓
	LE810	$198	8/16	Planar	✓	✓				✓	0,2	✓			190x250x77	✓	✓	—
	Pocketronic	$189	12/24	Thermal Printer		✓					4				101x208x49	A	—	✓
Casio	8E	—	8	LED		✓				✓				Remington Rand	45x80x149	A	✓	—
	Casio-mini	$67	6/12	Fluorescent										Remington Rand	41x77x146	—	✓	—
	√121 — S	$345	12	Fluorescent	✓	—		—	✓	✓	0—6	✓	✓	Remington Rand	65x180x206	✓	—	—
	√162 — A	$495	16	Fluorescent	2				✓	✓	0—8	✓	✓	Remington Rand	76x241x317	✓	—	—
	101 — L	$250	10	Fluorescent	✓	✓				✓				Remington Rand	65x180x206	✓	—	—
	121 — L	$335	12	Fluorescent	✓	✓	✓			✓	0—6	✓	✓	Remington Rand	65x180x206	✓	—	—
Compuad (Systek)	Super 10	$100	10	Fluorescent		✓	✓	✓		✓	2,4,6,			Compuad (Aust)	56x145x200	✓	—	—
Facit	1114	$200	8	Itron tube		✓				✓	2,4			Philips Data Systems	152x223x82	✓	—	—
	1118	$300	12	Itron tube	✓	✓	✓				0—6	✓	✓	Philips Data Systems	220x90x252	✓	—	—
	1134	$500	16	Nixie	2	✓		✓	✓	✓	0—7			Philips Data Systems	301x330x100	✓	—	—
Friden	1115	$200	12	Nixie		✓				✓	0,2,5	✓		Singer Business Machines	100x255x325	✓	—	—
	1117	$300	12	Nixie	✓	✓				✓	0—9	✓	✓		100x270x310	✓	—	—
	1118	$500	14	Nixie	2					✓	0—9	✓	✓		100x270x310	✓	—	—
Hanimex	BC807	$99	8	LED		✓				✓	2,4			Hanimex	76x127x32	A	✓	—
	BC8KF	$109	8	LED		✓				✓	2,4			Hanimex	76x127x38	A	✓	✓
	MC1202	$139	12	Nixie							✓			Hanimex		✓		
Heathkit	IC2009 kitset	$92	8/16	LED		✓				✓				Heathkit (Aust)	76x133x43	A	—	✓
Hewlett Packard	HP35	$266	10+	Scientific calculator (17 function) one memory										Hewlett-Packard (Aust)	147x81x33	A	—	✓
	HP45	$356	10+	Scientific calculator (40 function) 9 memories											147x81x33	A	—	✓
	HP46	$626	10+	Scientific desk calculator with printer (40 function) 9 memories											277x394x140	✓	—	—
	HP80	$356	10+	Scientific notation programmed for business problems											147x81x33	A	—	✓
JAYEM (Systek)	ICI0K	$100	10	Fluorescent		✓	✓	✓		✓	2,4,6			Jacoby Mitchell	56x145x200	✓	—	—
MITS	1206	$60	6/12	LED							2,4			W.H.K. Electronics	146x82x38	—	✓	—
	1209	$80	9/12	LED							2,4				146x82x38	—	✓	—
	1212	$100	12	LED							2,4				146x82x38	—	✓	—
	816	$180	8/16			✓					0—7				222x324x102	✓	—	—
	1440	$250	14	LED	✓			✓	✓		0—9				222x324x102	✓	—	—
	7400A	$380	14	LED	2	Scientific (3 registers) 17 functions									222x324x102	✓	—	—
	7400B	$400	14	LED	2	Scientific (5 registers) 17 functions									222x324x102	✓	—	—
	7400C	$420	14	LED	2	Scientific (7 registers) 17 functions									222x324x102	✓	—	—
National	JE88OU	$110	8	Fluorescent		✓				✓				McDougall's Office Equipment	83x133x31	—	✓	—
	JE86OU	$195	8	Fluorescent		✓			✓	✓	(has π key)				100x165x45	A	✓	✓
	JE801	$150	8	Fluorescent		✓				✓	0,2,4	✓			173x192x65	✓	✓	—
	JE1210	$295	12	Fluorescent	✓	✓	✓	✓		✓	0—7				270x178x71	✓	—	—
Ricoh	1213	$305	12	Fluorescent	✓	✓	✓	✓		✓	0—6	✓	✓	Hanimex	140x185x70	✓	—	—
	1215																	
	1000P	$269	—	Printer	✓	✓					0—4	✓			230x295x91	✓	—	—
	1010P	$339	—	Printer	✓	✓		✓			0—4	✓			230x295x91	✓	—	—
	1610	$345	16	Fluorescent	✓	✓	✓	✓		✓	0—7	✓	✓	Hanimex	93x225x330	✓	—	—
Sanyo	ICC805	$100	8	Fluorescent		✓				✓	0—5			Sanyo (Aust)	150x235x70	✓	—	—
	ICC810	$100	8/16	plasma						✓					92x152x33	A	✓	—
	ICC1416	$400	14	Printer	✓	✓		✓			0,2,3,4,9	✓	✓		275x365x120	✓	—	—
	ICC3101	$300	12	Fluorescent	✓	✓	✓	✓		✓	0,2,3,4,6	✓	✓		135x52x210	A	—	✓
Sharp	EL801	$140	8	LED		✓				✓				Sharp (Aust)	74x29x104	A	✓	✓
	EL811A	$300	8/16	Fluorescent	✓					✓	(last 8 digits available by switch)				70x62x102	A	—	✓
	EL814	$190	8	LED	✓	✓				✓					89x31x148	A	✓	✓
	Space prevents inclusion of the entire under $500 range from Sharp (15 machines available including printing & 2 memory models)																	
Sony	ICC-88	$280	8	Planitron										Dataprint Pty Ltd	176x49x100			
	ICC-100	$395	16	Planitron	✓										228x80x280			
	ICC-200	$495	16	Planitron	2				✓	✓					210x66x248			
Toshiba	BC0802	$149	8/16	Digitron		✓				✓	0,2			Hanimex	130x54x210	A	—	✓
	BC1204	$169	12/24	Digitron		✓		✓		✓	0,1,2,4,8	✓	✓		166x65x240	✓	—	—

No of digits: Where the number of digits is not specified as for example 8/16 this means that eight digits are displayed but the machine has a 16 digit accumulator allowing a meaningful answer from the multiplication of two eight-digit numbers.

Prices: Prices quoted are recommended retail only

Power supply: The letter 'A' under ac indicates mains operation by separate mains adapter or battery charger.

SENSORS ON

A new, regular monthly feature by 'Talus'

Australia — and solar energy

AMERICA's fuel supply must be rapidly dwindling for the Nixon administration will soon release an emergency plan to restrict the use of energy supplies. In reporting this, the US news media also stated the use of 3 10^6 gallons of jet fuel used by the US armed forces per day bombing Cambodia. This gives an idea of the immense rate of consumption by the Northern Americans — and also an insight into their apparent affluence — not many nations could afford such luxuries. (sic).

Somehow, here in Australia, we feel untouched by world problems. We have been lucky — no serious political unrest on the continent, a common government on one land, plenty of natural resources, no real scars of war — perhaps these and other factors give us a false sense of security.

Much public money is put to ensuring our primary export trade — a lot less goes to technology. We have no equivalent to the atomic submarine, the high speed train, the supersonic transport aircraft, the supertanker or the integrated automatic manufacturing plant. No! We seem all the time to buy it in or follow the leader in the technologies. We are no longer an infant country — not even emergent anymore, so where are our comparable achievements, pro rata, in the world of applied science and engineering?

It was then, very heartening indeed to read of Professor Watson-Munro's statements in the national press — and in Search, April, 1973 — regarding the use of solar energy. (He heads a committee formed by the Australian Academy of Sciences to report on the future use of solar energy in Australia).

I would think the advantages of solar power are obvious — virtually unlimited supply (especially if clouds are not a problem), clean at source, delivers itself to where it is needed, and, perhaps, clean conversion to other forms. But there are, at present, cost disadvantages.

A thorough study has been made of the many ways to exploit solar energy — it is simply a matter of how to convert it and store it at economic cost. Not only photo-electric methods can be used; for example, trees can be grown and burnt to provide energy for conventional power-stations.

Using photo-electric methods, efficiency is currently said to be about 10%, and the costs per square metre about $100 000. Research in the USA today aims for costs of $10 — $100 per square meter.

Australian scientists have made useful contributions in the use of solar energy — hot water heating systems using copper roof sheets; air temperature control in private and public dwellings (using rock beds under the floor that act to average the temperature by appropriate pumping of ambient air in or out of the storage bed — many schools in construction are using this method; solar sills to produce water in arid regions.

The suggestion made by Professor Watson-Munro is that we embark on a modest programme to develop our abundant natural solar energy. But perhaps it should not be *too* modest. This could be our second international technological claim to fame. (The Opera House, I believe was the first). We have the expertise, the plant and the right source of energy. How would we finance a really large programme? From my secure pulpit I can easily suggest ideas, whether they are feasible is another matter. But let us consider a few.

The first that comes to mind is public subscription — not on, you say! But the Opera House was largely funded that way using lottery proceeds. Wrest Point Casino in Tasmania is going well. It all depends on the use of the word 'subscription'.

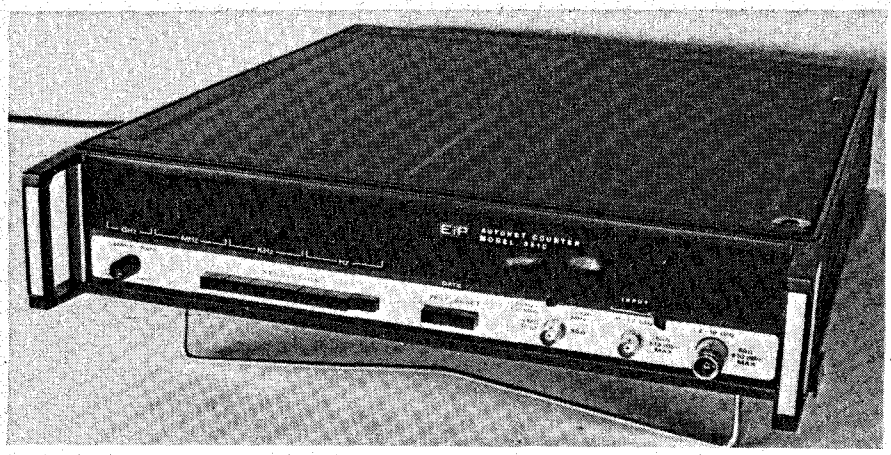
A second way is to levy all natural resources at present being exploited. Earmark these funds for research into the more efficient use of the resources and for other socially applicable technological needs.

A third way is to copy the Japanese (reverse the game they played on the world during their reconstruction era in the post 1945 years). They finance ship research from the proceeds of motor boat racing, agricultural research from horse racing, transport from motor racing. Would it not perhaps be a natural progression to finance solar energy from surf carnivals and sunbaking on the Barrier Reef and Gold Coast?

The direct conversion of solar energy to electrical form fits in well with the trend toward electric vehicular propulsion. Many of the ideas put forward to convert solar power so far are not, however, as convenient to use as a gallon of petrol or a bottle of natural gas, and as many of our individual demands are related to portability, the conversion of solar energy to electrical energy must be an important matter to research. ●

EQUIPMENT NEWS

DIGITAL READOUT FREQUENCY COUNTER COVERS 20Hz to 18GHz



A completely automatic digital readout frequency counter with very fast yet highly accurate readout and the very wide range of 20Hz to 18GHz has been developed in the USA by EIP Inc., of California. The counter is available in Australia through Jacoby, Mitchell Ltd. The instrument's outstanding performance results from a specially developed Autohet circuit, that uses two digitally programmed YIG-tuned converters to translate any CW signal into the range of a 210MHz counter. This technique is basically the same as that used in the conventional manually tuned heterodyne converters. The unit is claimed to measure frequency, even of signals with a considerable component of FM, 30 to 1000 times faster than any other automatic frequency counter currently available.

The EIP Model 351 Autohet Frequency Counter steplessly covers the range 20Hz to 18GHz. Also available is the Model 350B, with range coverage of 20Hz to 12.4GHz.

This broadband coverage is achieved without loss of performance. Accuracy of both models is claimed to be ±1 count ±the stability of the crystal time base (less than 5 parts in 10^9 per 24 hours). For particularly critical applications, where the highest degree of accuracy is necessary, this figure can be further improved by using an external reference, or one of a range of optional higher stability time bases available from the makers (typically better than 5 parts in 10^{10} in 24 hours).

The designers have taken particular care to simplify accurate frequency measurements, and models of the 350 series incorporate a number of innovations to this end. For example, the 11-digit readout has been conveniently sectionalised in GHz, MHz, kHz and Hz. Confusing gate time and measurement units necessary with conventional counters are unnecessary with the 350 series, because of its high resolution and fast reading time; resolutions of 10Hz and 1Hz are obtainable at maximum rates of 10 readings/sec and 1 reading/sec respectively. For applications where less resolution is required, push-button display blanking is provided to simplify the readout by turning off unwanted digits.

Further details from: Jacoby, Mitchell Ltd, 215 North Rocks Road, North Rocks, NSW 2151.

LABORATORY MULTIPOINT RECORDER

Philips have released a compact multipoint laboratory recorder, which also operates as a multi-range instrument. The company's Test and Measuring Instrument Manager, Mr. Bill Robbie, announced the unit as the PM8235, the first in a new series of recorders from Philips.

The PM 8235 is claimed to be the first multipoint instrument designed especially for laboratory applications and eliminates shortcomings evident in traditional multipoint recorders which say Philips, are really industrial instruments adapted for laboratory use.

A very important aspect of the instrument's versatility is its use of plug-in range modules that considerably extend its input capabilities. Use of these modules ensures that the PM 8235 can function as a single-range one-to-twelve point recorder, as a twelve-point 6-range unit, or as a multi-range instrument. With the multi-range input module, the recorder has a sensitivity that is adjustable from 1 mV to 5 V full scale in twelve calibrated steps, with a non-calibrated control that extends full-scale sensitivity to 0.3 mV.

On the six-range module, full-scale sensitivities can be preset with the respective printed-circuit range boards. Range sensitivity is determined by interconnections made between range cards and channels via a pin-board matrix. Virtually any range sensitivity can be used with any channel.

With the single-range module, range cards for millivolt, milliamp, thermocouple, resistance-thermometer, and other inputs are available, as for the six-range module. Those employed with thermocouple inputs, etc. feature automatic cold-junction compensation. Also noteworthy is the fact that through use of the pin-board matrix any given number of channels can be employed, thereby adapting the recorder to a given application need.

NON-DESTRUCTIVE TEST EQUIPMENT

A versatile, thermal problem-solver now available from DC Electronics Pty. Ltd. is claimed to be able to detect faults and imminent failures – structural or operational – in practically every conceivable industry.

Known as the Thermo-Imager, the equipment comprises an infra-red camera and a display unit. The camera detects the thermal emission of an object, converts it into electrical signals, and passes these signals to the cathode ray display tube. The visible image shows warmer areas light, cooler areas dark, and may be recorded magnetically or on film for permanent records.

A visual view-finder provides parallax-free target location, and the camera sensitivity is independent of the object's distance: measurements can be made from several hundred yards. Normal focus and close-up zoom controls are provided, and sensitivity is adjustable to give full scale (black-to-white) over a temperature range of as little as 1°F, or the maximum of 3600°F.

The Thermo-Imager is claimed to be the lightest, smallest, and lowest cost IR imaging system commercially available. Applications range from testing active electronic components to power distribution lines: detecting crop diseases or forest fires: monitoring jet engines or refrigeration systems.

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

MINIATURE ELECTRONIC SCOREBOARDS

The British company Hird-Brown Ltd, responsible for the giant scoreboards used during the recent Olympic Games in Munich, Germany, are now producing miniature electronic scoreboards for smaller sports arenas and indoor halls.

Typical applications are for volleyball, basketball, badminton, handball, ice hockey and any other game whose scoring and timing procedure fit the display layout of the boards. If desired, several units may be installed.

Two sets of three digits form the top line display to indicate scores of opposing teams or competitors. Up to 199 can be indicated. The middle row of digits is a time-elapsed clock showing minutes and seconds which can, if required, be counted down from 45 minutes.

In the bottom row are four indicator lamps to mark which time period is being counted and there is a klaxon to warn of the start and finish of each period.

Boards are supplied complete with remote control consoles. Where several boards are installed, a composite console may be used to operate all of them from a central point.

Further details from: Technical and Scientific Equipment Co. Pty. Ltd., GPO Box 1726 P, Melbourne, Vic. 3001.

STRIP CHART RECORDER

The latest version of the Gulton Techni-Rite TR-711 analog strip chart recorder weighs only 10 pounds, and is protected by a cast aluminum case (finished with scratch-proof epoxy enamel) that will withstand rugged field use. It will record voltages as low as 10 mV per division over a frequency range of dc to 125 Hz. Accuracy is 1% with a drift characteristic of 1/3mm per eight hours. Chart speeds from 1 through 50 mm/sec. are switch selectable.

A heated stylus records on a 40 mm wide channel using no ink, and provides clear, clean and crisp traces without the maintenance requirements associated with ink-writing recorders. The latest integrated circuitry is used in the pen motor/amplifier located within the pen motor. Stylus limiters built into the pen motor/amplifier precisely limit the excursion of the stylus, and protect the stylus from signal overload.

Power required is 240 Vac, 50 Hz, 25 watts. Optional 12 Vdc operation available.

Further details from: D.C. Electronics Pty. Ltd., 32 Smith Street, Collingwood. Vic. 3066.

CLIP-ON PEN FOR HIGH-SPEED SINGLE-CHANNEL RUNS

With a claimed accuracy of 0.25% and a 0.1% reproducibility, the PM 8235 features a wide range of chart speeds that vary from 20 minutes/cm to 0.01 minutes/cm. The instrument's print interval is adjustable from 1 to 20 seconds, and by pulling out a knob it is possible to stop the instrument's scan so that the recording on a given channel can be studied in detail. Also important in the above context is a special clip-on pen that can be used during single-channel runs to provide a continuous record of a given trace.

The recorder also offers remote-control facilities permitting operation of the instrument's chart transport in synchronization with outside events via a stepping motor. Further facilities available on the instrument as optional extras include two slave potentiometers for remote indication of the recorded variable, maximum and minimum setpoint potentiometers, and an event marker.

EDITORIAL RESPONSIBILITY

Each month, Electronics Today International contains editorial sections entitled Component News, Equipment News and Audio News.

These sections are prepared from material supplied to us by manufacturers and in the majority of cases our staff has not seen or reviewed the items described.

It must be appreciated therefore that statements or claims concerning the operation of any items described are manufacturers' claims and are not in any way endorsed (or otherwise) by this magazine.

Material published in these sections is reproduced completely free of charge. The final decision whether or not to publish any specific item rests with the Editor. Preference is given to equipment or components that have unusual or wide technical interest.

Continued on page 107.

INTRODUCING MINI-SONALERT

Mini-Sonalert is the latest addition to the Mallory range of electronic audible signalling devices.

It is compact, lightweight and highly versatile, consumes less current than a normal indicator light and can be used to complement visual signals. The Mini-Sonalert employs the same solid state circuitry as the larger SC628 and SC628P models, also illustrated, to ensure maximum efficiency, lowest current requirements and highest reliability.

Instant, positive and penetrating audible warnings are emitted, making this miniature device ideally suited for use in fault alarms for computers, fire signals, instruments, medical electronics, appliances, communications, telephone signals and protection equipment.

Five Mini-Sonalert models are available in operating voltages ranging from 1 to 30 VDC whilst corresponding current requirements range from 4 to 16 mA.

Sound output is from 60 to 70 db @ 25°C at a frequency of 3,500 Hz ± 500 Hz (depending on model and applied voltage).

All models are available ex stock.

Literature is available on request to the Professional Components Division.

PLESSEY

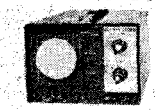
Plessey Ducon Pty. Limited
Box 2, P.O., Villawood, N.S.W. 2163
Telephone 72 0133. Telex 20384
Melb.: Zephyr Products Pty. Ltd. 56 7231
Adel.: General Equipments Pty. Ltd. 63 4844
Bris.: Douglas Electronics Pty. Ltd. 97 8222
Perth: H. J. McQuillan Pty. Ltd. 68 7111
Everett Agency Pty. Ltd. 8 4137
Henderson (N.Z.): 64 189

AC 81

TRIO OSCILLOSCOPE Model CO-1303A.

DC – 1.5MHz. 75mm Solid State Oscilloscope

This is an all solid state 75mm scope, with outstanding performance features-vertical sensitivity of 20mV/cm, frequency response from DC to 1.5MHz – despite its small size and ease of operation. Lightweight and portable, it will prove to be a very handy and reliable instrument in electronic equipment assembly centres, school class-rooms and amateur radio stations for a wide range of scope applications. Sweep frequency 10Hz – 100KHz in 4 range. 100v (or 117/230v) AC 50/60Hz 15 watts. Complete with operating instructions and Data.



Price: $155.00 Post $1.50.

MJ COMPONENTS
EVERYTHING IN ELECTRONICS

SALE CENTRES: 95-97 Regent Street, Redfern, N.S.W. 2016. Telephone 69-5922.
188-192 Pacific Highway, Gore Hill, N.S.W. 2065. Telephone 43 5305.

HEAD OFFICE: & M.O. DEPT.: 1st floor, Suite 2, 168 Redfern Street, Redfern, N.S.W. 2016. P.O. Box 156, Redfern 2016.

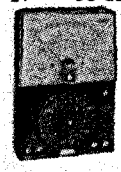
MULTIMETERS

Superior type made by SANWA

TYPE A-303TRd – $28.35 plus 50c post and Packing.

The 20,000 ohm per volt instrument with just about every useful facility combined with a 44 micrampere meter movement. Compare the specifications and notice: LI and LV scales, dB range, 25KV probe available, add to that, protected movement, and AC voltage frequency up to 100KHz for lower ranges.

Measurement Ranges: DCV 0.3 1.2 3 12 30 120 300 1.2K 6K (20KΩ/V). ACV 6 30 120 300 1.2K (8KΩ/V). DCA 60μA 3mA 30mA 300mA 12 amp (300 mV). OHMS R x 1 R x 100 R x 1K R x 10K (MAX 50 M ohm). L.I. 60mA 600μA 60μA. LV 1.5V 1.5V 1.5V. DB -10~+17~+63 dB.



Type U50DX – $20.55 plus 50c post and Packing.

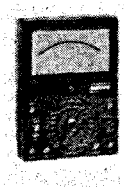
High performance circuit tester of 35 microampere sensitivity. Protection circuit safeguards the movement. Mirrored scale. dB range. 5/25 amp shunt and 25KV probe available.

Measurement Ranges: DCV 0.1 0.5 5 50 250 1000V (20KΩ/V). ACV 2.5 10 50 250 1000V (8KΩ/V). DCA 50μA 0.5mA 5mA 50mA 250mA. OHMS R x 1 R x 10 R x 100 R x 1K (MAX 5M ohm. DB -20~+62 db. Capacity 0.0001~0.2μF. MEGOHM 1~500 M ohm. USE EXTERNAL POWER

Type 450ED – $52.00 plus 50c post and Packing.

100,000 ohms per volt with ±2% accuracy for DC ranges with only 10 microamperes loss at full sclae. H.F. current blocking when making DC measurements Polarity switch 12 amps AC AND 12 amps DC ranges, Mirrored scale. 30KV probe available.

Measurement Ranges: DCV (±) 0.3 3 12 30 120 300 (100KΩ/V) 1.2K (16.6KΩ/V). ACV 3 12 30 120 300 1.2K (5KΩ/V. DCA (±) 12 μ A).3mA 30mA 300mA 1.2A 2A (300mmv). ACA 1.2A 12A (300mV). OHMS R x 1 R x 10 R x 100 R x 10K (MAX 50M ohm). DB -20 ~+63.



Type P-2B – $12.50 plus 50c Post and Packing.

Electricians and Handy-man's pocket sized instrument. East operation makes even the beginner master of this fine instrument. Internal resistance 200Ω/V for AC and DC.

Measurement Ranges: DCV 10 50 250 500 100V ACV 10 50 250 500 1000V. DCA 0.5mA 10mA 250mA OHMS 1m~500K ohm. DB -20~+22 dB and + 20~+36dB. MEGOHOMS 0.1~50 MΩ CAPACITY 0.0002 @ 0.3μF 0.1 ~0.6μF WITH EXTERNAL POWER.

AND NOW FROM MSC!!

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THE GREATEST COMPONENT VALUE EVER OFFERED. ASTOUNDING SAVINGS BROUGHT TO YOU THROUGH OUR BULK PURCHASING ...

'TRIMPAC' Plessey miniature trimming Potentiometers, Types V10k5 & PMD. 21 different values from 100 ohms to 2 megohms. All P.C. mounting. ONLY **$2.50** plus 15c post.

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'CAP-PAC 50 assorted High grade electrolytic capacitors. All useful values & voltages. Guaranteed quality. ONLY **$6.50** plus 30c post.

'REEDPAC' 5 each of the following REED switches, Type XS14 Normally Open, 150v AC, 250V DC, 3 watts resistive load, Type XS4/2 Normally Open, 200v AV, 250v DC. 5 watts resistive load. Normal value of these is **$13.00.** OUR PRICE ONLY **$4.75** plus 20c post.

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'KNOB-PAC' 20 assorted GOLD & SILVER finished knobs. Mainly Radio & Television types. ONLY **$2.00** plus 20c post.

'ZENAPAC' 15 different values of the BZY88 series Zeners by Mullard. Rating 400 mW. The following voltages are available: 3.6v, 3.9v, 4.3v, 4.7v, 5.1v, 5.6v, 6.2v, 6.8v, 7.5v, 9.1v, 8.2v, 10v, 12v, 20v & 30V. Complete Pac ONLY **$7.00** plus 12c post.

'JACKPAC 1' 20 3.5mm Jack Sockets. ONLY **$1.60** plus 12c post.

'JACPAC 2' 10 3.5mm Jack Sockets, shrouded. ONLY **$1.00** plus 12c post.

'JACPAC 3' 10 2.5mm Jack Sockets, shrouded ONLY **$1.25** plus 12c post.

ALL THE ABOVE COMPONENTS ARE GUARANTEED NEW & UNUSED ... NO REJECTS.

EXTENDING AERIALS

Transistor or Television type. Sturdily made & finished in heavy chrome. Extends from 6" to 36". Totally directional due to the integral swivel base. Only from M.S.C. can these be bought at the fantastic price of $1.15c each or 2 for $2.00. Post & Pkg. 25c.

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The CHEAPEST OF 'EM ALL SEMICONDUCTORS AT UNBEATABLE PRICES

Manufactured by N.S. ELECTRONICS – S.T.C. – PHILIPS MOTOROLA – FAIRCHILD – G.E.

BZY88 Series ZENER Diodes – 400Mw Rating.

P.B.40 – 25A 400V Bridge Rectifier $6.70c	
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P.A.60 – 8A 600V Bridge Rectifier $5.90c	
BC107 (BC147)	6 for $1.95
BC108 (BC148)	6 for $1.95
BC208	6 for $1.85
BC109	6 for $1.95
TT797	$1.15
TT798	$1.15
TT800	$1.15
TT801	$1.15
BC177 (BC157)	50c
BC179 (BC159)	50c
2N3055	$1.50 or 2 for $2.75
2N5485 F.E.T.	2 for $2.15
2N5459 F.E.T.	2 for $1.75
2N3638	2 for $1.00
2N3638A (moulded)	2 for $1.20
TC1102 TRIAC 400v 6A, & Diac	$2.75
OA95 115v Signal Diode	10 for $1.50
EM401 100v 1A Rectifier	10 for $1.95
EM404 400v 1A Rectifier	8 for $1.95
EM408 800v 1A Rectifier	5 for $1.95
EM410 1000v 1A Rectifier	4 for $1.95

All above plus 10c post

BZY88/3.6V-12V zener diode – 50c
BZY88/13V-30V zener diode – 65c

100's of others in Stock

Please send your enquiries.

ALL NEW ALL GUARANTEED

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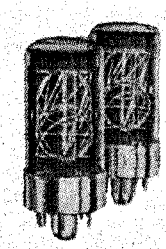
SCOOP PURCHASE OF 'RODAN' DIGITAL INDICATOR TUBES

Type GR-112. Electronic Gas-filled Cold Cathode display device. In-line 9 – 0 Side viewing. Complete with 14 pin Tube Base.



Specifications:

Anode Supply Voltage (Vdc) Min.	200v
Ionization Voltage (Vdc) Max.	170v
Cathode Current (mA DC).	5 m/a
Power consumption per Electrode	1W
Diameter of Glass Tube	30 mm
Height of Tube (Excluding pins)	63 mm ±3
Height of Digits	35 mm
Colour of Display digits	Neon Red

MSC Price ONLY $4.35 plus 20c post Under ½ of normal price. LIMITED QUANTITIES ONLY.

HOURS OF TRADING

Mondays to Wednesday and Friday: 9 a.m. to 5.30 p.m.
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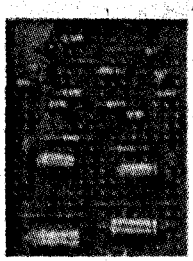
SCOOP PURCHASE!!

'VORTEX' Stereo Cassette Deck mechanism with Tape eject facility and resettable counter. Easily operated by 5 push-button (Piano key) controls, and includes High Quality "ALPS" recording or play-back head and erase head. Tape speed 4.75cm (1-7/8") sec. Plus or minus 1.5% Wow and flutter less than 0.25%. Operates on 250VAC. Fantastic value at only **$28.00** post free.

Full data and specifications now supplied FREE with each purchase.

STEREO TAPE ADAPTOR KIT



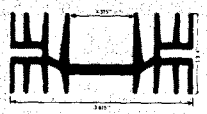
Kit consists of all necessary components and instructions to construct this Unit which is designed to operate with the 'VORTEX' Stereo Cassette Deck. Technical Data: 2 channel amplifier internally equalised to accept signals from tape heads and converts it to feed any amplifier system. Max. output 200m/V. Freq. response 25Hz. Power requirements are 18 volts at 6m/a., which can be supplied by 2 x 9v batts. Complete kit of parts **$6.25** plus 25c post.

MiniFin

HEAT EXCHANGERS

Black anodized finished. Special feature of serrated fin sections that will accept fixing screws for easy fixing to chassis.

2"	$2.40
3"	$3.00
4"	$3.60
6"	$4.80



All plus 25c post.

WINSTAR Miniature Transistor Type Speakers

TYPE 'A'
3" 8 ohms
$2.00 plus 20c post

TYPE 'B'
2¾" 8 ohms **$1.85** plus 20c post.

ALL NEW AND INDIVIDUALLY PACKED

PLESSEY 3 + 3 AMPLIFIER.

Beautifully packed easy to build kit. includes volume, bass and treble controls, power supply components (Transformer not included) and Plessey I.C.'s. Complete with comprehensive instructions. Price **$27.50** plus 50c post. (Transformer to suit **$4.75** plus 25c post)

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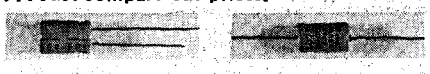
Top Grade ... No hidden Surcharges or Tariffs. LOWEST IN THE COUNTRY ... Just compare our prices.



Cap (Mfd)	VW	Type	Price ea.
1	25	PT	13c
1	50	PT	15c
1	50	PC	15c
1	350	PT	23c
2.2	25	PT	14c
2.2	25	PC	14c
2.2	50	PT	15c
2.2	50	PC	15c
2.2	350	PT	30c
3.3	25	PT	13c
3.3	50	PC	16c
3.3	50	PT	16c
4.7	16	PC	14c
4.7	25	PT	15c
4.7	25	PC	15c
4.7	50	PT	16c
4.7	50	PC	16c
10	16	PC	15c
10	25	PT	17c
10	25	PC	17c
10	50	PT	20c
10	50	PC	20c
10	160	PT	45c
10	350	PT	55c
22	25	PC	15c
22	25	PT	15c
22	50	PT	20c
22	50	PC	20c
24	250	PT	40c
33	10	PT	14c
33	10	PC	14c
33	16	PT	16c
33	16	PC	16c
47	10	PT	12c
47	10	PC	12c
47	16	PT	16c
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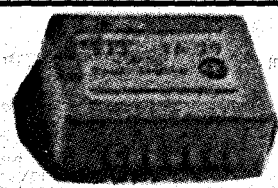
47	25	PT	19c
47	25	PC	19c
47	50	PT	23c
47	50	PC	23c
100	10	PT	12c
100	10	PC	12c
100	16	PT	19c
100	16	PC	19c
100	25	PT	23c
100	25	PC	23c
100	50	PC	28c
100	350	PT	75c
220	16	PT	24c
220	16	PC	24c
220	25	PT	27c
220	25	PC	27c
220	35	PT	35c
220	50	PT	37c
220	50	PC	37c
330	16	PT	24c
330	25	PC	27c
330	50	PC	57c
470	10	PT	27c
470	10	PC	27c
470	16	PT	30c
470	16	PC	30c
470	26	PC	38c
470	50	PT	62c
470	50	PT	62c
470	50	PC	62c
1000	25	PT	58c
1000	25	PC	58c
2200	16	PT	63c

POSTAGE 10c
SPECIAL PRICES FOR QUANTITY ORDERS



I.T.T. 20 & 25 WATT HYBRID AUDIO POWER AMPLIFIERS. Now the lowest price in the Country. Outstanding features:— Single-ended push-pull circuit ... Can withstand a 5 second short-circuit across the output terminals ... No external components required, full protection & temperature compensation ... Harmonic distortion less than 0.5% at full power ... Frequency range 20Hz to 100KHz at 1 W output, 20Hz to 20KHz at full power output.

TA20 42v/55v ..... $6.50 plus 25c post
TA25 48v/55v ..... $7.50 plus 25c post
TA20C 22v/29v ..... $12.00 plus 25c post
TA25C 24v/32v ..... $14.50 plus 25c post,
Data sheets supplied for each amplifier

ANOTHER SMASH HIT FROM M.S.C. ...

Special purchase of INTEGRATED 3 WATT AUDIO POWER AMPLIFIERS. Type M5102AY complete with necessary diode. 10 pin I.C. in modified JEDEC T03 Case. Vcc + 13.8 volts Max 18 volts. Full Data sheet and layout wiring supplied.

ONLY LIMITED QUANTITIES AVAILABLE ... ONLY **$3.25** each Plus 12c post or 2 for **$6.00** plus 15c post.

M.S.C. DOES IT AGAIN

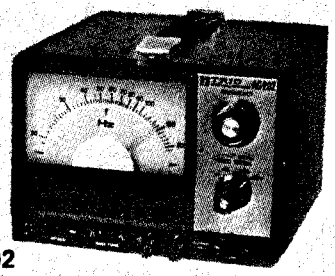
Exclusive purchase of High Quality REED RELAYS

Tubular Type mftd. by OKI of Japan.
Type MRD-112 250ohms 6v D.C. Type. MRD-113 800ohms 12v D.C. Type MRD-114 1500ohms 18v D.C. Type MRD-116 4800ohms 48v D.C. **All the above are Single Make and Break Contact.** All **$2.25** each.
Rectangular Type mftd. by ELFEIN of West German.
Type 801-2R2 Normally open 24v Single Contact **$1.50.** Type 801-2H2 Normally open 24v Two Contacts **$1.75.** Type 802-1R10 Normally Open Single Contact 6v and 12v **$1.95** Type 802-2R10 Normally Open Two Contacts 6, 12 and 24v D.C. **$2.85.** Type 802-1G6 Normally Open Single Contact 6v **$1.95.** Type 802-1R17 Single Pole changeover 6v **$2.85** Elfein Miniature Tubular Reed Realy Type 830 Normally open Single contact 6v **$1.50** Type 830 Normally open Single contact 12v **$1.50** Data sheets available for MRD — 801 — 802 Reed relays when purchasing. Postage on the above 12c each.

M.S.C. THE 'NO GIMMICK' SQUARE DEAL FIRM ... VALUE FOR MONEY ...
RAPID MAIL ORDER SERVICE AND OF COURSE ... SERVICE WITH A SMILE.

SOLID STATE SINE SQUARE WAVE AUDIO SIGNAL GENERATOR

TRIO



MODEL AG-202

The AG-202 is a Wien bridge CR-type, sine and square wave audio signal generator which is invaluable for high fidelity analyses in the lab, on service benches and in electronic educational classrooms. All solid state in construction, it produces excellent sine waves instantly with a minimum of distortion and square waves with fast rise time that are ideal for hi-fi tests. Input for synchronization with external signal sources has been provided to further enhance the versatility of this fine instrument.

SPECIAL FEATURES

1. Near-perfect sine waves, excellent square waves.
2. Instant signals, superior stability due to all solid state circuitry. No warm-up waiting time needed.
3. 10 V r.m.s. high level output at low impedance. Simple sure attenuation control.
4. Easy-to-read, single dial with frequency readings accurately calibrated in four ranges; smooth dial mechanism.
5. Input provided for external signal sources, synchronization which produces signals of the highest accuracy.
6. Frequency and output level of signals are practically unaffected by line voltage fluctuations.
7. Ideal for high fidelity analyses and test work. Also for educational purposes.

PARAMETERS
PTY. LTD.

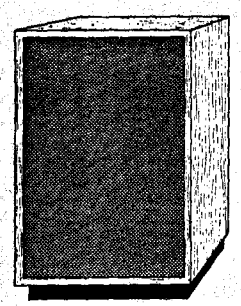
SYDNEY 43 6577 • MELB 90 7444 • ADEL 51 6718

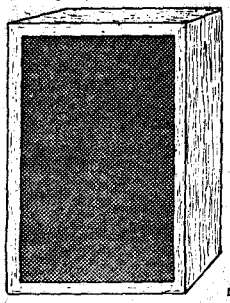
TVT

VICTORIAN DISTRIBUTOR FOR MAGNAVOX LOUDSPEAKERS

Complete speaker boxes and full range of speakers Magnificent units for the music lover at unequalled prices.

The TVT 20
1 — 12" Woofer, 1 — 5" Mid-range,
1 — 3" Tweeter





The TVT 10 This system has been especially designed for maximum performance, space saving, low cost. 1 — 8WR twin cone wide range, 1 — 3TC Tweeter. Complete range available through most wholesalers.

All completely wired with crossover and phased external connectors in large vented enclosures.

Available in Teak and Walnut.

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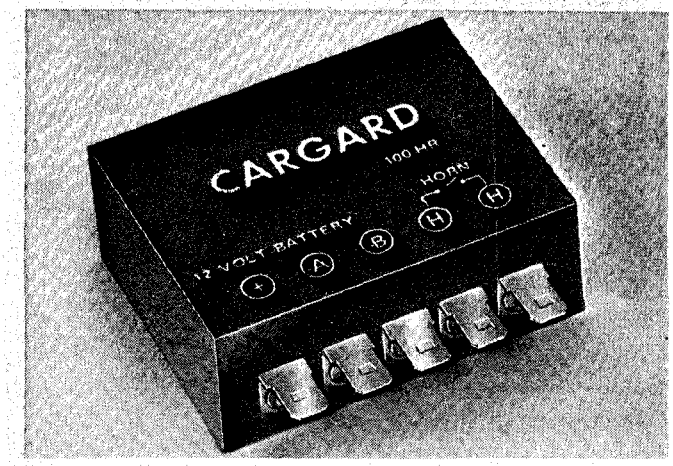
THORNBURY, VICTORIA 3071
TELEPHONE 44-6179

CAR BURGLAR ALARM*

* Aust Patent 34882/71



CARGARD 100 HR*

A fully automatic car burglar alarm which can be installed in minutes in any 12 volt vehicle. (It detects any disturbance in the electrical system of the car e.g. when a door courtesy light operates — so it eliminates all special wiring, door switches and other installation problems). An electronic exit/entry delay is included in the module so the unit can be switched on from inside the car before the driver leaves. The output is a pulsating horn relay which automatically resets after three minutes.

A full set of parts, assembled and tested with detailed instructions for the do-it-yourself man to install in any 12 volt car is available for $29.50 including post and packaging.

CARGARD is fully guaranteed by the manufacturers for 12 months from date of purchase.

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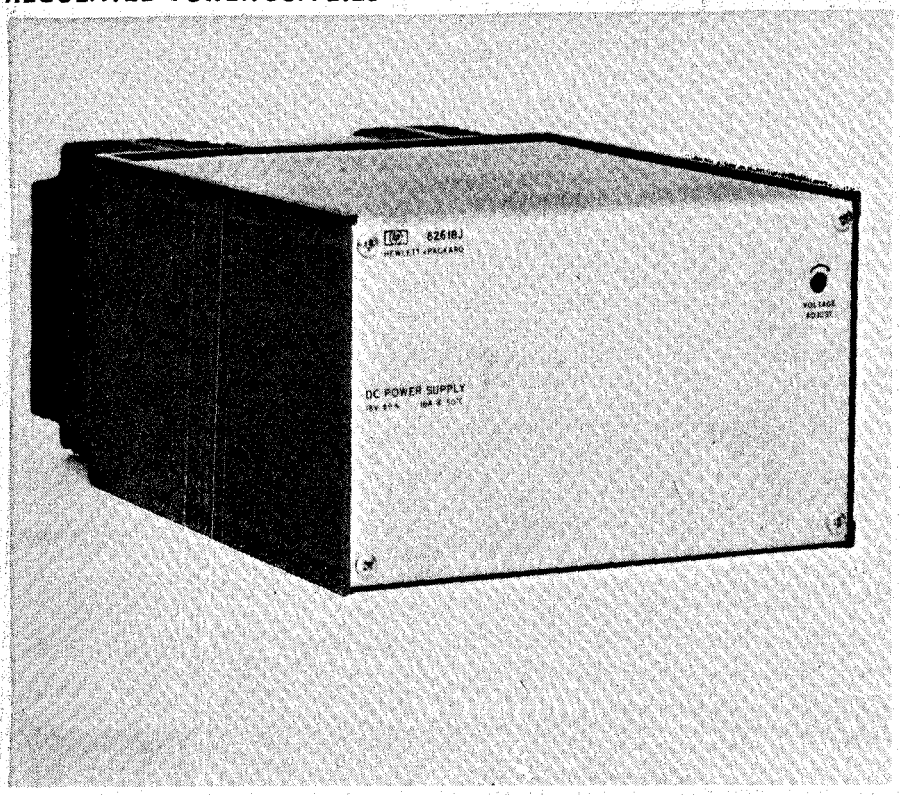
EQUIPMENT NEWS

(Continued from page 102)

NEW MEDIUM-POWER, SWITCHING-REGULATED POWER SUPPLIES



A series of transistor-switching regulated power supplies has been added to the Hewlett-Packard line of modular power supplies. Nine voltage outputs most often used in system, computer and buried OEM applications are available in this 62600 Series. Output ratings range from 4 volts, 160 watts to 28 volts, 300 watts. All units deliver full rated output to 50°C, with linear derating by only 50% at 71°C.

An advanced 20 kHz transistor switching circuit is employed in these new supplies, taking advantage of the foremost virtue of the switching regulator, namely efficiency, coupled with ripple and noise of levels compatible with most low-voltage applications including computer mainframes, digital systems, and systems for industrial process automation; and operating efficiencies up to 80%. Thus the units can be packaged in half-rack width cases (5 inches high by 8 inches wide by 11½ inches deep).

All nine models are specified to 0.1% line or load regulation, 20 mV rms, 60 mV p-p ripple and noise, and 3 ms transient response following a load change from 100% to 50% and 50% to 100%. Overvoltage, overcurrent and over-temperature protection are standard features on all models.

Two no-cost ac input power options are available. Option 101 connects the supply for 220V (nominal), 48-440 Hz operation; option 102 allows 204V, 48-440 Hz is standard.

Further details contact Hewlett-Packard Australia Pty. Ltd. 22-26 Weir Street, Glen Iris, 3146. Phone 20-1371. Branches in Adelaide, Brisbane, Canberra, Perth and Sydney. Also in Auckland and Wellington, New Zealand.

PORTABLE MODULAR FREQUENCY CONVERTERS

A range of static frequency converters for a wide variety of instruments – from process control to aircraft – is claimed to have an overall efficiency of 85 per cent, which is considerably better than that obtained with conventional rotating types.

The modular converters, developed by Moore Reed and Company in the UK provide a sine-wave output of 115 V, 400 Hz from a 240 V 50 Hz supply. They are light in weight and have low acoustic noise and high reliability, requiring little or no routine maintenance. Their modular construction enables assemblies to be custom built.

Devices incorporate solid-state thyristor circuitry and are offered with power outputs from 500 VA to 15 kVA. They are suitable for virtually all applications for which rotary types had previously been the only products available. All units conform to the British Standards for electrical equipment and indicating instruments for aircraft. Full overload protection is provided.

Among the modular converters are a

EQUIPMENT NEWS

phased controlled rectifier (mains to dc), a dc filter, a bridge inverter (dc to square wave), a transformer for voltage adjustment, an ac filter to produce sinusoidal output, a dc control logic device, an ac control logic device, and overload and circuit protection units.

A typical unit in the SFC range, the 1 kVA model, measures 290 mm by 540 mm by 580 mm and weighs 50 kg.

Further details from: Association Services Pty. Ltd., 110 Tynte Street, North Adelaide, S.A. 5006.

NEW WESTON MULTIMETER

Recently released by the Schlumberger group is the model 4444 digital multimeter designed for portable high accuracy measurement applications. Autoranging is a standard feature for all modes of operation and a new triple slope conversion technique has been developed to minimise the time taken in range selection.

Measurement modes include ac/dc voltage, resistance, and current, RF measurements being possible with an accessory probe. 10 uV sensitivity is available on the lowest voltage ranges. Readout is a four digit plus overrange LED display with automatic polarity and decimal point indication.

Weight is 2½ pounds and size is similar to that of a conventional analog meter.

Further details from: Schlumberger Instrumentation Australia Ltd, P.O. Box 138, Kew, Vic. 3101.

DIGITAL MULTIMETER

The Schlumberger/HEATHKIT model IM 1202 is a 2½ digit low cost solid state Digital Multimeter specifically designed for those people who normally use only analog meters.

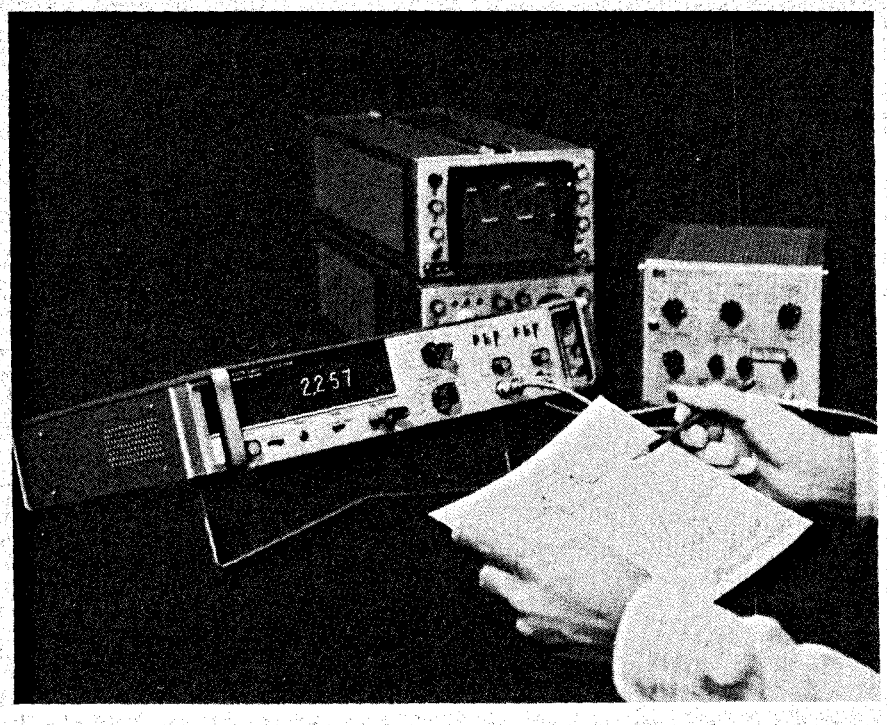
It is available in kit or assembled form and measures ac/dc voltage, ac/dc current, plus resistance.

Facilities offered include 29 selectable ranges, automatic positioning of decimal point, and a reading rate of 60 per second.

It measures voltages from 10 mV to 1000 V on dc, 10 mV to 700 V rms ac, 10 uA to 2 A dc or ac and 1 to 2 M resistance. The instrument also features an internal calibration standard.

Further information from: Schlumberger Instrumentation Australia Ltd., P.O. Box 138, Kew, Vic. 3101.

TIME INTERVAL AVERAGING



If you understand time interval averaging you can, when measuring repetitive events, improve the resolution of time interval measurements a thousand times, achieving resolution as fine as 100 picoseconds, and even measure intervals as short as 150 pioseconds. Averaging accomplishes a huge improvement over conventional one-shot interval measurements, which are limited by the period of the counter's clock.

A new application note from Hewlett-Packard resolves all mysteries surrounding the time interval averaging process, gives a rigorous analysis of possible errors, and explains how to avoid them. Hewlett-Packard Application Note 162-1 is available without cost. Contact Hewlett-Packard Australia Pty. Ltd., Marketing Communications Department, 22-26 Weir Street, Glen Iris, Vic. 3146.

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Build this exciting "Super Kit" which utilizes latest "State of the Art" Components and Circuitry.

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- Uses such exciting new devices as light emitting diodes.
- Features solid state "Diode Switching"
- See the review in the June issue of Electronics Australia.
- Full printed label supplied.
- Satisfaction guarantee — if you are not satisfied return the kit in its original condition and your money will be refunded in full.

ONLY **$8.75** Plus battery (216) if required 53c. P/Postage FREE.

CIRCUIT BOARDS pre-tinned

The "Rolls Royce" of circuit boards are now available from Dick Smith — give you equipment that professional look — all boards are heavy duty and most are fully pre-tinned to prevent oxidation marks and to make soldering easier.

72/G7	Guitar Amp.	1.50
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72/10	IC	.95
72/S11	4 Channel Converter	1.50
72/SA10	Playmaster 136	1.90
ET025	Super Stereo	1.90
ET026	Tape Slide Sync.	1.50
ET029	Tuner	1.45
	IC Power Supply	2.50
ET033	Int. Audio system	2.60
ET034	Int. audio system	2.60
ET111	Power Supply	1.50
ET1413	100W AMP	2.20

PARTS FOR RECENT PROJECTS

Signetics 55 TIMER I.C. $2.35
SIGNETICS NE 561B Phase lock Loop I.C. $9.56
P&P 20c.

SWEET AND LOW VARILIGHT KIT (UP TO 1000 WATTS)

This exciting device allows you to turn the lights down low — ideal for you single blokes! The kit includes triac (8 amp), diac and all components as listed in the parts list other than the chassis which can easily be made from any oddment piece of tinplate. (A tin can is ideal)

$6.90 P & P 30c

"Short form kit" includes all electronic components; allows you to build the kit into any form you require.

$4.90 P & P 30c

Separate Parts for above kit.

ST4	98c
Special 8 amp triac	$3.20
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DIGITAL LOGIC TRAINER KIT

For the first time in Australia it is now possible for the home experimenter to learn the basics of digital electronics, in practice, without spending a fortune. We are pleased to provide a complete kit at a price much less than the normal wholesale price of the separate components.
Extras with this kit include an extremely attractive brushed aluminium panel finished in black, tinned copper board and high quality American toggle switches.

$82.00 P & P 50c
$82.00 P & P 50c

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7400 Quad 2 input gate	90c
7413 Dual Schmidt trigger	$1.20
7404 Hex inverter	90c
7437 Quad 2 input buffer	$1.80
7805 5 volt regulator	$3.20
Light emitting diode	$1.00
73 ti P.C. board	$2.40
Power transformer PF3599 (Equiv. PF3504	$5.50 P & P 50c
Silk screened panel (undrilled)	$6.90 P & P 30c
McMurdo pack of 250 insulated feedthroughs (FT1)	$8.95
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Dick Smith "Super Kits" are very special as they have been selected by him for "V.I.P" treatment. At least one of each kit has been built by Dick Smith or his staff and is on display at the electronics centre. Other features are:

1. Expensive pre-tinned "silver" boards.
2. Full copies of construction articles included.
3. Any changes in circuits, addendums, etc are included — saves checking following issues.
4. Most kits contain "extras" at no cost. These extras have been added where Dick Smith thinks they may be more reliable or where he feels the constructor may have difficulty in purchasing them.

30 WATTS R.F. TRANSISTORS AND KITS

VHF POWER TRANSISTORS 30 Watts at 12.6 volts — FANTASTIC OFFER TO AMATEURS — $9.05.

These transistors manufactured by "Solid State Scientific" are exactly as currently being used by Australia's largest VHF mobile radio manufacturers. They are virtually indestructible (they withstand severe V.S.W.R.) and are guaranteed to give in excess of 30 watts at 144 mcs on 12.6 volts (more at 13.8 volts). Supplied complete with data sheet test circuit and layout diagram.

FEATURES:

- Withstand severe V.S.W.R.
- Low inductance stripline package.
- All leads electrically isolated from stud.
- Greater than 4.4 db power gain.

TYPE 2N 5591 $9.85 plus 50c p&p.

DRIVER TRANSISTORS AVAILABLE

Complete with data sheet and suggested circuit and layout diagram —
2N 5590 (15 watts) $7.75.
2N 5589 (7 watts) $6.50 p&p 50c
The complete set of three transistors is available as a special package offer for $22.50 plus p&p 50c.
Data sheets available separately 30c plus 20c p&p.

144 M.C. KIT AND BOARD SPECIAL

We now have available special circuit boards and kits to make your own high power output stages — including power transistors, special trimmers, all parts and easy to follow instructions.

7 watt stage — complete kit	$11.50
P.C. Board only	$1.50
15 watt stage — complete kit	$13.50
P.C. Board only	$1.50
30 watt stage — complete kit	$17.50
P.C. Board only	$1.50
Complete kit to build R.F. Transmitter 300 M.W. in to 30 watts out	$37.50 Save $5.00
Packing / postage on all kits	50c

100 WATT AMP. (E.T. DEC. '72)

We have just built our second model of this Super-power amplifier and the results are breathtaking — when fed into two Rola 12U50 speakers the amplifier can be heard over a mile away! Remember this amp. has a true power output of 100 watts R.M.S. (not peak).
At the time of going to press we have a stock of the heard-to-get S.T.C. die-cast boxes. However, if supplies run out again we have a special Hammertoned metal box which we will supply with the kit at no extra charge. The kit, as supplied, comes with special "tinned" boards, pre-punched heatsinks and special notes written by us to make building easier. Also included is a can of heat absorbing spray paint and a quantity of silicon grease for transistor mounting. New Low Price: $65.00 P & P $1.00.

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PF 3577 Transformer $10.60 P & P $1.00
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PRE-AMP KIT FOR 100W AMP.

We now have available an economical pre-amp kit for the 100W amplifier supplied complete with volume, treble and bass controls the unit allows for guitars or microphones of two sensitivities. The kit includes a pre-tinned circuit board, wiring diagram and all necessary parts other than a case.
100W Pre-amp $9.50
P & P 50c

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NEW STANDARD FOR ELECTROMAGNETIC INTERFERENCE

This new Australian Standard should reduce interference from phase control devices.

AT last the long awaited standard "Electromagnetic Interference Limits and Measurements for Semiconductor Control Devices" – AS1054 – 1973 has been published.

This Standard, prepared by the Telecommunication and Electronics Technical Committee on Electromagnetic Interference seeks to limit electromagnetic interference from regulating and control devices embodying semiconductor devices, in particular – SCR's and TRIAC's.

The method of measurement proposed is that detailed in CISPR Recommendation No. 43 and the specification has also taken note of BS800.

Two forms of semiconductor control systems are commonly used. Burst firing (sometimes known as zero point switching) and phase control. Burst firing is more suitable for resistive loads and generates relatively low interference, whilst phase control (controlled fractions of half cycles) is necessary for the effective control of motor speed and for light dimming applications.

Phase control has a major disadvantage in that considerable RFI is produced by virtue of the switching action. This RFI can cause severe interference with radio reception and with high fidelity equipment. Television is rarely affected.

Satisfactory interference levels can be achieved by correct filtering and shielding but this can be expensive – in fact it may well be that some of the domestic light dimmers now on the Australian market cannot be suppressed adequately and still be an economic proposition.

The Standard lays down the above limits, details the measurement method and describes a suitable Artificial Mains V-Network.

If the Standard is complied with, interference from phase controlled appliances and equipment should be virtually eliminated. All that remains now is to ensure that the PMG or some other body be empowered to enforce the limits. At the present time all that can be done is to ask the RFI offender if he would please desist – hardly a satisfactory situation.

However the new Standard is certainly a step in the right direction.

The recommended levels are as follows:-

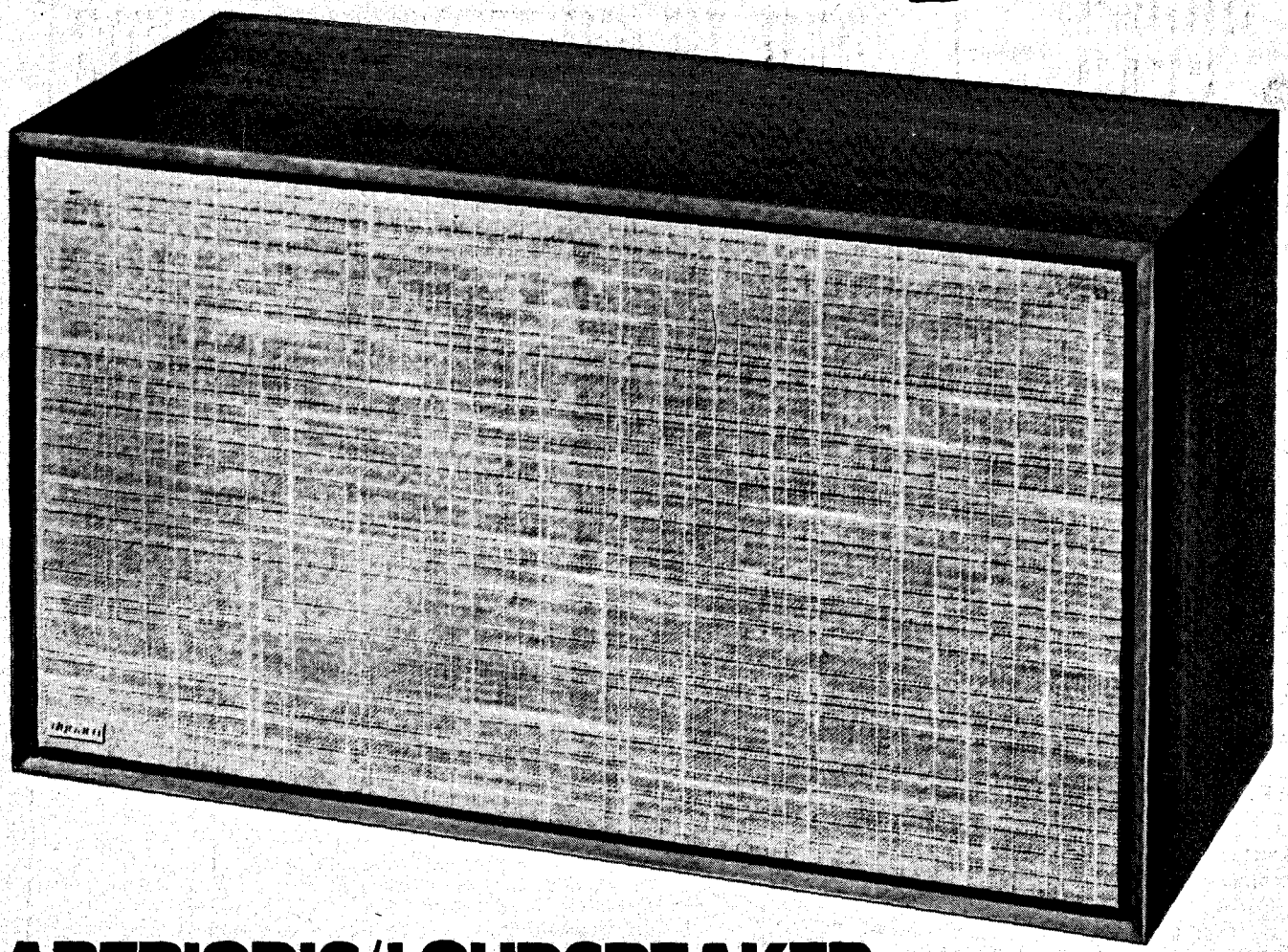
TABLE 1
LIMITS FOR RADIO FREQUENCY VOLTAGE INJECTED INTO THE SUPPLY MAINS

Purpose of control	Frequency range MHz	Limit dB (μV)	Limit μV equivalent
Speed control of portable tools	0.15 to 0.2	70	3000
	0.2 to 0.49	66	2000
	0.49 to 30	60	1000
General-purpose control of domestic appliances and lighting	0.15 to 0.49	66	2000
	0.49 to 30	60	1000

TABLE 2
LIMITS OF RADIO FREQUENCY VOLTAGE APPEARING AT THE LOAD TERMINALS

Purpose of control	Frequency MHz	Limit dB (μV)	Limit μV equivalent
All types of control	0.150	72	4000
	0.150 to 0.49	Falling linearly from 72 to 60	Falling linearly from 4000 to 1000
	0.49 to 30	60	1000

dynaco



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BOOK REVIEWS

REVIEWERS: Brian Chapman, Roger Harrison, Colin Francis.

The Radio Amateur's VHF Manual by Edward P. Tilton, (W1 HOQ). FM chapters by Douglas A. Blakeslee (W1 KLK). Published by the American Radio Relay League, Inc. Newington, Connecticut. 352 pages. Review copy from Technical Book Co. Vic. Price $4.20 + 70 cents postage.

This is the latest edition of the VHF Manual from the ARRL, and frankly, while it contains some good basic material, I think I'll wait until the ARRL changes some of its attitudes/policies before I add another VHF manual to my library.

This edition contains much of the same as the previous one, with a few additions (not altogether worthwhile in my opinion), and a few deletions (mostly disastrous).

The chapters are as follows:-

1. How it all Started
2. A Vast Resource
3. Reception Above 50MHz
4. VHF Receivers, Converters & Preamplifiers
5. VHF Transmitter Design
6. VHF Exciters and Amplifiers
7. VHF Stations
8. Antennas and Feed Systems
9. Building and Using VHF Antennas
10. FM – Theory and Techniques
11. FM Transmitters, Receivers and Accessories
12. Repeaters – Theory and Practice
13. UHF and Microwaves
14. Test Equipment for the VHF Station
15. Interference Causes and Cures
16. Bits and Pieces

Chapter 1 is the same as last time – interesting (even stirring!), but in need of expansion. No new achievements or work has been included, the last year mentioned being 1960!

More than a decade – six amateur satellites, ten moonbounce records (at a rough count), all vhf/uhf distance records, 432MHz meteor scatter, 50MHz moonbounce, and a host of circuitry techniques have passed into a rapidly changing historical tradition. I expected a little more from Ed Tilton (W1DHQ) . . . the editor . . . and the ARRL.

Chapter 2, purportedly about VHF/UHF band characteristics, propagation and capabilities is the same as last time . . . only now it is more outdated. And still misleading in places. The section on propagation is greatly in need of overhaul and substantial expansion. Some sections are so brief as to be misleading, apart from using old information and research which has since been proved either erroneous or simplistic. Admittedly the ARRL do better than their competitors in this field, but vast inadequacies still exist. I have seen too many amateurs led astray on these topics simply because the VHF Manual (and those of the other individuals and groups) gave too little space and insufficient information in their treatment of the subject.

More recent information on all forms of vhf/uhf propagation was available at the time I imagine this edition was compiled, and it is difficult to see why it has not been included. This oversight severely dates the information in this chapter, making it near useless except for the neophyte and/or historian; misleading even then. A pity, if not a ripoff.

I do not make these criticisms on the grounds that the book was written for an American audience (as the information is widely applicable), but on the grounds of its present applicability. I might add that the section "Reliable VHF Coverage" is good material and ageless. Many Australian VHF operators could well take heed.

Chapters 3, 4, 5, 6 contain good basic stuff, well illustrated. However, they could well do a little more in the area of VHF/UHF receiver techniques by not sticking rigidly to mentioning only the conventional converter-tuneable IF idea. It restricts peoples' thinking. Same goes for transmitters and the Xtal oscillator-multiplier and/or VFO concept.

Some new circuitry has been included using MOSFETS and DUAL-GATE FETS. There is still some conservatism showing in the transmitters where valves are used in places in which solid state circuitry would be more suitable. To be effective, a manual of this type should lead, not follow. Fortunately, most components are available in this country.

Chapter 7 is more for beginners but contains some material, for those with experience, on other approaches to VHF stations. The system design concept is introduced . . . and the beginner is then told to go and look up the details in an old QST, or buy reprints.

Perhaps it's good for reprint sales.

Some of the articles described in this chapter are a bit old . . . and perhaps not too applicable these days. I'm not one to believe in solid state for solid state's sake . . . if another device does a better job or has other inherent advantages, I'll use it. Some of the transverters use hybrid techniques, but in some of the circuits I cannot see justification for using valves. Surely this leads to confusion.

The idea of using SSB on VHF is laudably promulgated, but somewhat offset by the inclusion of a portable 144MHz transceiver using a super-regenerative receiver! I admit it's simple, but such techniques in units of that type are not necessary. For the raw beginner (schoolboy-SWL type) such a receiver (solid state of course!) is a very good beginning, but that's about its only application.

Chapters 8 and 9 are much the same as previously, with a few deletions. The 1296MHz antennas are gone for a start. I detect the dreaded Lurgi has crept in here . . . in the guise of money. FM sells better it seems. Something had to give. Surely a manual of this type should give general information on the subject and not cop out to the best sellers in reprints from the parent journal? Rank bloody commercialism! It seems that the ARRL is in it for the rake off other than for the amateur, with all due respects.

The information contained in these chapters is very good and quite detailed. *All* the antennas *work* if built as shown. The range of types is limited though and one would have to look elsewhere for other antennas to suit given situations or for investigation. Chapter 8 should be read more closely by more Australian amateurs. Maybe some of you would then find out what a "Tilton Yagi" is.

Chapters 10, 11 and 12 are complete new additions. The theory given in Chapter 10 is brief but adequate for most purposes. The picture of the frequency spectrum of an FM transmitter output should be carefully examined by almost all amateurs operating FM equipment in Australia. It might clear the air a bit!

The transmitting and receiving techniques illustrated are up to date . . . including digital and phase-lock methods.

Eleven references are given in the bibliography but are not specifically referred to in the text.

Chapter 12 on repeaters is very good . . . certainly way ahead of current practice in Australia. Repeater groups could well benefit by reading this chapter.

Chapters 10, 11 and 12 are certainly well-worthwhile inclusions. A pity that other very good information was deleted to include it.

Chapter 13 is sadly incomplete. Shorter than the last edition it falls short of even whetting the appetite for UHF work . . . where they previously state are the "frontiers". (Chapters 3, p.16, para. 3). The pulse modulation work has been reduced to a mere 2/3 page plus references. The last handbook had one of the few descriptions of 2300MHz equipment in the literature. But, alas poor Yorrick . . .

Chapters 14, 15 and 16 contain good basic stuff and the odd kinky hint. A short article on parabolic antenna design and construction is appended to the "Bits & Pieces" chapter. A longer treatise on the subject is needed in a manual; why a subject of this relevance (and importance?) was stuck up the back I'll never know.

Generally speaking the manual contains quite a deal of information that is useful, either directly for construction purposes or employment of new techniques, or for reference purposes. The newcomer to VHF is not catered for adequately in some areas, particularly construction of simple but effective and up-to-date equipment and band characteristics and propagation. References and bibliographies are quite extensive but may be generally hard to obtain in this country thus decreasing their inherent usefulness. Large community libraries or technical libaries may be of assistance but inconvenient.

There are many problems inherent in using a book with so many drawbacks and disparities and I would not wholeheartedly recommend this manual to anyone not already cognizant with

continued on page 118

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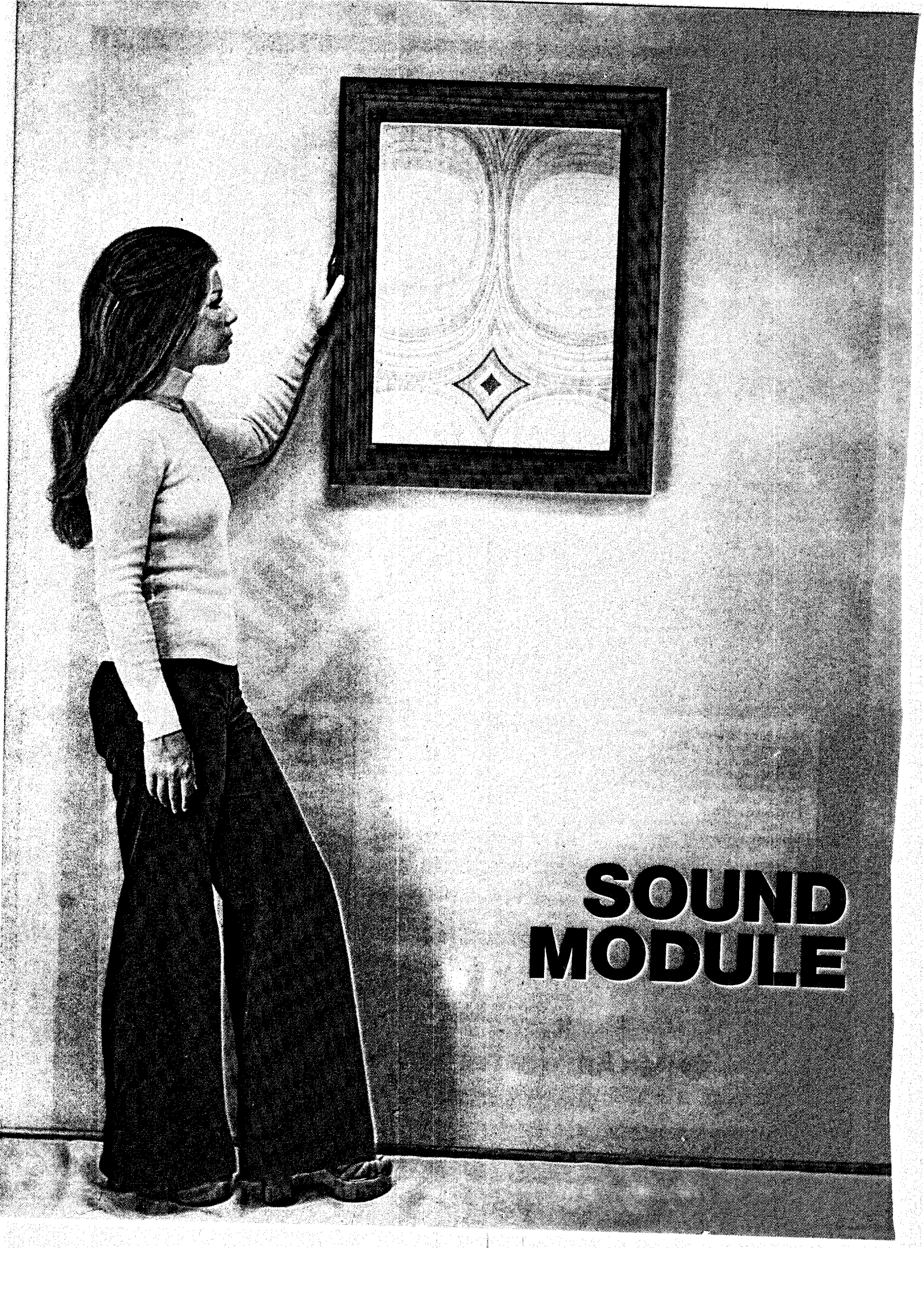

SOUND
MODULE

Philips sound modules

—MODEL SM 130

Sounding as good as they look, these new loudspeakers from Philips embody new operating principles.

THE last five to ten years have seen major advances in speaker designs and concepts, including the reintroduction of folded horns, marked improvements in electro-statics, and numerous omni-directional speakers, such as the Phillips Quadraflect and the Bose.

The Philips sound module reviewed here is a new generation of speaker using a specially moulded flat panel to obtain a wide frequency response with negligible colouration; many attempts have been made in the past to obtain the ideal panel shape and construction, but mostly they have a very limited frequency response range.

The panel used in the Philips sound module has been patented by an Argentinian who developed the basic diaphragm design. He spent many years studying the modal behaviours of various types of panels under different stresses and excited by various types of signal. The expanded polystyrene diaphragm used in this speaker, together with a non-linear coupling on the bass driver, is the result of this research.

Externally, the sound modules have a large decorated centre panel measuring approximately 43 cm by 59 cm. This panel is mounted proud on a heavy oiled timber surround that is approximately 8 cm wide by 2.5 cm thick. A 1 cm wide edge strip is fixed around the centre panel and finished flush with the front of the panel.

Of the samples we received, two were a matched pair, and the other two unmatched, to show the range of various possibilities in the front panel finishes. The matched pair were covered with a white cloth which had been screen printed with a black swirling abstract pattern. Of the others, one had a symmetrical arrangement of oranges, reds and browns in large concentric arcs, and the other was screen printed in vibrant greens, blues and purples, in another abstract pattern.

The sound modules were supplied with two clip-on feet so that they may be free standing on the floor, alternatively they can be hung on a wall — providing they are spaced off the wall approximately 2" to 3" in order that the rear vent is not blocked (which otherwise considerably reduces the low frequency performance).

EXPANDED POLYSTYRENE DIAPHRAGM

The expanded polystyrene diaphragm has been moulded in one piece and has a recessed kidney shaped rear. This panel is driven by a large driver, mounted off centre, and supported on a moulded plastic frame that is extensively ribbed to minimise flexing in any direction.

The coupling between the bass driver and diaphragm is a 1 cm thick disc that has a non-linear transfer characteristic. As the frequency increases so the force on the diaphragm decreases. The second driver, which covers the high frequency range from approximately 1.8 kHz up, is mounted in the top left-hand corner, and drives on to a 1" thick section of the main panel.

The venting at the rear is through a 3/8" thick panel which has a cut-out approximating the shape of a violin. The opening is covered with a black acoustically transparent cloth. A pair of terminals is mounted directly below the opening for the speaker wires.

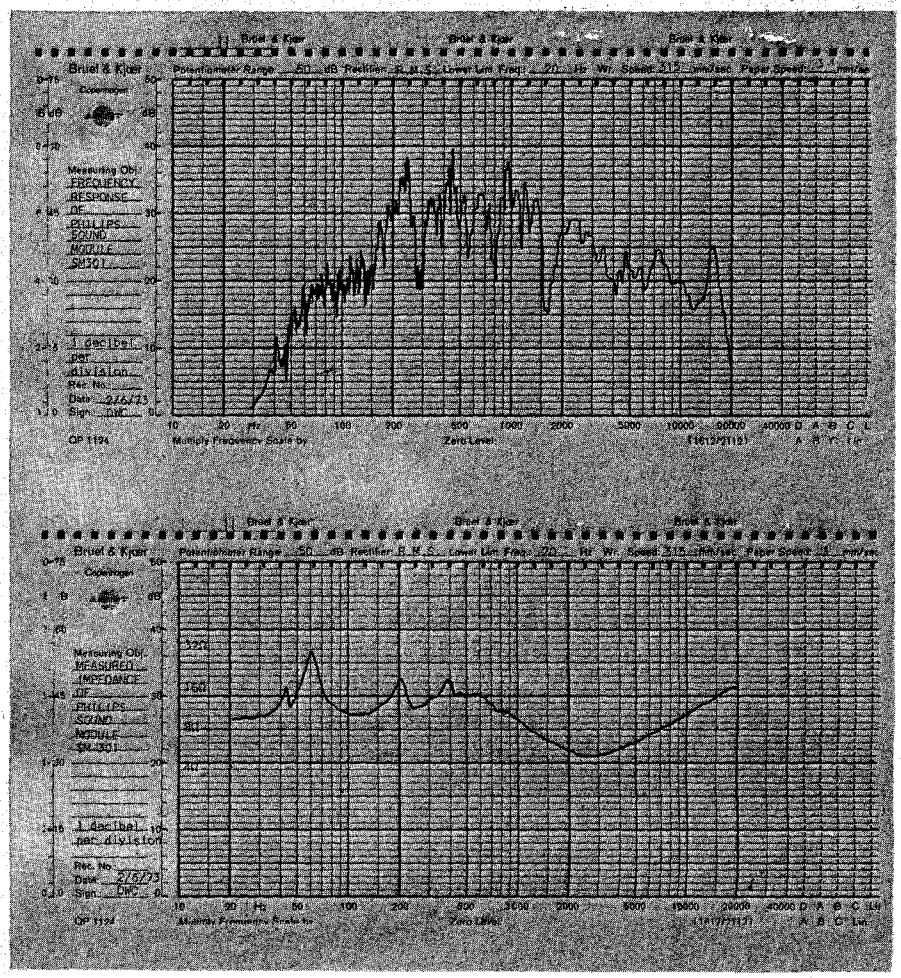
Because of the type of materials used, these speakers may be used externally or underwater, provided the timber frame has been suitably waterproofed with a sealer!

The cross-over network is extremely simple, consisting of just one capacitor. This provides the cross-over frequency of approximately 1.8 kHz.

Maximum recommended power input is 30 watts 'rms'.

SUBJECTIVE IMPRESSIONS

Subjectively, the speakers are quite pleasing due to the exceptionally transparent presence and smooth bass response, which although rolling off below 200Hz may be easily corrected by the bass tone control to provide a good response down to about 40Hz.



Philips sound modules

MEASURED PERFORMANCE OF PHILIPS SOUND MODULE SM 301
SERIAL NO. 1006

FREQUENCY RESPONSE:
50Hz to 18kHz ± 10dB

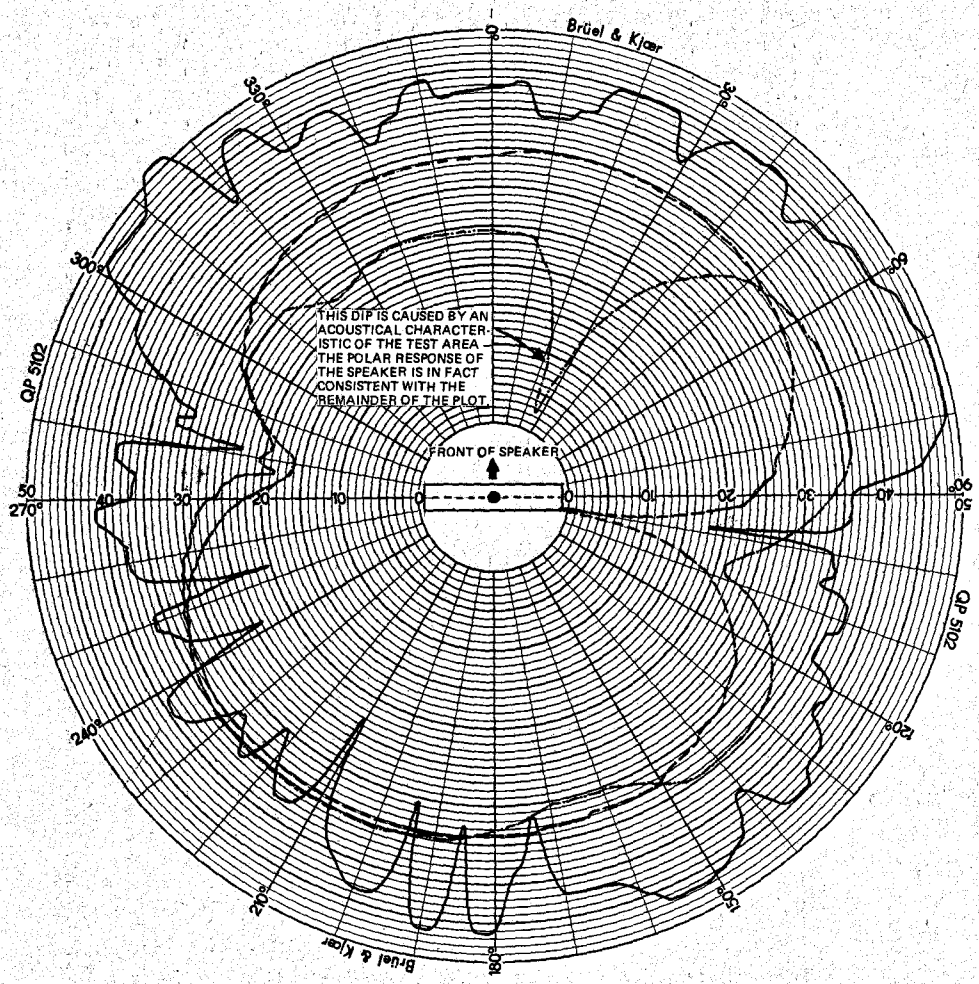
TOTAL HARMONIC DISTORTION FOR 1 WATT INPUT:
100Hz 1.2%
1kHz 0.5%
6.3kHz 1.6%

ELECTRO-ACOUSTIC EFFICIENCY AT 1kHz:
0.6%

MEASURED IMPEDANCE:
100Hz 10.6Ω
1kHz 9 Ω
6.3kHz 7.8Ω

DIMENSIONS:
75.5 cm high by 60.5 cm wide by 7.3 cm deep

WEIGHT:
9.6kgs.



POLAR RESPONSE OF PHILIPS SOUND MODULE MODEL SM 301 IN TYPICAL HOME ENVIRONMENT 100Hz – – – – – – 1kHz ·–·–·–·–· 10kHz ———

Approximately 6dB boost at 50Hz is necessary to obtain this performance.

The top end also provides a reasonably smooth performance and amazingly enough extends right up to some 18 kHz. We did not expect this top-end performance due to the cellular nature of the diaphragm and the thickness of the panel used for the high frequency radiator.

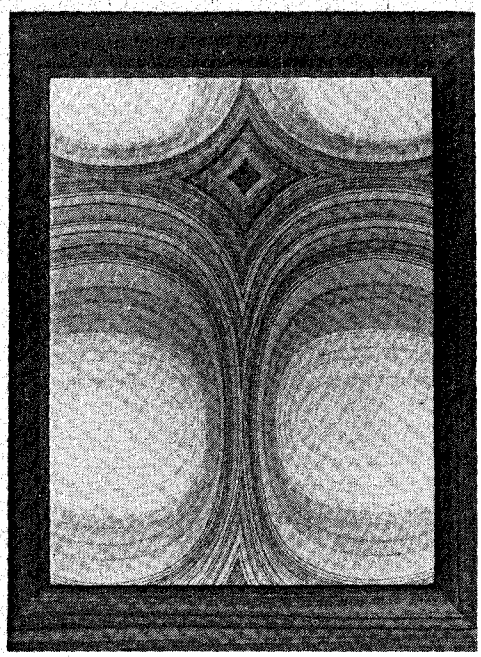
EXCELLENT POLAR RESPONSE

Because of their excellent polar response, the stereo spread in the average living room is very good and can be observed virtually anywhere in the room if the speakers are mounted approximately 6" off the wall and angled slightly towards the centre of the room. Because of their size and shape, the speakers could be placed in virtually any position without markedly affecting their subjective performance.

The laboratory measurements show that the polar response in the average living room is quite exceptional with the front to back performance only varying by approximately 10dB in the range 100Hz to 10kHz. The most noticeable drop-outs occurred at 100° off axis, where we expected them, due to the effect of the timber surround and the rear vent. Our polar response curves are reproduced on this page.

The measured frequency response confirmed our subjective assessment, showing that the bass performance rolled off at approximately 200Hz but was relatively smooth.

The top end also showed a slight roll



off, but this could be corrected with a 3dB boost to give an overall frequency response of approximately ±8dB from 30Hz through to 18kHz.

The measured acoustical efficiency of the speakers was quite high, although when subjectively compared with a conventional speaker, this would not appear to be so. This apparent inefficiency is due to the exceptional polar response which results in equal energy radiation in virtually all directions.

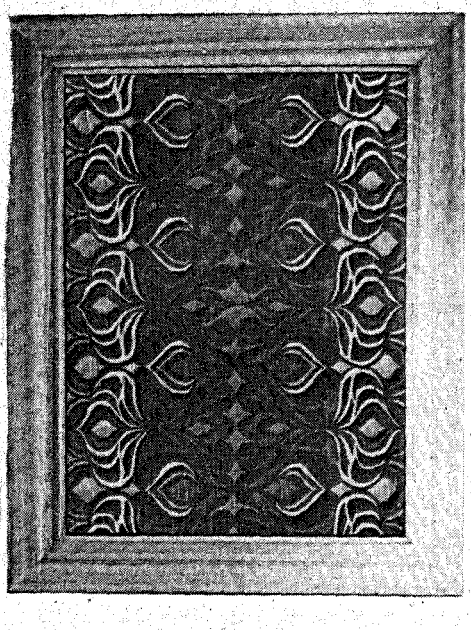
The measured distortion was also very low, being around 1% right through the spectrum (at 1 watt input).

At 1 watt the measured pressure level was approximately 90dB (at 1 metre on axis). This is adequate for average listening conditions. Below 70Hz the distortion rose considerably with an increase in power input due to the non linear movement of the speaker diaphragm limiting the driver excursion. This is the opposite to the action of conventional speakers — where the limiting factor is coil travel.

SUMMARY

The Philips sound modules have a very pleasing sound — due largely to their clean presence, and, with slight adjustment of amplifier bass and treble controls, they have a very reasonable frequency response, particularly so if this performance is related to price.

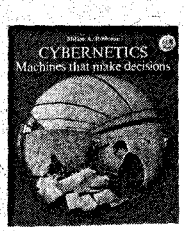
At a recommended selling price of $149 each, the Philips sound modules should satisfy a wide section of the domestic market. ●



(Continued from page 112)

VHF/UHF practices and techniques. Certainly not for beginners generally . . . at least not without guidance from someone well experienced. One really annoying problem is the inadequate binding. The pages have a tendency to come out after a number of months of use.

Anyhow, have a VHF Manual. – R.H. VK2ZTB.



CYBERNETICS: Machines that make Decisions – Milton A. Rothman. Published for the International Library by Collins Publishers (London) and Franklin Watts, Inc. (New York). Hard covers, 128 pages 10¼" x 7¼"

Rather than just a textbook on Cybernetics, the author has approached the subject in a broad, yet informative, manner. His easy style makes an otherwise complex science fascinating to even semi- and non-technical readers, alike.

Cybernetics – a word coined by American mathematician Norbert Weiner as recently as 1947 – describes the concept of machines that can handle information, make decisions, and control the operation of other machines. Weiner saw the interface of cybernetics with such disciplines as physics, engineering, biology and mathematics.

Professor Rothman views the science in still broader terms. He sees the concept of "feedback" in general economics and even interpersonal relations. He discusses cybernetics as an interdisciplinary science which embraces and unifies the work of the servomechanisms and systems engineer, the communications engineer, and certain aspects of the work of the physiologist, neurologist, sociologist, and economist.

Although there are several unifying links with other disciplines, the major and most common factor in Cybernetics is "feedback", which is basic to all problems of regulation and control. Contrary to most other sciences, the transfer of energy is usually of little consequence; it is the transfer of information that is paramount.

This 128-page book is attractively illustrated, predominantly in colour. Apart from an interesting history of the growth of Cybernetics as a science in its own right, the author cites numerous examples of feedback and control of automated processes and systems. He singles out the two major contributions to Cybernetics since World War II – the development of the digital computer and the advances in physics leading to the transistor.

Professor Rothman, author of numerous books on scientific subjects, holds science and engineering degrees as well as a doctorate in physics. He is currently Professor of Physics at Trenton State College in New Jersey, USA. – C.F.

OPERATIONAL AMPLIFIERS by G.B. Clayton. Published 1971 by Butterworth & Co. Ltd. Hard covers, 235 pages 8½" x 5½". Review copy supplied by Butterworth. Australian price $6.45.

The high-gain dc amplifier employing negative feedback has been in use for some 30 years or more, albiet in valve form, in analogue computers and servo systems. The ability of such amplifiers to perform mathematical functions led to the name 'Operational Amplifier' which has now become universal for these devices whether used for mathematical functions, or not.

In recent years, with the advent of transistors and then integrated circuits, the operational amplifier has found ever increasing application. It is in some cases being used as a substitute for single transistor stages by virtue of its programmable and stable gain, high input impedance and low output impedance. In fact, as the prices of op-amp IC's fall, the applications are limited only by the designers imagination.

There is need then for a book specifically elevated to such amplifiers and the work under review fills this need admirably. The text is clear and concise and requires only high school mathematics and a basic knowledge of transistor amplifier terminology as prerequisites.

The op-amp is treated as a component, there is no attempt made to describe the internal circuitry and hence the book is essentially practical in its format.

The level of the text, however, is quite adequate for undergraduate students of science or engineering or research workers who use electronic instrumentation techniques and require an insight into the capabilities of the modern operational amplifier.

Good value. – B.C.

RECORDINGS
POP

REVIEWER: Mike Delaney

"The Byrds created many, many pieces of art — high art. Approximately perfect" — says Michael Delaney.

"Gene Clark, Chris Hillman, David Crosby, Roger McGuinn, Michael Clarke" – The Byrds. E.M.I. Stereo. SYLAA.8754.
"Greatest Hits Vol. 1." – The Byrds. C.B.S. Stereo. SBP.233440.
"Greatest Hits Vol. 2." – The Byrds. C.B.S. Stereo. SBP.234256.

"There are only a few groups with value, who relate to values beyond the sound of music. There are only a handful of those with the power to reach to the edge of the world and touch, just touch a human spirit and leave that touch to work and activate what it may. The Byrds are one of these groups and one cannot say why, because if it isn't felt, then it isn't to be explained in words." Derek Taylor said that.

". . . What distinguishes the Byrds from all imitators, however, is the purity of their style. More than anyone, they demonstrated that traditional white American music – folk and country/western – can be infused with rock without significant alteration. The Byrds have never left rock's forefront. Byrd bars are scattered throughout any number of rock songs as the group continues three paces ahead of where music's at today. The Byrds plant musical roots. But it's anyone's fair game to make them grow." Allee Willis said that.

". . . In their emergence, they signalled the first beginnings of a thus-far stillborn morning. They endure, thank goodness, and it's actually beginning to look like they might see the real dawn. Hopefully, you and I will be as lucky." Jim Bickhart said that.

Anyway, time really does fly. And it was just a short eight years ago that the Byrds came up with "Mr. Tambourine Man"; a short seven years since "Turn, Turn, Turn"; a short six years since "Eight Miles High" . . .

After that, the Byrds went this way and this way and that way. Evolving, multiplying, dividing and sub-dividing. They cross-bred and bred again: Gene Clark left first and formed Dillard & Clark with Douglas Dillard, cut a couple of fine albums there and two beautiful solo jobs – one before Dillard & Clark and one after. Nobody heard any of them.

Next, just before "The Notorious Byrd Brothers", David Crosby got fired for being too political; Michael Clarke split before "Sweetheart Of The Rodeo" and Chris Hillman followed straight after. Clarence White, John York, Kevin Kelly, Gram Parsons, Gene Parson, came in, saw the band through "Sweetheart Of The Rodeo" and well into Byrds Phase Two, then, with the exception of White and Gene Parsons, split.

Gram Parsons ('I'm your toy . . . I'm your old boy') went over to Hillman and formed the Flying Burrito Brothers; John York wrote "Fido", played bass on the "Ballad Of Easy Rider" set and then split; Kevin Kelly (Hillman's cousin) gave up drums and started playing piano for folks like Tim Buckley; Michael Clarke eventually resurfaced with the Burritos circa "Burrito Deluxe" – album No. 2.; Crosby wrote love songs for Jefferson Airplane, discovered and produced Joni Mitchell through her "Songs For A Seagull" album, formed Crosby, Stills & Nash.

Skip Battin came in on bass and the Byrds (McGuinn, Clarence White, Gene Parsons, Battin) continued through three more: the double "Untitled", "Byrdmaniax" and "Farther Along".

"And whoever the Byrds are is just alright". Peter Fonda said that a couple of years ago.

Basically, the Byrds have been two: (McGuinn, Clarke, Crosby, Clark and Hillman; McGuinn, Parsons, White, Battin. The original line-up (a quintet to a quartet to a trio) cut five albums up to and including "The Notorious Byrd Brothers". Six, if you include "Greatest Hits Vol. 1."; seven, if you include "Preflyte" – a collector's piece made from old demo tapes. "Dr. Byrds & Mr. Hyde"/"Ballad Of Easy Rider" albums sort of bridged the gap between Byrds Phase One And Two. A bit shaky in places.

Now, the Byrds are gone. McGuinn split Byrds phase two in order to get the originals back. Also, in between band sessions (roughly two albums a year), he intends to work solo.

But everything's fine anyway: Battin has his first solo album coming out through W.E.A.; Clarence White has reformed his pre-Byrd band, the New Kentucky Colonels with ex-Dillard Herb Pedersen and two brothers, Roland and Eric; Gene Parsons has his first solo on the way, too. Then, of course, there's news about McGuinn cutting a set with Crosby; Hillman making a solo with help from various Byrds, ex-Burritos and Stephen Stills/Manassas; Gene Clark trying another one; a new Crosby, Stills & Nash; a new Crosby, Stills, Nash & Young; another Crosby/Graham Nash set; a new Crosby solo; McGuinn's first ever solo album. Keep that circle turning.

Perspective is the thing with the Byrds. Perspective, temporal and perceptual, because with the Byrds and, say, the Beatles and Dylan, it is important. It is very important because they are/were beautiful and heavy and gentle and lasting. And because we were all part of what happened and what is still happening as a result, they will be revered.

With the Stones, it's always been the spectacle, the circus; with the Moody Blues, it's been the myth; with T. Rex and Bowie and Cooper, it's been ego. With the Byrds, Dylan and the Beatles, it's been the music. And music lasts.

Lasting. Dylan provoked and made it obvious that he *thought*, but the Byrds were articulate. They took things and did things, made songs, melodies, images from this new set of values. They made songs go through strangely epic changes – epic as in "Ben Hur"; almost heroic. But with majesty and stature. With incredible depth and

MORE POWER FOR YOUR DOLLAR

DOMINION

STEREO AMPLIFIERS

MODEL KTX-4000V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
25W x 25W RMS at 8 ohms
65W x 65W music power

FREQUENCY RANGE:
25 – 40,000 Hz ± 2dB

OUTPUT IMPEDANCE
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
At 1 watt RMS @ 1 kHz = 0.1%
At 25 Watts RMS @ 1 kHz = 0.1%
At 28 watts RMS @ 1 kHz = 0.5%

POWER SUPPLY
240 volts AC

MODEL KTX-2000V
Size: 13.8" x 7.9" x 4.3"

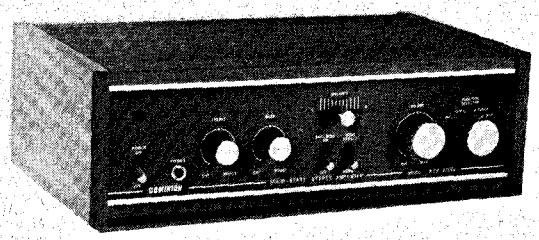
SPECIFICATIONS:
Output Power:
15W x 15W RMS 8 ohms
40W x 40W music power

FREQUENCY RANGE:
25 – 30,000 Hz ± 2dB

OUTPUT IMPEDANCE:
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
1 watt = 0.14%
14 watts = 0.16%
16 watts = 0.18%

POWER SUPPLY
240 volts AC.



MODEL KTX-1200V
Size: 13.8" x 7.9" x 4.3"

SPECIFICATIONS:
Output Power:
6W x 6W RMS at 8 ohms
15W x 15W music power

FREQUENCY RANGE:
40 – 20,000 Hz ± 3dB

OUTPUT IMPEDANCE:
4 – 16 ohms

DISTORTION (TOTAL HARMONIC)
1 watt = 0.2%
5 watt = 0.31%
6 watt = 0.7%

POWER SUPPLY
240 volts AC

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poignancy and hope. And warmth: Peter Seeger's "The Bells Of Rhymney"/"Turn, Turn, Turn", Dylan's "My Back Pages", "Chimes Of Freedom"; old traditionals like "Wild Mountain Thyme", "Satisfied Mind". And the songs they wrote themselves: "Renaissance Fair", "Eight Miles High", "Fifth Dimension", "So You Want To Be A Rock 'n' Roll Star".

'A time for love, a time for hate, a time for peace, I swear it's not too late.' Now that's epic!

Anyway, the original Byrds have come back together again, at least, for this album: "Gene Clark, Chris Hillman, David Crosby, Roger McGuinn, Michael Clark". Specifically, this is about the Byrds and their music and the changes that everybody goes through and beauty that shines from somewhere we've been before. Like Dylan says, "Take what you need, you think will last."

Simply, the Byrds created many, many pieces of art – high art. Approximately perfect. High art because it is simple, unpretentious, universal, involving, mellow, timeless, whole, definitively individual, thorough. It exists purely of its own accord: the Byrds were merely craftsmen. They merely gathered the forces together.

No. The Byrds don't sound like they did before. It would be ludicrous to expect them to recreate something that has already gone down. Besides, they're older, more developed, more into individual things. But, they are the Byrds, the feel is Byrds. Instinctively, you know it is the Byrds because of that warmth/poignancy/unassumed mellowness or whatever: the harmonies are cut way down, the 12-string Rickenbacker only gets the odd snatch and everybody sounds very distinct. David Crosby sounds like David Crosby, McGuinn – nobody sounds like McGuinn except Dylan. And even that no longer holds true. Gene Clark sounds exactly like he does on his solo stuff.

But that's not the way. The special thing about the Byrds has always been balance. Order. Finesse. It's still the same: attitudes, priorities, that amazing sense of themselves, their control and clarity.

Two Gene Clark songs, "Changing Heart" and "Full Circle"; two from Crosby and Hillman and McGuinn – each of which has the author leading. Two Neil Young Tunes, "Cowgirl In The Sand" and "(See The Sky) About To Rain", and Joni Mitchell's "For Free".

No. They haven't played together for a long, long time. The changes are many. They don't sound like the old Byrds probably because there wouldn't be any point and, besides, they couldn't even if they tried: they split because they'd done it, or thought they had. But then nobody ever does anything *completely*, which is why they've come back for a little while.

On the sleeve of "Greatest Hits Vol. 1.", Dave Swaney said that 'sometimes things happen so fast we lose track of what is really the most valuable'. You ought to realize for yourself that the Byrds and what they have to say mean a great deal to you.

But the Byrds are back, that's all. A lovely, gracious album: laid-back, wonderfully positive, optimistic; filled with beautiful songs, carefully arranged and performed and produced.

"If it's good, it's because it's good." Ezra Pound said that.

"Greatest Hits Vol. 1." has all the best, at least, all of the most memorable things from the first three years: "My Back Pages", "Eight Miles High", "Mr. Spaceman", "The Bells of Rhymney" etc. The essential folk-rock Byrds. Plus more.

"Greatest Hits Vol. 2." isn't a good compilation by anybody's standards. It's bitsy, terribly schizoid, unrepresentative, even misleading. Three tracks from the original line-up, "You Ain't Going Nowhere", "Wasn't Born to Follow" and "He Was A Friend of Mine" – the latter reaching right the way back to the "Turn, Turn, Turn" album. Two of the nearest things the Byrds had to hit singles: "Jesus Is Just Alright" and "Chestnut Mare". Only two tracks from the "Byrdmaniax" album and two from "Farther Along" – all four are not the best taken away from original context. No differentiation between who or which Byrds line-up recorded that. Dreadful. Forget it. Yecch. It's neither their greatest hits volume two, nor the best of the Byrds Phase Two. ●

Rectilinear® XIa

A LOW-COST BOOKSHELF SPEAKER SYSTEM FOR CRITICAL LISTENING

Design Goals

The Rectilinear XIa was designed to make available to critical listeners a budget-priced bookshelf speaker of genuinely accurate response and very low distortion, including low *time delay distortion*. The utmost simplicity of design was sought in order to eliminate unessential parts and keep labor costs down, as long as no compromise in performance would result. Particular emphasis was placed on high efficiency without loss of bass response, as well as on relatively constant impedance across the frequency spectrum. These characteristics were considered necessary to make the speaker compatible with receivers and amplifiers of moderate price and therefore of modest power output. The subjective listening quality of the Rectilinear XIa was to be judged by the same standards as that of higher-priced speakers in the Rectilinear line.

Basic Configuration

The Rectilinear XIa is a two-way speaker system utilizing an extended-range woofer and an extended-range tweeter, both of the moving-coil principle. The cabinet is of normal bookshelf size but somewhat unconventional in that it is a tube-vented bass reflex enclosure instead of being completely enclosed.

Woofer

The most sophisticated woofer ever used in a low-priced speaker system is the heart of the Rectilinear XIa. Its diameter is 10 inches, which is optimum size for a two-way bookshelf speaker. The butylized cloth surround, in combination with the spider and voice coil construction used, permits unusually large cone excursions without distortion.

Since the operating range of the woofer is from 45 to 1000 Hz, provision must be made for unimpaired response far up into the midrange. This cannot be accomplished with a small-diameter voice coil driving a large diaphragm; therefore a large voice coil of 1½-inch diameter is used. It is remarkable that this massive bass driver approaches the lighter and more specialized midrange speakers used in three-way systems as far as lack of coloration and low time delay are concerned.

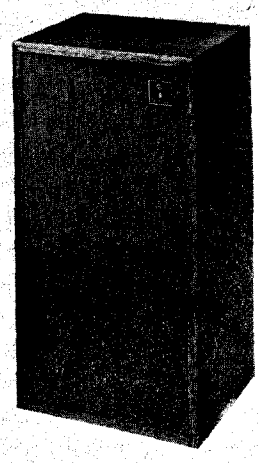
Since high efficiency is essential to the design concept of the Rectilinear XIa, the woofer requires less power to drive than most competitive models. An extra-long magnetic path is provided so that maximum electrical damping is applied to the moving mechanism. This results in unusually low distortion at high output levels, which is not an easy feat in a bass reflex design.

The response of the woofer begins to roll off naturally (i.e. mechanically) at 1000 Hz. This facilitates steep attenuation by means of an extremely simple crossover network.

Tweeter

This is a 3½-inch unit that covers the range from 1000 to 20,000 Hz, a span of more than four octaves. To avoid breakup at the bottom of this range requires a relatively large voice coil with a 9/16-inch diameter. Low moving mass is assured, however, by the special paper used in fabricating the cone and by the characteristics of the surround material. The resulting response is exceptionally flat, smooth and free from distortion. Total flux density of better than 11,000 gauss assures an extremely efficient, low distortion and linear response curve.

FIGURE 1:
Rectilinear XIa in oiled walnut.



Crossover Network

The woofer and tweeter of the Rectilinear Xla are crossed over at 1000 Hz, which is one octave from the point of maximum sensitivity of the average ear. This is unavoidable when no separate midrange driver can be used; however, the crossover network is so simple and so precisely tailored to the specific characteristics of the drivers that no discontinuity in response is audible.

The network elements consist of a series network with the tweeter and woofer in parallel with a capacitor and audio choke respectively. This makes it a quarter-section network with an electrical attenuation slope of 6 dB per octave in each direction. Actual attenuation, though, is not far from 18 dB per octave below the crossover point, since the latter was selected to coincide with the natural roll-off point of each driver. This is a case of eating your cake and having it, too: a sharp-cutoff crossover with a minimal network.

A wide-range tweeter level control is provided, accessible on a recessed panel in back of the speaker, so that the high-frequency output may be adjusted to suit the acoustic environment.

Cabinet

The outside dimensions of the Rectilinear Xla are 23" by 12" by 10½" deep. The cabinet is of extremely rigid one-piece construction, in ⅝-inch stock, with heavily damped walls. It is filled with sound-absorbent material. The cabinet edge is only ¼-inch deep to eliminate diffraction effects. The finish is oiled walnut.

The enclosure is tuned for optimum bass response by means of tube venting, in a sophisticated application of the bass reflex principle. Bass reflex cabinets are seldom used in bookshelf speaker systems, but in the case of an unusually efficient speaker like the Rectilinear Xla this is the best technique for maintaining efficiency down into the low bass without roll-off. (In a completely enclosed cabinet, response would drop 6 dB from 120 Hz to the fundamental resonance of 60 Hz. Or, alternately, mid-bass efficiency would have to be sacrificed.)

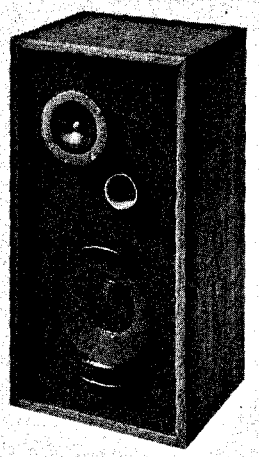


FIGURE 2:
Rectilinear Xla with grill cloth removed.

Impedance and Efficiency

The nominal impedance of the Rectilinear Xla is 8 ohms. As the curve in Figure 3 indicates, impedance never drops below 7.5 ohms, assuring that the speaker cannot overload solid-state amplifiers of limited power capability. Maximum impedance is at 65 Hz, where the woofer and tube-vented cabinet show a single impedance peak of 29.4 ohms. This relatively low figure is an indication of the excellent damping (low Q) of the bass reflex design used.

Efficiency is close to the ultimate achievable in a low-cost bookshelf system. Any amplifier capable of about 10 clean watts per channel will drive the speaker to window-rattling levels.

Frequency Response

Although Rectilinear engineers strongly believe that there are more important speaker specifications than pressure amplitude response (the conventionally cited "frequency response"), the curve of the Rectilinear Xla happens to be spectacularly flat. Figure 4 shows the results of a single uninterrupted frequency run taken from a single microphone position, rather than a misleading composite of the separate response curves of the woofer and tweeter. As can be seen the slight rise in bass response is the only departure from almost amplifier-like linearity.

Dispersion

The superior design of the tweeter and the shallow edge of the enclosure assure an excellent radiation pattern right up to the highest frequencies. Dispersion is wide enough to make high-frequency transients fully audible off axis, without loss of quality.

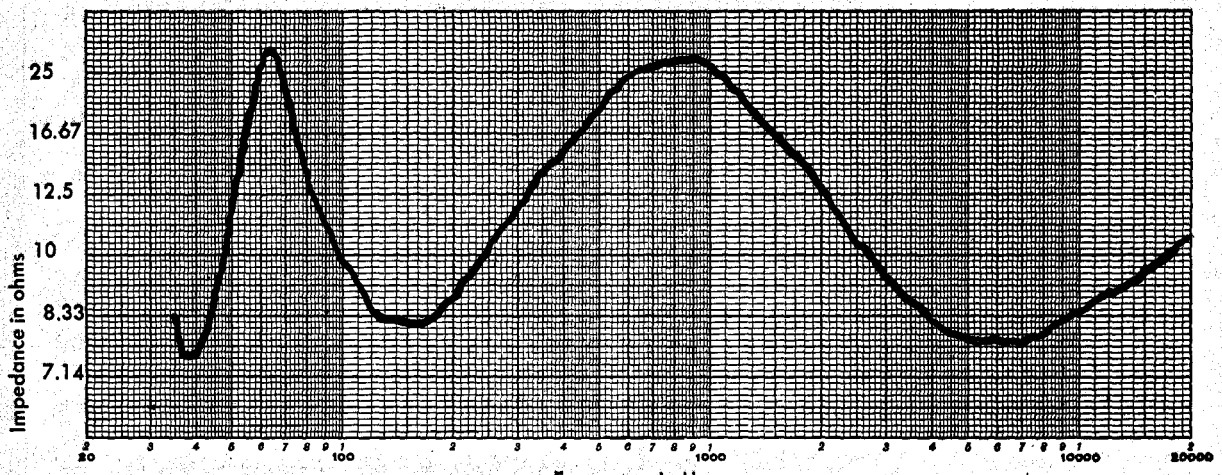


FIGURE 3:
Rectilinear XIa impedance.

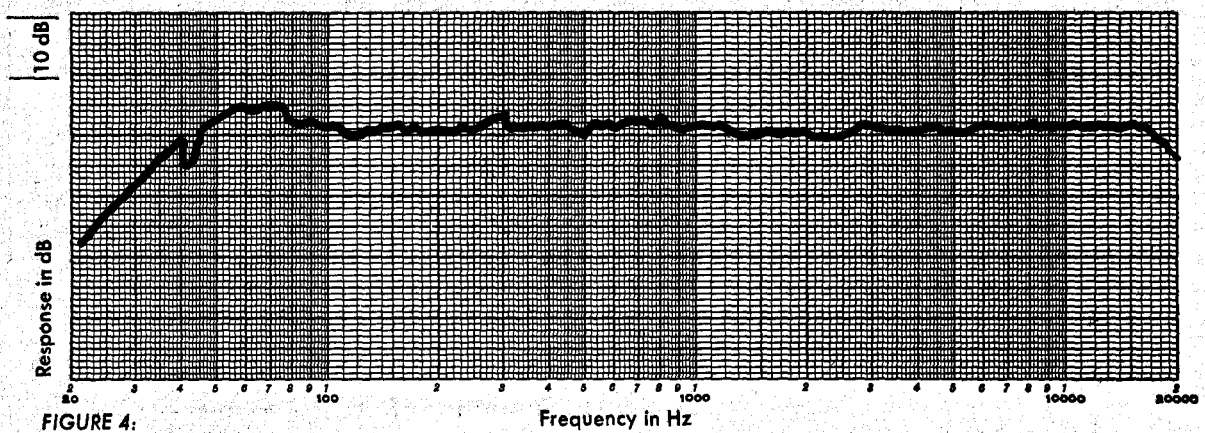


FIGURE 4:
Rectilinear XIa frequency response on axis; tweeter control turned up to maximum.

Frequency of fundamental	50 Hz	60 Hz	70 Hz	80 Hz	500 Hz	1100 Hz	3500 Hz	5000 Hz	7500 Hz
2nd harmonic distortion	1.8	1.4	1.0	2.2	*	0.18	0.04	0.12	0.19
3rd harmonic distortion	1.1	1.8	0.4	0.9	0.32	0.13	0.32	0.28	0.13
4th harmonic distortion	0.56	*	*	*	*	*	*	*	*
higher harmonics	*	*	*	*	*	*	*	*	*

FIGURE 5:
Harmonic distortion in %, with 1 watt input.

*negligible

Harmonic Distortion

The chart in Figure 5 gives a complete harmonic analysis of spurious response with a fundamental input of 1 watt at key frequencies. This is a more revealing specification than total harmonic distortion expressed in a single figure. Since 1 watt of actual program material produces an extremely loud level through an efficient speaker like the Rectilinear XIa the percentages shown indicate virtually nonexistent distortion.

Transient Response

The tone-burst photographs in Figure 6 are proof that the Rectilinear XIa reproduces transient with outstanding fidelity and freedom from ringing throughout its frequency range. However, an even more severe test of transcient performance is the reproduction of square waves, usually reserved for testing amplifiers. The square wave photograph in Figure 7 would be considered mediocre for an amplifier but is little short of astonishing for a speaker.

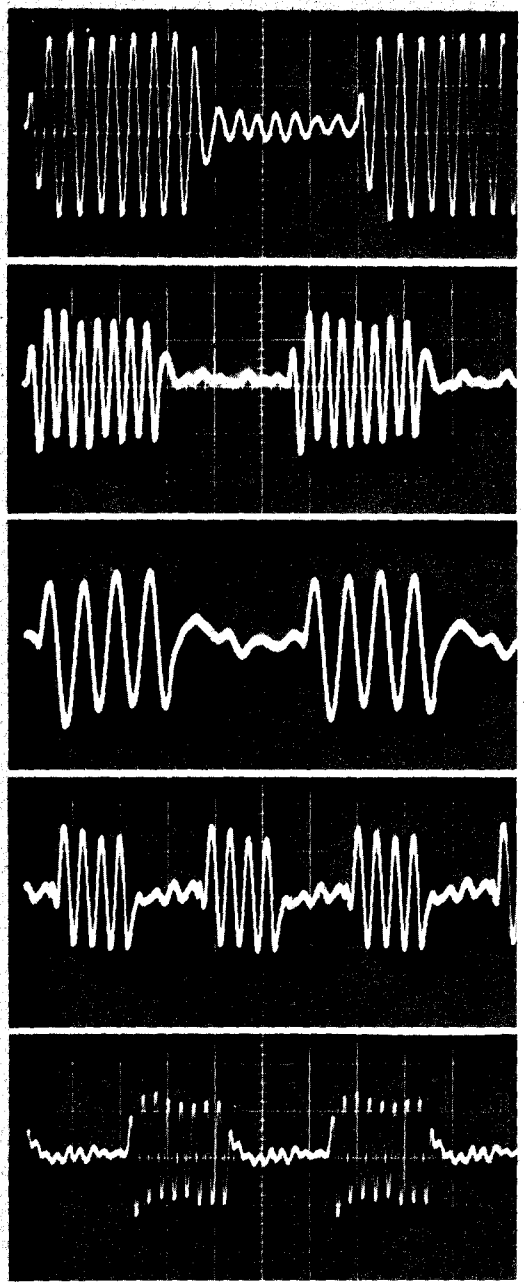


FIGURE 6:
Tone-burst tests for transient response and ringing. (From top to bottom) 75 Hz, 150 Hz, 300 Hz, 1200 Hz, 7500 Hz.

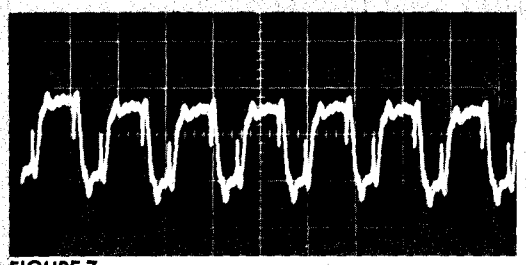


FIGURE 7:
Reproduction of 350 Hz square wave.

Time Delay Distortion

It is becoming increasingly apparent that phase response (phase angle plotted against frequency) is a more significant criterion of speaker performance than what is ordinarily called frequency response (pressure amplitude plotted against frequency). Between two reasonably advanced speaker systems, the one with the better amplitude response is not necessarily the one that sounds better (i.e., more natural or lifelike). But the one with the better phase response will be almost invariably preferred by the critical listener.

Superior phase response is dependent on low time delay distortion. Time delay distortion occurs when a speaker does not produce an acoustical output the instant an electrical input is applied to it. There is a measurable split second of delay between input and output. The delay is nearly always frequency-dependent, being greater at low frequencies as a result of higher inertial mass. The consequent disturbance of phase relationships is now suspected to be the chief cause of "canned," unnatural speaker sound.

All speakers produce *some* time delay distortion, but the Rectilinear XIa is superior in this respect to any other two-way system. The tight acoustic coupling of the woofer, the simplicity of the crossover network and the unusually low mass of the tweeter all contribute to outstandingly low time delay figures throughout the frequency range.

Summary of Specifications

Size:	23" by 12" by 10½" deep
Drivers:	10 woofer, 3½" tweeter
Crossover Frequency	1000 Hz
Nominal Impedance:	8 ohms
Minimum Power Requirement:	10 watts rms
Maximum Power Handling Capacity:	50 watts rms
Frequency Response:	45 to 20,000 Hz, ±4dB
Time Delay:	woofer, 0.7 to 1.0 millisec.; tweeter, better than 0.1 millisec.
Control:	tweeter level
Connection to Amplifier:	Binding posts
Cabinet:	oiled walnut
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Price:	$129.00

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RECORDINGS classical

REVIEWERS: Tanya Buchdahl John Araneta

NEW SOUNDS IN ELECTRONIC MUSIC: Richard Maxfield – NIGHT MUSIC; Steve Reich – COME OUT; Pauline Oliveros – I of IV. CBS Odyssey 2003 ($2.75). Distributed by Avan-Guard Music.

No matter how many times the virtues of electronic music are described to me, I fail to see how anyone can actually find pleasure in it, or, for that matter, beauty, elegance or edification. So I assume it is not emotional content we are looking for (probably the idea is even emotional alienation as in Brecht) but interest in the different combinations of possible sounds, now that we have developed from the 12-tonal to the atonal and now to the mis-tonal. This involves much mechanical prowess, but really – is it *art?*

I doubt it, judging by the three pieces on this record, which are all quite different from one another and no doubt representative. The first is the most interesting, being nine minutes and five seconds of plastic bird noises. It strikes me that the lyre-bird is the one who does it par excellence, but the juxtaposition of sounds is what makes the piece, I suppose.

But I regret to report that Theme and Variations died with the second piece 'Come Out'. It begins with the words "I had to, like, open the bruise up and let some of the bruise blood come out to show them" (words of a 19-year-old negro beaten up by police in Harlem), and then the phrase "come out to show them" is repeated for nearly 13 minutes with no more than a slight increase in echo-effect and a stroboscopic pattern on the record grooves. It should have been subtitled 'Disintegration' or 'Screaming Neurosis' or something like that. They do say the art of a society reflects its condition.

As for the third piece, here, for the first time on record, in the comfort of your own home, you can relive in glorious technicolour those first magical moments when you hear the sweet jangle of your alarm clock, right through your daily traffic jam – complete with pneumatic drills! (I'm not sure how many of the car horns originated in the grog show next door) to the moment you sweep through your office-building doors. It even ends with a whimper.

Allow the composer to elaborate: "The equipment consisted of twelve sine-tone square-wave generators connected to an organ keyboard, two line-amplifiers, mixer, Hammond spring-type reverb and two stereo tape recorders. Eleven generators were set to operate above twenty thousand cycles per second, and one generator at below one cycle per second. The keyboard output was routed to the line amplifiers, reverb and then to Channel A of recorder 1. The tape was threaded from recorder 1 to recorder 2. Recorder 2 was on playback only. Recorder 2 provided playback repetition eight seconds later. Recorder 1 channel A was routed to recorder 1 channel B, and recorder 1 channel B to recorder 1 channel A in double feedback loop. Recorder 2 channel A was routed to recorder 1 channel A, and recorder 2 channel B was routed to recorder 1 channel B. The tape repetition contributed timbre and dynamic changes to steady state sounds. The combination tones produced by the eleven generators and the bias frequencies of the tape recorders were pulse modulated by the sub-audio generator." Elementary. I think I'm beginning to disappear up my own arse.

I would still recommend Frank Sinatra for a dinner-for-two, then, but this record can be highly recommended for lonely traffic cops, confessed aviarists and your friendly neighbourhood psychopath. – T.R.B.

PERGOLESI – STABAT MATER. Mirella Freni (soprano), Teresa Berganza (alto). Ettore Gracis & Solisti dell'Orchestra "Scarlatti" Napoli. DGG Archiv 2533 114.

The inclusion of this work in the Archiv series leads one to expect a performance that emphasises the strange admixture of baroque and galant styles in Pergolesi's writing.

After hearing this recording, I am rather sorry this assignment had not been given to a group with a more precise knowledge of the disparate styles to be found in this work, and a group preferably using more authentic instruments. This bit about original instruments is not mere pedantry on my part; after all, when one considers what effects more appropriate instruments would have for the tonal palette and rhythms in a baroque piece, then this reservation is nothing less than fundamental. The strings in this and every other performance on record are far too lush and authentic sound should emphasise the peculiarly transitory style of the Stabat Mater. Naturally enough, the use of modern instruments must entail a distortion of tempos, rhythms, and phrasing as well. At this point of time, when we are more familiar with the sound and effects of baroque instruments it should be possible to have a recording of the Stabat Mater which makes us really hear the tension in the contrasting styles of writing. Every performance on record, including the present one, sounds as if the players involved were unaware the Stabat Mater was written before 1736. The present forces make hardly precise distinction between baroque and galant-sounding tempos and rhythms.

Generally speaking, tempos are far too slow and romantic, the opening number being a very clear case in point. The rhythms suffer because accents are not more sharply delivered. And why must Italian baroque groups continue to be unaware of performance practices before Rossini? The handling of the organ continuo is uninteresting and registration (what I can hear of it) rather ordinary. I do not expect organs in this period in Italy to sound like Northern German ones but here the organ continuo hardly sounds baroque.

But after all this, the present recording is by far the best available recording to be hand. The use of a relatively small group of strings is something to be grateful for, and the playing (stylistic considerations aside) is precise and refined. The trills at "pertransivit gladius" are wonderful to hear. But what does make this recording preferable to any other is the singing. I could wish for more appropriate ornamentation on the part of the soloists but there is no denying the beauty of the sound. This recording properly eschews the use of the double chorus at no. 8 and the Amen.

Good sound though I wish the singers were not as close and the organ more clearly heard. – J.A.A.

OFFENBACH – Tales of Hoffman (Complete). Sutherland, Tourangeau, Bacquier, Domingo. Chorus and Orch. of the Suisse Romande, Pro Arte of Lausanne. Richard Bonynge (conductor). DECCA – Set 545/7.

In his Notes to the libretto accompanying this album, Bonynge writes, "Contrary to what is often written Offenbach completed a piano score of the opera and orchestrated the Prologue and First Act. He sketched the orchestration of the remaining acts – this was completed with great care by Ernest Guiraud . . ." Much to my surprise, a consultation of several standard guides does in fact bear out Mr. Bonynge's statement, even when these guides cite various performances in the last few years, no indication is given that some of these were attempts to approximate Offenbach's original intentions. No complete restoration is possible, of course, so much original material being no longer extant, but neither is the score of *Tales* as we usually hear it these days an ideal solution either, and it is good to remember that this latter score is not the work of Ernest Guiraud alone but also perpetuates the work of other, less skilled hands. Most of the changes used for this recording are discussed by Mr. Bonynge in his introduction, and I limit myself to comments on what I consider the more important "restorations".

The return of the spoken dialogue to this recording of *Tales* is perhaps the single most effective restoration by Bonynge. No doubt the presence of dialogue here will have the unfortunate effect of keeping away a number of collectors from this recording. While it is imperative that a director or conductor have at his disposal a good cast of actors or better still, a group of singers who are also effective speakers, nevertheless it is my experience that so-called opera lovers who dislike dialogue have very little

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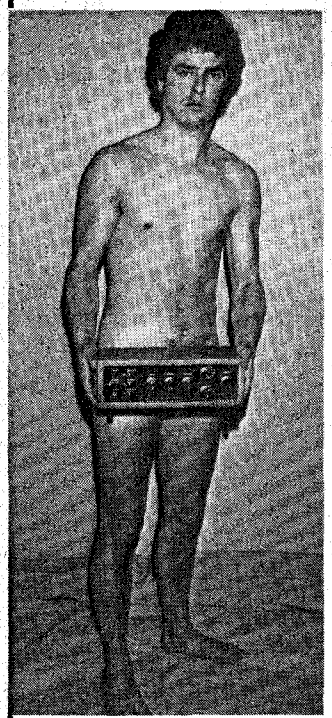

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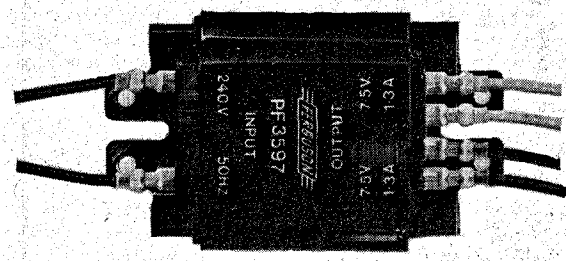

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conception of opera as drama. Singing is the main concern, and singing all the time, and never mind what the composer had in mind. In the present case of Tales the recitatives (not all by Guiraud) are dull and time-wasting in the way spoken dialogue never is. Even more than in the case of Carmen (yet another opera with Guiraud recitatives) one never fails to be struck by the contrast between the quality of the recitatives and the set numbers. It may well be that higher quality recitatives in this opera may have a more balanced relation to the set pieces but that sort of balance is not in fact what is desirable in this opera or in other French opera with dialogue. What is desirable is the overall effect of the relation between dialogue and sung portions. In Carmen, the overall sense of realism is enhanced by enabling a set piece to be, as it were, the crystalization of the dialogue in that in the sung portion a given character gives lyrical expression to fantasy or feeling. In the present case, an unmistakable sense of the fantastic is conveyed by the juxtaposition of spoken and sung sections. As an illustration of this, let anyone listen to side 4 of this set, the conclusion of the Guilietta episode, and compare it immediately with any version of the opera that uses recitatives. For once, Offenbach's opera bears some kinship with the real Hoffmann.

Some of the other changes by Bonynge are as follows: The Giulietta episode is played before the Antonia, which makes practical sense in as much as the former episode is generally admitted to be musically weak; in the Guiletta episode the duel is fought later in the Act and is not accompanied by the Barcarolle but by music originally composed by Offenbach which definitely enhances the sinister quality of the scene; the Sepetet in the Giulietta episode becomes a quartet in the Epilogue, and while I cannot quite agree with Bonynge that the original is "thick and clumsy" the transformation is very well done and is in any case dramatically effective in the Epilogue. I am not so much surprised by Bonynge's changes as by his retentions. The Barcarolle at the beginning of Act II is retained, as are the arias for Dapertutto and Coppelius. One feels, however, that Bonynge has here been guided by practical reasons: "the ear is used to them" and so it is – but in addition the opera as a whole does not suffer from these retentions and in at least one case, the singing of the Barcarolle by Giulietta and Niklaus I rather find the ironic character of the scene enhanced.

Much of the effectiveness of this recording lies with the decision of Mr. Bonynge to cast Miss Sutherland in the various roles of Olympia, Giulietta and Antonio; likewise Lindorf, Coppelius, Dapertutto and Miracle are sung by Gabriel Bacquier. In addition the roles of Muse and Niklaus are given to Huguette Tourangeau. All this not only serves to enhance the unity of the opera but also brings the symbolism out clearly.

What about the performance? Nothing seems to take fire until the end of the Prologue. Things should have been more whipped up, or so it seems to me. But in all fairness, the Prologue is after all the least interesting section of Tales, and in any case things go very well after it. Bonynge's tempos are in general very brisk and light, with well-sprung rhythms, qualities which suit the opera as a whole. Perhaps a greater sense of excitement would not have gone amiss in the Prologue, but things get very dynamic as far as the three central episodes go. The dialogue is generally excellently delivered by the singers concerned, the more successful being Gabriel Bacquier, Paul Plishka (Crespel) and especially Hugues Cuenod in the various roles of Andres, Cocchenille, Pitichinaccio and Frantz. Miss Sutherland is more successful as Giulietta and Antonia or at least I feel that in the Olympia episode one is not really given a strong sense of the mechanical in Olympia's character. Nevertheless, the singing and the acting elsewhere is very fine indeed. One is tempted to think that Placido Domingo's Hoffman is the only real weakness in this cast. There is no real trouble in the singing, although the words are not always that clearly delivered. What seemed at first a curious way of delivering his spoken lines, with its almost self-conscious over-emphasis, now sounds to me like it sounds Hoffmann's character very well.

In sum, then, a fine achievement from all concerned and strongly recommended for those who think they know this opera already. Recording is excellent as usual but we do get the now common Decca noises on some of the sides. – J.A.A.

INPUT GATE

LETTERS FROM OUR READERS

AUSTRALIAN MANUFACTURERS

I read with considerable interest the article "Sensors On" by "Talus" which appeared in the June 1973 edition of your magazine.

As the article correctly stated, the major problems facing the Australian instrument designer and manufacturer are the relative size of the Australian market and the high cost of research, development and promotion.

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L. R. RIGGALL
Marketing Manager.
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Whilst I certainly agree with Talus' comments concerning the need to manufacture electronic equipment in Australia, I must take issue with his inference that importers of overseas manufactured equipment are "on to a good thing".

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Another factor that raises the price of imported equipment is the need for extensive servicing facilities — often required just to service a mere handful of specialized instruments.

Surely your columnist must realize that if the importers were making excessive products, the competition thus attracted to the market would bring prices down again very smartly.

As I am directly involved in this business I would ask you not to publish my full name.

K.W.
Sydney 2000

** Our columnist, Talus, did not say that importers were making excess profits — nevertheless to our certain knowledge a small minority of scientific equipment importers have mark-ups of 75% to 100% — and provide no service facilities at all — Ed.*

READERS' LETTERS

It is our policy to reply to all readers' letters — but not necessarily via these columns. Please ensure that you write your full name and address on your letter. We have a number of letters — mostly from our younger readers in which not even the writer's initials are included.

We try to reply to letters as quickly as possible — however on occasions there may be some delay. But please don't think that your letter has been ignored.

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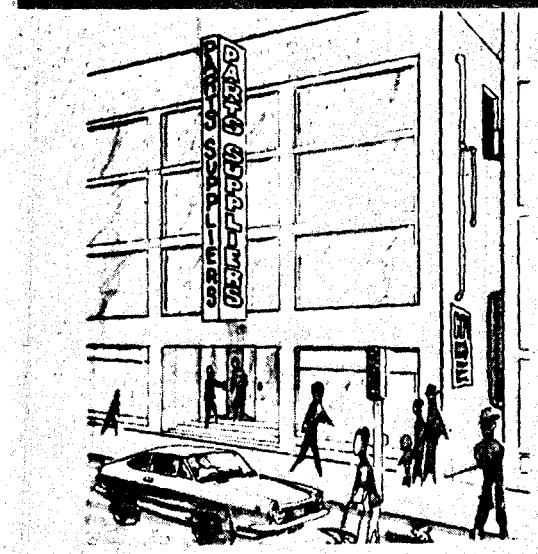

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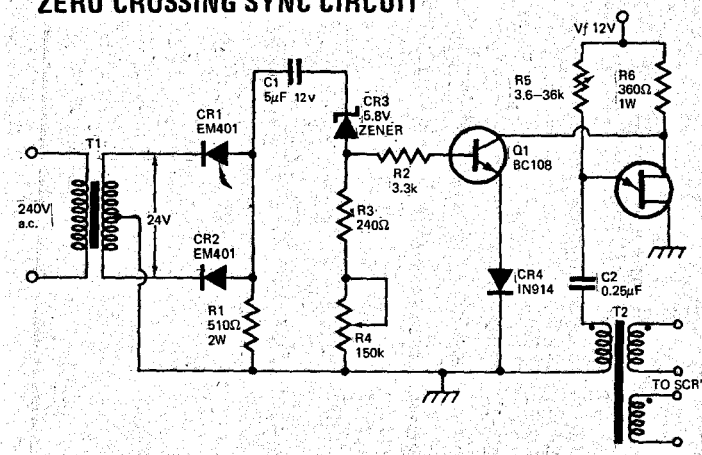
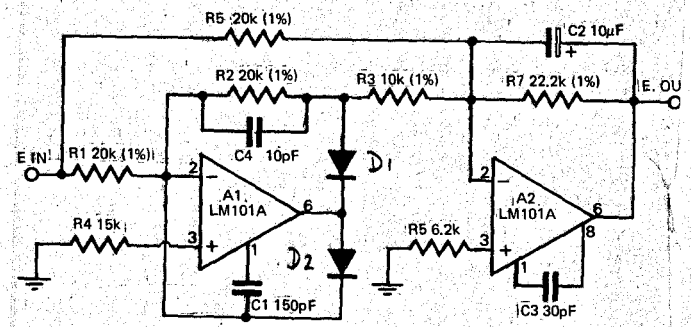
ZERO CROSSING SYNC CIRCUIT



Zero crossing control of SCRs or Triacs is preferable to phase control because less RF1 is generated. The circuit shown was developed for a temperature control system and effectively maintained temperature at any set point from ambient to 100°C. Resistor R5 may be a potentiometer, a thermistor or any type of sensing device. R4 is adjusted so that the breakover point of CR3 is at the peak of the reference voltage (zero crossing point of ac wave).

PRECISION AC TO DC CONVERTER



The circuit shown provides better than 1% conversion accuracy of ac signals up to 100 kHz. The output is calibrated to read the rms value of the sine-wave input with less than 1% ripple at 20 Hz.

Amplifier A1 with diodes D1 and D2 forms a precision half-wave rectifier and the amplifier A2 sums the half-wave rectified signal and the input signal to provide a full-wave output. For negative input signals, the output of A1 is zero and no current flows through R3. Neglecting the effect of C2,

the output of A2 is $-\frac{R7}{R6}$ E in.

For positive input signals A2 sums the currents through R3 and R6

$E_{out} = R7\left(\frac{E_{in}}{R3} \quad \frac{E_{in}}{R6}\right)$

If R3 is ½ R6, the output is $\frac{R7}{R6}$ Ein

Hence the output is always the absolute value of the input.

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For further information on Advertisers listed below complete the coupon/s stating information required including company and position held (if relevant). Cut out the coupon and post to:—

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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
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8H70	Triple 3 input NAND (HS)	0.35
8H80	Quad 2 input NAND (HS)	0.35
8H90	Hex inverter (HS)	0.35
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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
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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
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LINEAR INTEGRATED CIRCUITS

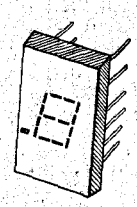
Fairchild and Signetic devices (no choice). Some of this line is not marked but it is fully tested and sold on a money-back guarantee. State first choice on package (TO-5, 8-pin dual in line, or 14-pin DIP—**we will not ship flat packs**).

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 MAN1 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

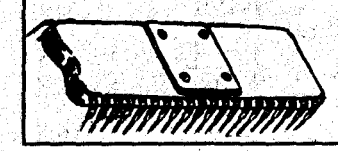
This TO-3 device is a complete regulator on a chip. The 309 is virtually blowout proof, it is designed to shut itself off with overload of current drain or over temperature operation. Input voltage (DC) can range from 10 to 30 volts and the output will be five volts (tolerance is worst case TTL requirement) 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).

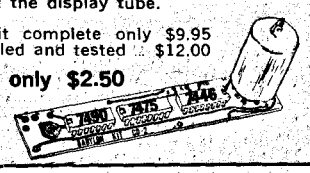
A 7490 decade counter IC is used to give typical count rates of up to thirty MHz. A 7475 is used to store the BCD information during the counting period to ensure a non-blinking display. Stored BCD data from the 7475 is decoded using a 7447 seven segment decoder driver. The 7447 accomplishes blanking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

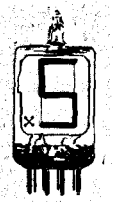
Kit includes a two sided (with plated through holes) fibreglass printed circuit board, three IC's, DR-2010 (with decimal point) display tube, and enough Molex socket pins for the IC's.

Circuit board is .8" wide and 4⅜" 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





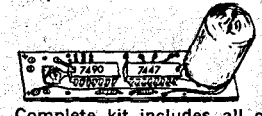
RCA DR2010 Numitron digital display tube. This incandescent five volt seven segment device provides a .6" high numeral which can be seen at a distance of 30 feet. The tube has a standard nine pin base (solderable) and a left-hand decimal point. Each $5.00

SPECIAL 5 for $20

UNIVERSAL COUNTER DISPLAY KIT CD-3

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

a. Does not include the 7475 quad latch storage feature.
b. Board is the same width but is 1" shorter.
c. 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.
d. 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.

Bi-directional record and playback tape deck
Model A-4070
● 4 Ferrite heads (6 head function) ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz at 7½ ips ● S/N ratio 58dB

Make music- not noise

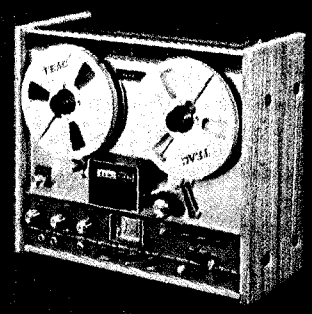
You may not realise it, but until now, even the best tape decks allowed a degree of noise during recording and playback. This may have been all right for conventional tapes, since they were far from perfect.

But with the recent introduction of the low noise/high output tapes, it's no longer permissible.

Which brings us to a new generation of decks by TEAC. And TEAC calls them Superior Sound/Low Noise decks: decks designed to get the most out of the low noise tapes as well as the conventional types.

Five of these new generation decks are described here. If you'd like to know more, write to us and we'll send you further information (catalogue, dealer list and price list) on the unit(s) that interests you.

Sterec Tape Deck
Model A-3300
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .06% at 7½ ips ● F/R 25 to 24,000 Hz ● S/N Ratio 55dB



Stereo Tape Deck
Model A-1230
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB

Automatic Reverse Stereo Tape Deck
Model A-1250
● 3 heads-4-head function ● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● Triple motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB

Combination Head Stereo Tape Deck
Model A-1030
● Reel size 7" ● Tape speed 3¾ ips and 7½ ips ● One motor mechanism ● Wow and flutter .08% at 7½ ips ● F/R 30 to 22,000 Hz at 7½ ips ● S/N Ratio 55dB ● Auto. Shut-off

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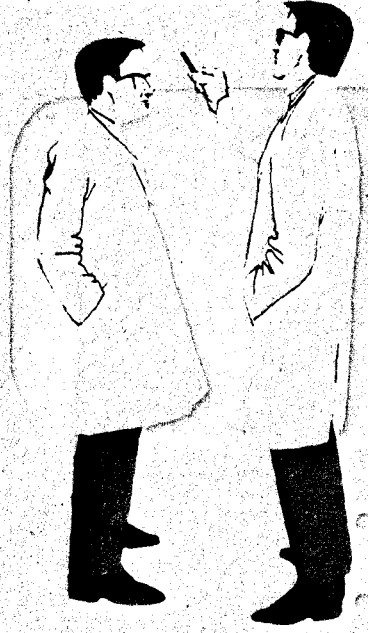

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